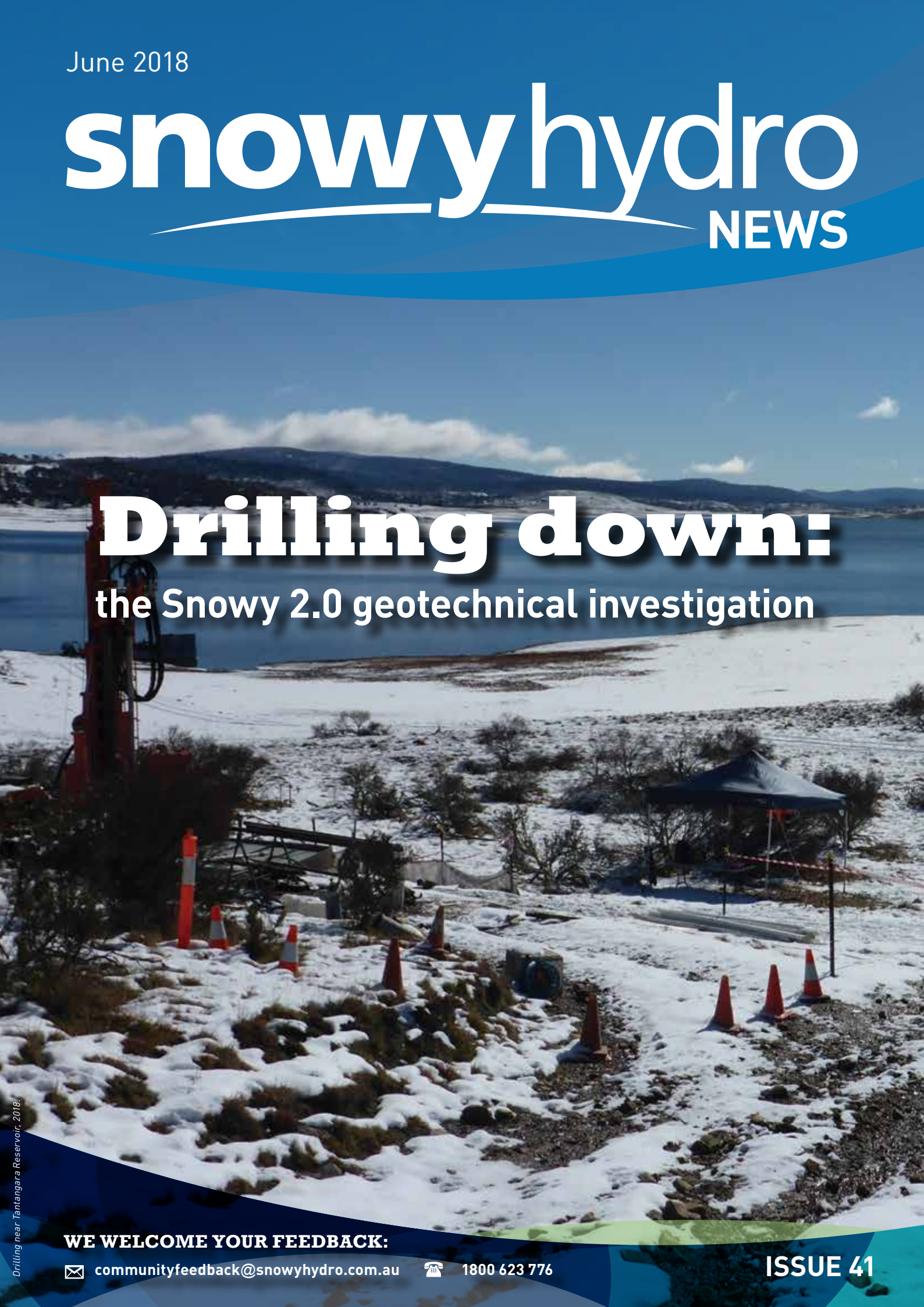
June 2018

snowy hydro NEWS

Drilling down:

the Snowy 2.0 geotechnical investigation



Drilling near Tantangara Reservoir, 2018.

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ISSUE 41

Snowy 2.0- explaining th

With Snowy 2.0 in the works we are currently in the heart of the energy policy debate. CEO Paul Broad gives an update and talks about the economics of the project...

It's no surprise that with Snowy 2.0 on the cards, public and media interest in our business is heightened.

