

Gold Mine Recycled as Australia's Largest Pumped Hydro Storage

June 16th, 2016 by [Susan Kraemer](#)



Australia's Genex Power is recycling a disused gold mine as a 400-[450 MW](#) pumped hydro storage project, with the potential to store and generate around 2,225 MWh daily, making this Australia's largest energy storage project by far.

The site will ultimately include 150 MW of PV — with 100 MW of that to be integrated into the hydro transmission once complete — making [dispatchable solar generation at utility-scale](#).

Genex cofounder Simon Kidston told *CleanTechnica* that Queensland's Kidston Gold Mine turned out to be perfectly suited to very large-scale pumped hydro storage.

The abandoned mine, which closed in 2001, has two gigantic holes already carved deep into the rock, at a sufficient height differential for 400 MW of hydro generation for five to six hours daily from storage.

Australian government backing

ARENA, the Australian Renewable Energy Agency has shortlisted the project for funding, and has even included an option to become a shareholder.

“Our ARENA funding is structured as a convertible note which is payable once we get to financial close. ARENA has the right to convert that into equity,” Kidston confirmed.

This surprising degree of government commitment follows several years of slow-walked renewable energy funding by ARENA during Australia’s right-wing Abbott government.

“I think they are keen to join with us,” he said. “ARENA has recognized that you cannot have strong growth in renewables without more storage, and they recognize that pumped storage is the most efficient form of storage on the planet.”

The need for dispatchable renewable energy is great. Australia has the highest solar penetration in the world, supplying nearly [20% of demand from solar](#), and Queensland has been shuttering coal projects.

“As the proportion of renewable energy in the grid increases you tend to see instability. Look at South Australia where you’ve got a very volatile market. When there is no wind, that has led to brownouts,” Kidston said.

“So the Queensland government sees pumped storage as an enabler to the growth of renewables, so is enormously supportive of this project because it is integrated, and it is the only efficient large scale storage project being developed.”

In addition to the pumped storage, Genex has approval to build 150 MW of solar at the site. Initially, the first 50 MW of solar will be built and fed straight into existing transmission, he said.

Then the remaining 100 MW of solar will be integrated with, and built simultaneously with, the 400 MW hydro storage project, along with construction of new transmission infrastructure.

One-fifth the cost of “natural” pumped hydro

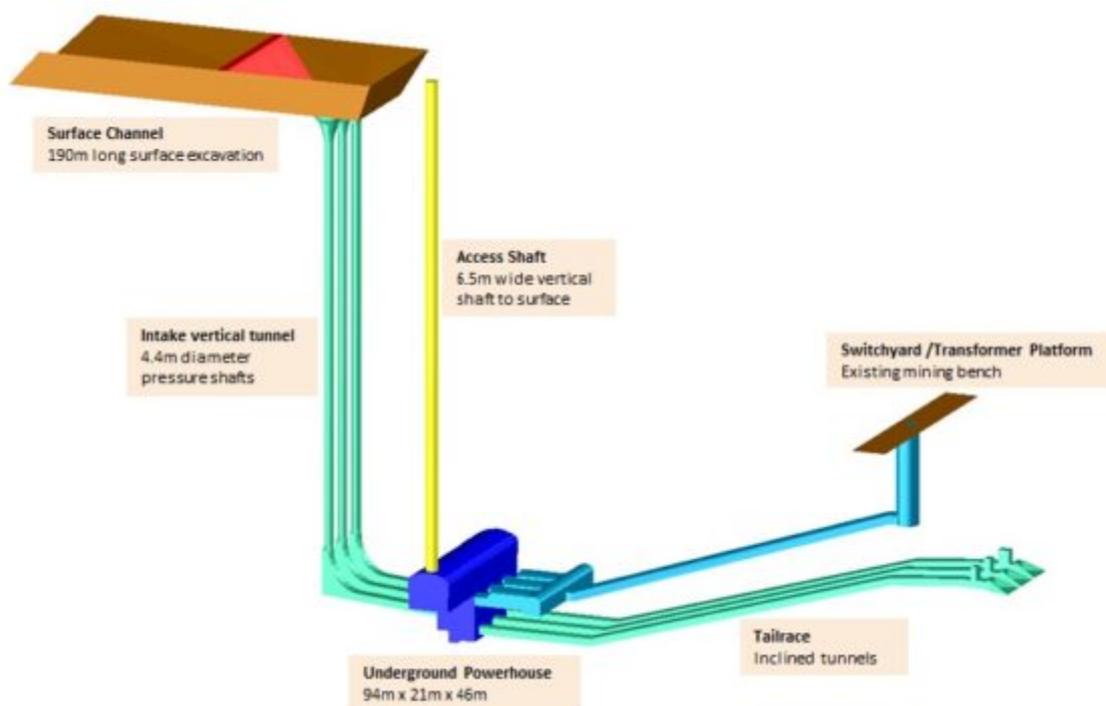
The idea of recycling a mine developed out of their costing process, according to Kidston, who had a finance background prior to cofounding Genex with Managing Director Michael Addison and CFO Ben Guo in 2013.

