

The Big Read **Renewable energy** [+ Add to myFT](#)

Renewable energy: Australia bets on a 'water battery'

Pumped hydro can store irregular wind and solar power. But critics worry it is too expensive

[Twitter](#) [Facebook](#) [LinkedIn](#) [Share](#) [Save](#)

Jamie Smyth in Tumut, New South Wales 7 HOURS AGO

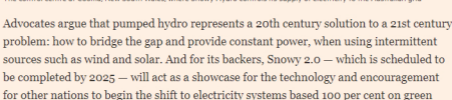
46

It took 100,000 construction workers a quarter of a century to bore through the Snowy Mountains to build Australia's largest hydroelectric scheme. The vast nation-building project links nine power stations and 16 dams via a network of 145km of tunnels and pipelines, providing irrigation water and energy that has helped transform the country's economy since it began operating in 1974.

Now, almost half a century later, Australia's newly elected government is placing the state-owned Snowy Hydro plant at the vanguard of another energy transition by transforming it into a massive "water battery" that will help keep the lights on as the country shifts from an electricity grid based mainly on fossil fuels to one built around renewable energy.

"We are betting the whole company on it," says Paul Broad, Snowy Hydro's chief executive, who confounded critics by persuading Canberra to back an A\$5bn-plus expansion, that was dismissed — just a decade ago — as too expensive and risky. "You can't have renewables without reliable storage and the best form of storage is water."

Pumped hydro is a century-old technology, which provides about 95 per cent of worldwide energy storage linked to electricity grid systems. It works by using excess or cheap power at off-peak times to pump water into raised water basins, from where it can be released to generate electricity when demand and prices are highest. The need for storage is expected to accelerate massively with the greater use of renewables — and while there has been a lot of hype surrounding lithium batteries, pumped hydro is expected to remain the backbone for the renewables revolution.



The control centre at Cooma, New South Wales, where Snowy Hydro controls its supply of electricity to the Australian grid

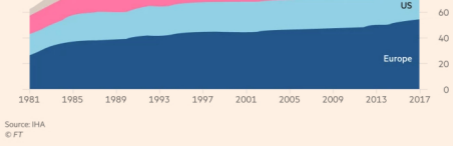
Advocates argue that pumped hydro represents a 20th century solution to a 21st century problem: how to bridge the gap and provide constant power, when using intermittent sources such as wind and solar. And for its backers, Snowy 2.0 — which is scheduled to be completed by 2025 — will act as a showcase for the technology and encouragement for other nations to begin the shift to electricity systems based 100 per cent on green energy.

It is the centrepiece of Canberra's energy policy, which opposition parties, business and environment groups criticise for lacking coherence. The conservative coalition, led by Prime Minister Scott Morrison, is a staunch supporter of coal, which still generates 60 per cent of the nation's electricity and was its top export earner last year worth A\$69bn.

But A\$31bn of investment on renewable energy since 2017, driven by falling prices and the resumption of a green energy target set by the previous Labor government, is changing the nation's energy mix.

Boom time for hydro

Hydropower total installed capacity (MW '000)



Source: IHA
© FT

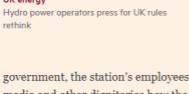
Just over a fifth of Australia's electricity is now generated by renewables. Over the past two years the country has deployed wind and solar generation up to five times faster than the US, China or the EU on a per capita basis. This shift away from coal, a reliable and easily dispatchable power source, to intermittent wind and solar, combined with weaknesses in transmission networks and lack of storage has made the power system vulnerable.

A statewide power cut in South Australia in 2017 and outages in Victoria in January, demonstrated how the nation's electricity system has become exposed at times of peak demand amid questions over the reliability of solar and wind farms in adverse weather.

Coalition backbenchers have lobbied for construction of a new coal power station to stabilise the system but there is little support for such a controversial project given the need to reduce emissions. Faced with a political dilemma the coalition turned to Snowy Hydro to provide enough storage to boost the grid's resilience when the sun isn't shining and the wind isn't blowing.