The debate around energy policy is ongoing so we've continued our efforts to outline the critical role that Snowy 2.0 and the Snowy Scheme will play in the energy market of the future. In our view we're past the tipping point. With the cost of new renewables falling and the scheduled closure of coal plants, the economics favour a future energy market with a higher amount of intermittent renewable generation. This market reality means we're going to need more dispatchable generation and large-scale storage to ensure our lights stay on.

Too often we hear 'Snowy 2.0 or...' - the reality is we're going to need 'Snowy 2.0 and...'. We're quite excited about some of the other projects being considered across the country. We expect that a range of new generation, energy storage options and demand management will be needed to meet our needs in the future.

Snowy Hydro takes a very commercial approach to all capital investments and we continue to scrutinise the Snowy 2.0 business case as we progress to a final investment decision later this year. We have a proven track record of investment, having never written off a single dollar on investments we have made.

Pursuing Snowy 2.0 is a commercial decision to strategically grow our business. The project will provide reliable, dispatchable energy generation (2,000 megawatts (MW)) and large-scale energy storage (175 hours or 350,000 megawatt hours (MWh)) and builds on our existing capabilities. With a higher amount of intermittent energy generation, we expect to see increasing market volatility which means higher high prices and lower low prices. This spread of pricing, or difference between the peaks and troughs, is a key factor that underpins the energy storage products in the business case.

At times where there is an excess supply of energy and low (or even minus) prices in the market, Snowy will pump. When energy demand is high -

Snowy Mountains Control Centre

e economics

we'll generate and help put downward pressure on the price spikes in the market. The combination of dispatchable generation and large-scale storage means Snowy 2.0 and our existing Scheme can sell a range of products to the energy market including:

- Storage products - buying energy at low prices and selling at higher prices. Note: Snowy 2.0's current modelling assumes pumping (backed to a great extent by excess renewable supply in off-peak periods) at $40 MWh and generating at peak times at $86 MWh (and above).
- Capacity products - selling 'insurance' to provide price certainty to market participants and protecting them from price shocks. For these contracts, premiums are paid in advance ($ per MW per hour).
- Firming products - contracts with intermittent renewable generators where Snowy generates to make renewables both physically reliable and financially viable so they can commit to supply contracts. *Note: 1MW of hydro can 'firm up' more than 1MW of wind and solar*
- Ancillary services - services to stabilise the grid and provide system security, such as load following frequency control, voltage control, inertia etc.

Even based on conservative assumptions, Snowy 2.0 has an internal rate of return of 8%, which exceeds our stringent investment hurdles. An independent economic report produced as part of the 2.0 feasibility study confirms that the products we sell today will be in even greater demand in the future. The MJA report and an overview of the business case are available on the Snowy Hydro website.

MJA and Snowy Hydro's modelling also suggests that the capacity of Snowy 2.0 alone will not be enough to meet the NEM's demands in the future. From the early 2030s, we expect to need further expansions of the Snowy Scheme (Snowy 3.0 and 4.0) to keep up with the rapidly-changing NEM.

We expect to internally fund Snowy 2.0 from our own balance sheet and we are in discussions with a range of financial institutions about funding.

You may have seen some of the geotechnical drilling program which is well past the halfway mark now. We are doing a lot more drilling, particularly to the western side of the project area, to ensure we have a better understanding of the rock in the cavern location. While in some areas the rock conditions are better than we initially thought, the fault line which runs through the tunnel alignment placement is unfortunately as bad as we expected.

The next step for us is the exploratory works program which involves us doing even more drilling. It may seem like we're doing a huge amount of drilling but it's the best way for us to 'de-risk' the project. The more work we do now to understand the geology the more accurate our project designs will be, saving us money and time in the long run. It's much better for us to know exactly where the fault line is now, rather than encounter it mid-way through digging a tunnel.

The exploratory works aim to get us that next level of geological information. The project involves us tunnelling into the spot where we expect to put the main power station cavern and once in-situ, doing horizontal drilling to pinpoint the exact location and cavern orientation. We are currently preparing a comprehensive Environmental Impact Statement for these exploratory works and once again, more information is available in this newsletter and our website.

I'd like to take this opportunity to acknowledge the work of some of the fantastic local businesses who have, and continue to, support us with Snowy 2.0 including Jindabyne Landscaping, Mulligan's Drilling, South-East Printing, Heli Surveys, South-East Waste Recovery, Withers Earthmoving, Ryans Dozer Hire, Snow Goose Adaminaby, Peter Burns Surveyors and True North Helicopters, just to name a few.