"Australia is one of the first countries heading towards a mainly solar and wind based renewable energy system, so in a sense we are the international pathfinder to move towards a solar and wind future," says Andrew Blakers, professor of engineering at Australian National University. "Snowy Hydro is important because if we don't put in more energy storage then the electricity system will run into serious trouble by the mid-2020s."

Recommended



UK energy
Hydro power operators press for UK rules rethink

The floor begins to shake and a loud rumbling forces people to scramble for ear plugs when Guy Boardman starts up one of the six generators at Snowy Hydro's Tumut 3 power station. Under the floor thousands of cubic metres of water gush through enormous pipes that run up to a reservoir at the top of a nearby mountain, rotating turbines to generate electricity. Power can be dispatched to the grid within a few seconds.

Since Snowy 2.0 was announced by the government, the station's employees have been busy demonstrating to politicians, media and other dignitaries how the company's existing pumped hydro facility is already helping to keep the lights on in the nation's capital Canberra, which is about a two hours' drive away. The plan is to build an additional 2,000 megawatts of generation and quadruple the amount of electricity storage — enough capacity to power 500,000 homes continuously for about a week. The upgrades, which involve building an underground power plant and 27km of tunnels, would make the scheme one of the largest pumped-storage facilities in the world.

"The beauty of hydro is that it is a renewable energy supply that is available on demand. So when the market needs electricity we simply use the water that we have in our upper storage to drive the turbines in this power station, providing electricity to the market," says Mr Boardman, the area manager for Snowy Hydro. "When we have all six units pumping there is enough water flowing through our plant to fill an Olympic-sized swimming pool every two seconds."

These dramatic numbers have failed to impress critics who say that not only is the state-owned mega project too risky, but that it is crowding out more cost-efficient pumped-hydro projects. Others say competing storage technologies, such as lithium-ion battery farms and solar thermal-energy storage, as well as increased investment in transmission networks could provide a more cost-effective solution.



Snowy Hydro's Tumut 3 power station. When all six generators are pumping there is enough water flowing through the plant to fill an Olympic-sized swimming pool every two seconds

"Snowy 2.0 should dominate the storage market placing it in an incredibly powerful position for a state-owned company," says Tony Wood, energy expert at the Grattan Institution, an independent think-tank.

"It's also a big risk for taxpayers," he adds, citing the technical difficulties in digging tunnels and the possibility that future administrations will be less supportive of the renewables industry — a move that would limit future demand for storage.

In the 1960s and 1970s, pumped hydro was typically deployed by publicly-owned utilities alongside nuclear or coal power stations, which provided low-cost electricity to pump water up hills at night during off-peak periods that could then be used when consumer demand spiked. But as companies deploy more intermittent wind and solar energy on to national grids pumped storage is enjoying a renaissance as a means to help stabilise electricity systems.

China is investing in pumped hydro at a rapid rate, deploying 15,000 megawatts or about one-tenth of global capacity over the past decade. And is forecast to build 50,000 of the 78,000 megawatts of pumped storage capacity due to be installed worldwide over the next decade, according to the International Hydropower Association.

Spain and the US are building new pumped-hydro plants to boost storage. But investment is slower in western nations, where proponents of hydro power say raising finance for projects is made more complex by high upfront capital costs, long lead times in construction and the difficulty in forecasting future revenues, especially in liberalised energy markets.



Kieran Cusack, project director 2.0 at Snowy Hydro Limited at the Tumut 3 power plant

The IHA has warned that some markets are failing to properly incentivise pumped-hydro investment and western nations risk losing out on a clean and green expansion to integrate more renewables on to grids. "At the moment there is a race to the bottom in terms of electricity pricing where solar and wind tend to be cheapest," says Richard Taylor, IHA chief executive. "This acts as a barrier to pumped hydro and can make national grids unstable."

In the UK, which is undergoing a major energy transition, investment in pumped storage remains elusive, due to a lack of long-term contracts and a framework that does not adequately value the grid stabilisation services provided by the technology. Last month Ili Group, which is planning a £500m project in Loch Ness, joined other hydropower operators in calling for a shake-up of market rules to help them attract more funding.