As one of the major employers in the region with a long and proud track record of hiring locals, supporting local businesses and the wider community, it is great to see this project is generating economic activity across the region.

On a final note for Snowy 2.0, we have continued our community consultation right across the region. We have had over 270 people attend these consultation sessions in Cooma, Tumut, Adaminaby, Jindabyne, Talbingo, Corryong and Tumbarumba, and we are committed to keeping you all informed, and receiving your feedback, as we progress towards final investment decision later this year.

While Snowy 2.0 is keeping us busy there is always lots happening across our business. We recently released an expression of interest to the energy market for up to 800 megawatts of wind and solar generation. As a business Snowy Hydro is 'energy short', that is we need more energy to meet the needs of our customers than what we generate (through the Scheme and other generation assets). On an annual basis we need about 7 terawatt hours of energy and typically we only generate between 3-4 terawatt hours each year. This means we have to buy energy from the wholesale market. By signing these offtake agreements with new renewable projects we will have more contracted generation to help meet some of the shortfall.

Our retail businesses Red and Lumo energy continue to go from strength to strength - recently the retail team moved into the iconic, refurbished Bryant and May building in Melbourne, meaning all of our retail staff are now located in the one place.

Red Energy was also the recipient of four Canstar Blue Awards for Most Satisfied Customers Electricity Providers, NSW, Natural Gas Providers, NSW, Natural Gas Providers, VIC and the 2018 Solar, National award. These were in addition to the 2017 Roy Morgan Customer Satisfaction Award, Electricity Provider of the year. I am incredibly proud of all of our retail team and their achievements.

With winter well and truly setting in I would also like to remind the community to take extra care on our roads around the beautiful Snowy Mountains. The weather at this time of year creates increased traffic hazards with snow and ice on the roads, as well as increased travellers with the ski traffic heading to the slopes. I urge you all to be cautious, drive to the conditions and stay safe on the roads.

With winter well and truly setting in I would also like to remind the community to take extra care on our roads around the beautiful Snowy Mountains...

5 STAR CUSTOMER SERVICE

Canstar Blue Award Most Satisfied Customers

2010 Electricity Providers (VIC)

2011 Electricity Providers (VIC)

2012 Electricity Providers (VIC)

2013 Natural Gas Providers (VIC)

2014 Electricity Providers (NSW)

2015 Electricity Providers (NSW)

2016 Electricity Providers (NSW)

2017 Dual Fuel National

2017 Electricity Providers (NSW)

2017 Natural Gas Providers (VIC)

2017 Natural Gas Providers (NSW)

2018 Solar National

Roy Morgan Customer Satisfaction Award

2011 Electricity Provider of the Year

2014 Gas Provider of the Year

2015 Electricity and Gas Provider of the Year

2016 Electricity Provider of the Year

2017 Electricity Provider of the Year

RED57375 RE552V3190318

AUSTRALIAN MADE AND OWNED

Owned by snowyhydro

red energy

Engineers investigating potential sites for Snowy 2.0

Drilling down:

the Snowy 2.0 geotechnical investigation

Picture a group of blokes wearing beanies and backpacks slowly walking through the rugged Snowy Mountains bushland. They aren't tourists - they're Snowy Hydro engineers investigating potential sites for Snowy 2.0. Project Engineer, Paul Smith, explains...

To build Snowy 2.0, which links the Tantangara and Talbingo reservoirs with 27km of tunnels and several caverns for the underground power station, intensive geotechnical investigation is required

This critical process involves drilling deep into the earth to extract rock samples - or cores - which provide geologists with information to build a solid understanding of the geological conditions at the site. The investigation also identifies physical properties of the existing rock so the geotechnical engineers can design portals, tunnels and caverns.

The geotechnical work, which has been ongoing for 12 months, is the key to developing a final, buildable design for the Snowy 2.0 underground tunnels and power station complex.

We need to understand all the types of rock and their properties along the alignment from Tantangara to Talbingo, as well as the prevalent hydrogeological conditions, so we can develop a detailed design for construction and service life. You can use your best engineering judgement, but you need the data from the geotechnical investigation to really inform the design and how to build it.

Drilling:

Working with contractors SMEC and GHD, there have been more than 14,000 metres of cores, each about 63mm in diameter, extracted from the drilling work so far.

The initial scope was for 31 boreholes to be drilled, but that has been revised up to 40 - the deepest hole drilled has been 1165m and the shallowest 47m.

The varying terrain and remoteness of some of the locations has meant using a variety of drilling rigs - with some fitted on barges for over-water drilling. We are around 80 per cent through the program, so we expect about 17,000m of cores when we're done.

The rock cores are stored and reviewed for quality assurance in Cooma and are sub-selected for testing at specialist Australian laboratories for their physical properties, such as strength, permeability and hardness.

Geology:

The 2.0 team have already determined through their historical records and current investigations that the geological conditions at the project area are complex.

There are around 12 main rock types and eight faults, including the significant Long Plain fault, that would need to be tunnelled through.

Faults are areas of past movement and are therefore highly fractured rock, generally with low strength and high water inflows, which can be quite difficult to excavate. Faults slow you down a lot when tunnelling, but the main implications of faults relate to the engineering support of the structure.

From a construction point of view it's quite challenging. Excavating through a fault zone we would need to use pre-grouting, to limit groundwater infiltration in the excavation, and then primary support consisting of rock anchors and reinforced concrete to stabilise the tunnel. When the confining stress (the weight of material above the rocks) is particularly low in, or near, these fault zones, steel lining is required to provide support.

Essentially the more information we have from the geotechnical investigation regarding geological risks, the better we can plan and mitigate these risks.

Exploratory works:

Snowy Hydro is currently seeking approval for a program of exploratory works in the Lobs Hole area of Kosciuszko National Park, which includes excavation of a tunnel to the location of the proposed power station cavern.

The tunnel would be between 3km and 3.5km in length, 8m high by 8m wide and provide access to the top of the cavern complex so investigation drill holes can be drilled. This will allow further analysis of the rock properties and stress conditions to confirm the suitability of the site for the underground power station.

VARIABILITY OF GEOLOGY

So far we have drilled relatively small holes widely spread out across the alignment, but given the size and importance of the cavern complex we would like to excavate an exploratory tunnel. This will allow us to determine the exact geotechnical conditions, at a small scale, at the cavern location before the main construction goes ahead.

The same kind of tunnel was created for the Tumut 2 power station in the 1960s. They found a bad area where they had originally planned to build the cavern and actually moved it to a different location.

A comprehensive Environmental Impact Statement (EIS) for the exploratory works program will be lodged with the Department of Planning and Environment as part of the approval process. Members of the community have an opportunity to review the EIS and make a submission during the public exhibition period. Approval from the NSW Minister for Planning is required for any project works to be carried out and Commonwealth Government approval may also be needed.

More drilling:

While the majority of the geotechnical investigation has been completed along the project alignment, more investigation work is required in preparation for creation of support infrastructure. This includes some temporary and permanent work such as portals, access roads, bridge structures, camp locations and potential quarry sites.

Now that we're coming into winter some of the additional boreholes we want to drill around the cavern and surge tank location become problematic since they are accessed from above the snow line - we will have to wait until spring to do those.

In the meantime, detailed design work for Snowy 2.0 continues as the project progresses towards final investment decision by the Snowy Hydro independent board of directors at the end of 2018.

Drilling as part of the geotechnical investigation

Snowy 2.0
geotechnical investigation

14,100m
of boreholes drilled

63mm in diameter

deepest hole drilled has been 1165m

shallowest hole drilled was 47m

drilling has confirmed around 12 main rock types

FOR MORE INFORMATION & ENQUIRIES:

Snowy Hydro will keep the community up to date on the Snowy 2.0 project as it proceeds. Community enquiries can be addressed to community@snowyhydro.com.au.

For more information on the project, visit our website at:

www.snowyhydro.com.au/our-scheme/snowy20

Stress testing at Gooandra Hill

Why do we have gas and diesel assets?

Traditionally Snowy Hydro has been a hydro generator and only since 2004 have we invested in other forms of generation - gas and diesel-fired peaking assets. Gary Blanch, Area Manager Gas and Diesel, explains...

Snowy Hydro's investment in gas and diesel assets has been a strategic business decision to ensure we can maintain our market position and deliver energy to our customers and support our retail businesses.

Diesel and gas are both reliable sources of power generation with fast start capability. These assets significantly enhance our existing generation capacity, particularly at times of peak loads and during transmission constraints.

While the gas and diesels don't run anywhere near as much as hydro stations, they are critical in holding our market position particularly when transmission limits our ability to supply customers. They are able to react quickly in a dynamic and changing energy market. As with all our assets, reliability is absolutely critical. When we call on these units they have to start, so we invest in high levels of maintenance to ensure they do.