"Prior to market liberalisation in the UK you had more central planning and investment in pumped-hydro storage but no new facilities have been built since the late 1980s," says Karen Turner, a professor at Strathclyde University's Centre for Energy Reform and an advocate of more pumped hydro being added to the country's energy mix.



Australia bets on pumped hydro electric storage

Australia has been the scene of a decade long political battle over energy and climate change policies with opponents of renewables blamed for costing at least three prime ministers their jobs. The coalition has agreed to provide A\$1.36bn of the A\$5.1bn cost of the Snowy Hydro project and the utility's BBB+ credit rating should enable it to borrow money at an interest rate below 5 per cent.

"We aren't doing this because we're zealots for renewables," says Mr Broad, "we're doing it because it makes business sense — the economics are compelling... You have to have that storage in place or you are dreaming and you will have lots of blackouts."

"Snowy is the answer to that," he adds.

The scheme is just one of almost a dozen proposed pumped-storage projects seeking investment while scores of other potential projects in Australia are under consideration.

Snowy Hydro says its storage costs on a megawatt per hour basis are up to 60 times cheaper than that provided by the world's largest lithium-ion battery farm, which Tesla helped build in South Australia after the 2017 blackouts. Mr Broad adds the South Australian battery has a storage capacity of an hour and tends to switch on for only a few minutes at a time, while Snowy 2.0 can cover an entire week to fill in longer outages.

"It's not to say that batteries won't have a place. But they have other challenges as they have to be replaced, our tunnels last for ever," he adds.

Lithium-ion batteries can however respond to outages within milliseconds and are ideal for preventing the outages seen in 2017. Their cost is also falling rapidly, says David Leitch, consultant at ITK Services Australia.

Australia's biggest private energy company AGL Energy plans to build two pumped-hydro projects in New South Wales and South Australia, although no firm date has been set for work to begin amid concerns that the proposed expansion of Snowy could crowd out competitors. Brett Redman, AGL's chief executive, says the technology could support the transition to renewables but adds that more certainty is key to encouraging more investment and lowering costs.

"While I'm not convinced it is economic, government backing of Snowy 2.0 could help kick-start the greater change if done in a highly predictable way and not as part of a wave of government underwriting, which would scare away much needed capital," he says.

The biggest problem for Snowy Hydro, says Mr Leitch, is whether there will be enough demand for the vast amount of storage it will add to the grid.

"Snowy will keep the lights on but it could prove to be a commercial white elephant by never earning back its cost of capital," he says. "It is more expensive than some pumped-hydro rivals and will have some of its lunch eaten by lithium-ion batteries."

Pumped hydropower's role in the new energy mix

A mix of pumped hydro, lithium ion batteries, solar thermal technology, long-distance transmission networks and demand management (where customers agree not to use power at peak times) will be required to keep the lights on as renewables replace fossil fuel generation, according to energy experts.

Lithium ion batteries are getting cheaper, as technology improves. They can be deployed rapidly — it took 100 days to build Tesla's big battery facility in Jamestown, South Australia — and provide power and other grid stabilisation services within milliseconds. Aurecon, an advisory group, found the South Australia battery produced A\$40m of savings in the wholesale power market in its first year of operating by increasing competition.

But batteries need to be replaced every 14 to 18 years and are better suited to providing short-term storage solutions over seconds, minutes or a few hours. In contrast, pumped hydro is better suited to providing larger amounts of storage capacity over much longer periods, typically up to 70 years.

"It is not a case of batteries versus pumped storage — these are complementary technologies", says Paul Gleeson, energy leader at Aurecon.

He says that as more renewable energy is brought on to the grid the greater capacity offered by pumped hydro technology will be required.

Building more resilience into the grid is also essential. One of the challenges faced by Snowy Hydro is the lack of a sufficient high-voltage transmission network to carry electricity to parts of the energy grid that need it. For the Snowy Hydro 2.0 water battery plant to be effective, an additional A\$2bn investment is required in the grid, a cost that is likely to be borne by consumers.