Our gas and diesel assets back the mighty Snowy Scheme when energy prices go up and we have low water levels or an outage, then these assets can kick in and add to our supply to the market. A good example of this was in the tough drought years of the mid to late 2000s when our water levels were low for hydro generation, but by having Laverton North and Valley Power we were able to compete in the market, and importantly protect our contract position.

These assets are also critical from a transmission and geographic perspective. If Murray transmission is down into Victoria we can still get power to Melbourne by utilising the gas stations to feed energy into the grid further down the line. This is also why Colongra gas-fired power station, which was purchased in 2014, is so important for us in the NSW market. Its northern location means that if there are issues with the transmission in the southern part of the state we can still generate and get power through to Sydney from the north.

In South Australia we have three diesel peakers which provide peaking dispatchable generation in a state dominated by renewables, namely wind and solar, which are intermittent sources of energy. Prior to acquiring these diesel assets in late 2014 we didn't have any generation capacity in SA.

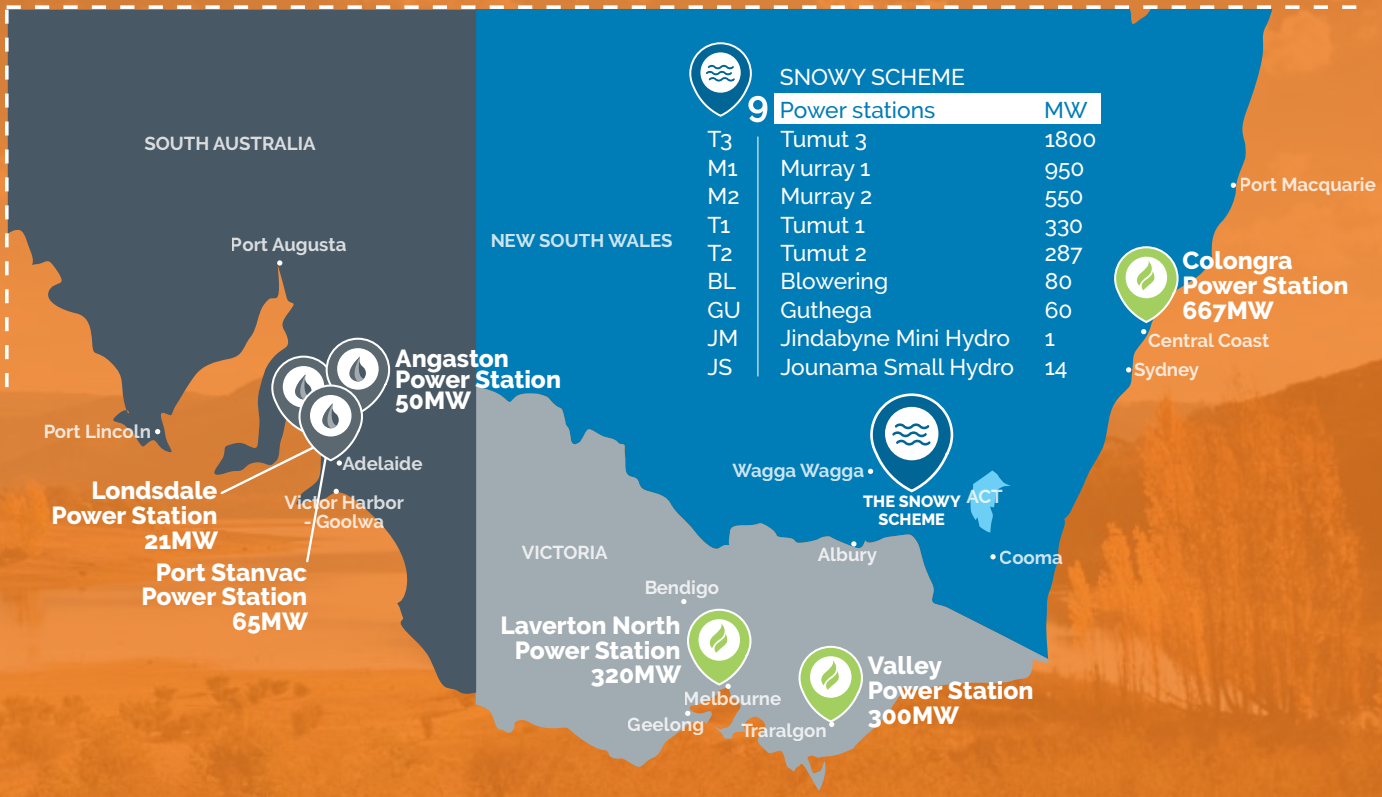
By having these assets Snowy can opt to use gas or diesel when hydro isn't available (due to water availability, outages or transmission constraints) rather than having to potentially buy from competitors to meet our retail and contractual commitments.

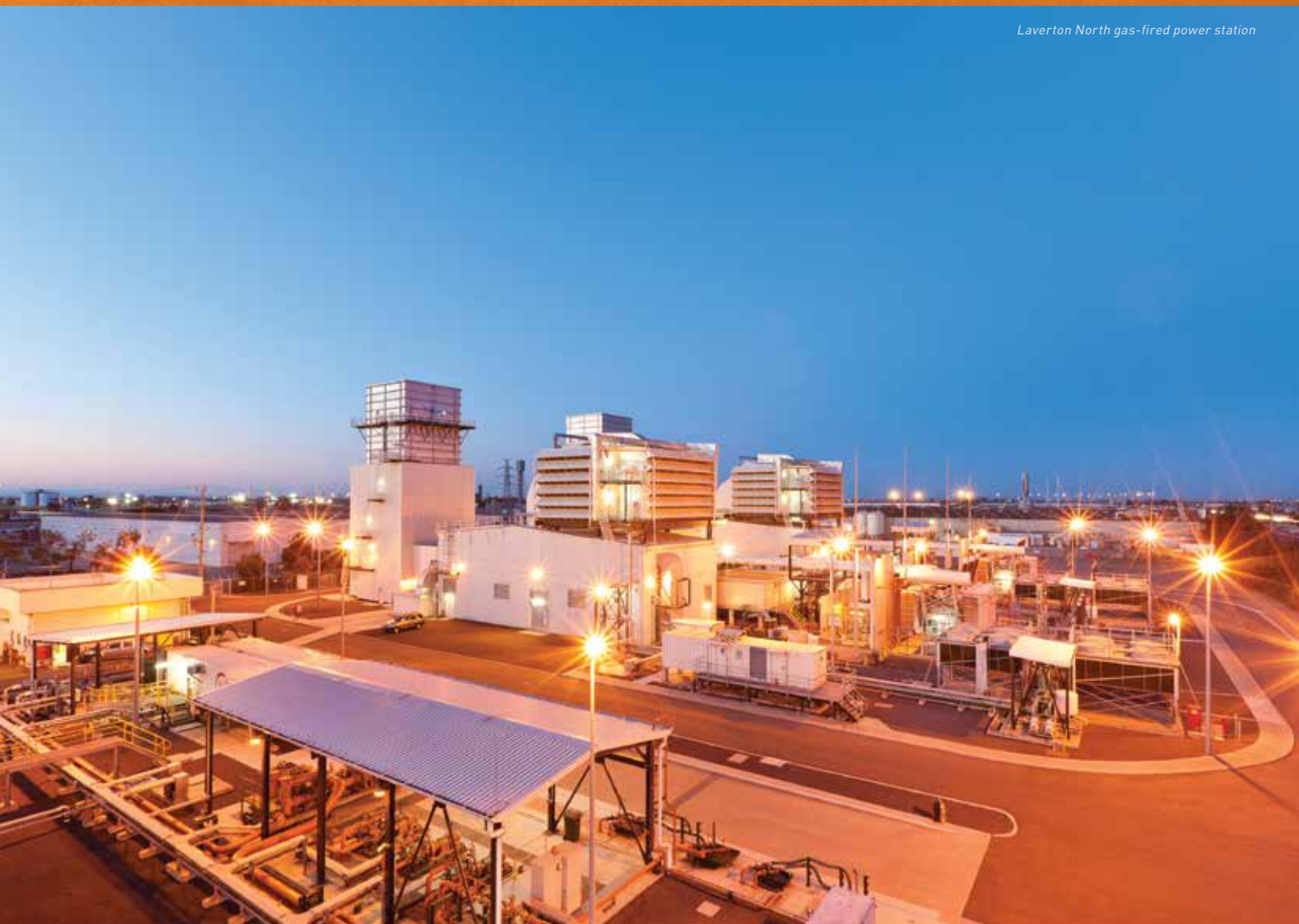
snowyhydro

OVERVIEW

OUR GENERATING ASSETS

Hydro Gas Diesel





Laverton North gas-fired power station

Eucumbene River

How weather and water impact our business

As a hydro-electric power company, it makes sense to expect that the weather plays an important role in our operations, but how significant is it? Manager Weather & Water, James Pirozzi, answers the question...

Snowy Hydro has a dedicated, internal Weather and Water team providing staff with weather, climate and water inflow forecasts to help the business identify the risks and opportunities that Australia's variable weather can present. Here are some of the ways weather influences our business.

The energy demands of our customers are highly dependant on the weather - heating loads on cold winter days and the ever-increasing air conditioning loads through summer heatwaves can result in massive swings in energy demand in the National Electricity Market (NEM). NSW, ACT, Victoria, Queensland, South Australia and Tasmania are all part of the NEM.

With the market's increasing reliance on renewable energy sources, solar and wind generation are both directly impacted by the day's weather. The intermittency of wind and solar output also causes large swings in energy supply in the NEM.

Hot weather reduces the output of thermal generators (including Snowy Hydro's gas and diesel assets) and thunderstorms and bushfires reduce the capability of the network's transmission assets. The variability of both supply and demand in the NEM creates peaks and troughs, which is where Snowy Hydro's flexible generation comes into its own. We are the leading provider of peak, renewable energy to the NEM.

Another important weather consideration is precipitation (either rain or snow). This leads to inflows into the Snowy Scheme reservoirs, which are managed so that water can be released when generation is required. Inflows and available storage drive the Snowy Hydro electricity generation plan at all times, from today to next decade.

The company's day-to-day operations can also be weather-dependent. For instance, many jobs can't be completed in windy, wet or icy conditions, or on hot days with high fire danger. Some work may also be deferred until another day because of generation requirements caused by very hot or cold weather. The quickly changing nature of conditions in the Snowy Mountains, for example, mean our operational staff are highly responsive.

Bryant and May Building

Red and Lumo move to iconic Bryant and May building

Red Energy and Lumo Energy's newly refurbished office space, the heritage-listed Bryant and May building, was officially opened in May by a gathering of dignitaries including Perry Wandin from the Wurundjeri tribe, the Minister for the Environment and Energy, the Hon. Josh Frydenberg, Snowy Hydro Chairman Noel Cornish, Snowy Hydro CEO Paul Broad, Red Energy CEO Iain Graham and other key partners and stakeholders.

The iconic red-brick building located in the Cremorne area of Richmond, Victoria, first opened its doors in 1909, manufacturing Australia's popular brand of matches. Back then Bryant and May became the epitome of a modern factory, providing workers with unprecedented working conditions including a shared dining hall, tennis court, bowling green and a working ethos that relied on values rather than rules.

Today, following careful restoration of the building's period features and the installation of fit-for-purpose technology, the building is home to 1200 community-focused employees of Red and Lumo who thrive in its positive working environment and live by the company's strong corporate values.

On entering the award-winning, five star Green Star-rated building, visitors are immediately struck by the impressive large-scale LED screen that covers the entire reception area wall featuring videos of the many Red community activities, and also Snowy Hydro footage.

Iain Graham spoke about the honour of writing a new chapter in the Bryant and May story.

"We are a proudly Australian business. Staying local and nurturing neighbouring cafes, restaurants and other businesses was incredibly important when we were looking for a new home for Red. It is an absolute privilege to walk into this beautiful building each day."

Spread over three levels, the 10,000 sqm of office space comprises workstation 'neighbourhoods'. Each level is themed, acknowledging the history of the building and Red Energy's story and heritage, including Snowy Scheme areas such as Happy Jacks, Eucumbene, Cabramurra and Murray.

Introducing our new community partnerships

At Snowy Hydro we are proud to work with our local communities, supporting initiatives which make a real difference to the people of the Snowy Mountains region.

We have often kept you updated with some of our major community partnerships like our Snowy Hydro Young Driver Training Program, Country Universities Centre and local festivals and events, but this time we wanted to highlight some of our new partnerships.

Three such partnerships include Snowy Stories, the Clontarf Foundation and the Wellbeing Health In-Reach Nurse Coordinators pilot program - providing a school nurse for both Cooma and Tumut.

We support activities that have a wide reach, are accessible and as much as possible, align with our shared values of safety, education, health and well-being. We don't just provide donations – we build healthy partnerships with the community.

We have a long history of involvement with communities to make a positive impact where we live and work and we will continue to partner with worthwhile projects such as these into the future.

Snowy Scheme stories

As we work towards an exciting future expanding the Snowy Scheme, we have been reflecting on our history and ensuring, where possible, we capture stories from those who helped build the Scheme. We recently launched a digital storytelling project with partner organisations Woden Community Service, Gen S Stories and PhotoAccess, which features the stories of 10 former workers and families of the Snowy Scheme.

These personal digital videos have been created with family photos and archival images, along with unique insights into the construction of the Scheme from 1949-74, and working for Snowy Hydro.

Paul Broad, Snowy Hydro's CEO, said current employees of Snowy Hydro are often inspired by the history of the Snowy Scheme.

Jenni Savigny from Gen S Stories (far left) with some of the former workers who created digital stories of their time working on the Snowy Scheme.

"As we embark on a possible expansion of the Scheme we marvel at the engineering feat that is the mighty Snowy," Paul said. "The hard work, determination and vision of the pioneers who came before us is truly remarkable.

"The digital storytelling project brings to life some of the stories from our past, and we're proud to be a part of it."

Snowy: Stories from former workers and families of the Snowy Mountains Hydro Electric Scheme, funded by Snowy Hydro, can be viewed on the Woden Community Service YouTube channel.

Clontarf Foundation

Football and learning are inextricably linked at the Clontarf Foundation, an organisation assisting young Aboriginal and Torres Strait Islander boys with education, life skills, self-esteem and improving employment prospects.

By tapping into the boys' passion for Australian Rules and/or Rugby League, the Clontarf Foundation attracts students to the program and encourages school attendance. By helping the students achieve success through football and to develop good academic habits, their self-esteem and confidence is increased.

Students of the Clontarf Foundation.

Snowy Hydro's partnership with the Clontarf Foundation is aimed at increasing awareness of the organisation's work by encouraging employee participation and highlighting employment opportunities available within Snowy Hydro.

In July, two Clontarf students will be hosted by Snowy Hydro's Upper Tumut region for a fortnight's work experience and a former Clontarf student will start a three-month contract working as a trades assistant.

Since opening its first academy for 25 boys in 2000, the Foundation has grown to cater for more than 6,500 boys in 97 schools across Western Australia, Northern Territory, Victoria, New South Wales and Queensland.

To remain in the Clontarf program, participants must continue to attend school and embrace the Foundation's objectives. This approach has seen year-to-year retention of students at 90 per cent or more and school attendance rates higher than 80 per cent. Encouragingly, more than 80 per cent of the Foundation's Year 12 leavers remain in employment or further study 12 months after completing their schooling.

School Nurse Program

Snowy Hydro is the proud sponsor of a new school nurse program supporting the health and wellbeing of local Snowy Mountains region students.

The NSW Government's Wellbeing and Health In-Reach Nurse Coordinators pilot program is aimed at improving education, health and social outcomes for young people in regional NSW.

Snowy Hydro has provided $520,000 in funding for two nursing coordinator positions in Cooma (Monaro High School) and Tumut (Tumut High School) from June 2018 until June 2020. The nurses will be available to assist students based at each school and also those in the surrounding region.

The trial aims to identify the physical and mental health needs of southern NSW students, providing essential health services, as well as preventive and early intervention services in an accessible way on school grounds.

If successful, the NSW Government will roll out the program across regional NSW.

The school nurses initiative aligns closely with Snowy Hydro's core values of safety and wellbeing, and is another way the company - a proud member of the Snowy Mountains community for almost 70 years - supports the development of our local young people.

Parliamentary Secretary to the Deputy Premier and Southern NSW, The Hon Bronnie Taylor, along with the Member for Wagga Wagga, Daryl Maguire and Snowy Hydro's Area Manager Lower Tumut, Guy Boardman, with teachers and students from Tumut High School at the WIFN announcement.

Matt Graham, **Olympic Silver Medalist.**
Red Energy Ambassador.

Behind you every bump of the way.

It takes much more than just technique, ability and talent to be considered one of the world's best. Just ask Aussie mogul skier and Red Energy Ambassador, Matt Graham.

After missing out on the 2014 Winter Olympic finals by just 0.01 of a point, Matt showed grit, courage and determination to climb up the world rankings to number 3. And then, at this year's Winter Olympics, Matt's hard work paid off when he put in the run of his life to pick up the silver medal.

But Matt's far from finished. With his eye on World Championship and Olympic glory, Red is proud to get behind Matt as he continues to chase his dream and do Australia proud.

www.redenergy.com.au

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