Genex was not originally looking at reusing an abandoned mine, let alone one with the family name attached. Coincidentally, the town of Kidston and the goldmine were named after Kidston’s own great-great-grandfather William, the former Premier of Queensland.

“When we were looking at developing some pumped storage hydro we tried to think imaginatively. How can we build a project at a fraction of the cost that it would otherwise cost to build a large-scale pumped storage project?” he said.

Building [traditional pumped hydro](#) costs around \$4 to \$5 million (AUD) per installed megawatt. Because pumped hydro storage involves damming and thus altering the behavior of existing riverine habitat, it has become more expensive, and time-consuming, and in some places not even legal to permit new projects.

“By using existing voids and pits left behind by mining activity there’s a massive capital cost advantage, and because of that it is a very compelling proposition,” he said.



“We believe our project can come in at \$1 million per installed megawatt, a quarter or a fifth of the cost of traditional pumped hydro.”

What they found was that recycling an abandoned mine would present a more viable potential alternative, because mining already leaves behind large voids cut into rock, and usually has water and transmission.

Construction costs would comprise about 1/3 each among the civil works such as underground tunnels, a new transmission line connecting to the national grid, and the turbines and other electrical equipment of the power plant itself.

No NIMBYs = fast track

Not only can this project come in at \$1 million per megawatt, compared to \$4-\$5 million for traditional pumped hydro, but there is [no NIMBYism](#) in this abandoned quarry or mine, as land and water are already disturbed.

“We are in a very remote part of Queensland. and since the mine closed down in 2001 there have been few economic opportunities for the people in their part of the world, and so they are enormously supportive,” Kidston said.

As a result, their approvals have been fast tracked, and the Queensland government has declared it a “Project of State Significance.”

“Government wouldn’t be supporting us so strongly if there was any sort of opposition on the ground because they like to make sure that all stakeholders are positive and we have had very strong community engagement,” he pointed out.



How repurposing abandoned mines overcomes traditional limits to pumped hydro

The way pumped hydro storage works is by using unused excess electricity (in the past, this mostly was delivered by wind power) to pump water uphill to a reservoir during off-peak, and then when the electricity is needed, allowing

the water to fall to a lower reservoir, running through turbines on the way to generate electricity.

But there are limits to how much traditional pumped storage can be built. The geographic requirements are very specific, requiring both an existing river and hills containing two potential reservoirs in proximity to each other at a great height differential. Most mountainous regions don't have several reservoir-shaped voids at different heights and require extensive damming to create them.

Reusing abandoned mines and quarries eliminates some of these geographic limitations, which is why ARENA has been actively helping Genex in investigating abandoned mine sites.

Although there are many abandoned mines, other factors such as adequate rock stability and adequate water supply are deciding factors in which mine to site, and there has to be the right market.

Needs a lot of wind or solar

"You need an electricity market that has a certain element of volatility: So who are the competing generators in that network? Because all of those other generators that are in the mix will factor into what is the forward price," Kidston explained.

"For example, we wouldn't explore in Tasmania or Victoria where you have a large amount of very efficient typical hydro generation and so you don't have the same movement in prices that we have in Queensland with a lot of solar, or in South Australia where you've got a lot of wind."

Exported natural gas makes peaker plants expensive

The partners' main motivation however came from the repercussions from the development of export terminals for LNG in Gladstone. (Regular natural gas gets compacted into its liquid form (LNG) in order to be more cost-efficiently shipped overseas.) Storage that includes dispatchable generation can eliminate natural gas peaker plants.

"The majority of Queensland peaking power is gas, but with gas exports starting, local gas prices have already doubled," he explained. "That's had a very bad impact on the power generators, and it's making peaking power marginal to uneconomic, and some of them are shutting down."

"Some peaker plants, instead of generating five hours a day, are now only generating two hours a day," he added. "And this is already happening when

they are only just starting to bring on some of these LNG trains now. And this means that we, with our generation from pumped hydro storage, will be at a much much lower cost.”

Historically, natural gas in Queensland was \$2 per gigajoule, but it is now trading at \$6, and the forecast is \$8. (All AUD).

The 2013 startup has moved fast

By [2014, Genex had bought the abandoned Kidston site in Queensland from the Canadian gold mining company Barrick](#). What initially attracted them to the particular site was both the two very deep voids very close to each other, with a “head differential” between those two points in excess of 300 meters.

Now the drop could actually be 340 meters.

The partners are currently undergoing a feasibility study of increasing the head differential by incorporating a natural “eagles nest” type of outcropping in the upper reservoir. The advantage of additional height is to further reduce the cost.

“The bigger the water drop the smaller the turbines, and the smaller the tunnels, so actually this additional head reduces the capital cost quite significantly,” Kidston explained.

The feasibility study should yield results by the end of this year.

At more than 98% of all existing storage, pumped hydro is by far the most widely-deployed storage now, and due to long-ago government financing of the initially high capital cost, and to its long life once built, pumped hydro storage has been a very cheap renewable storage resource.

But Genex Power is confident that the recycled gold mine can do even better.

Kidston said: “Look; we’ll be cheaper.” A ballpark estimate at this stage suggests that they could generate from stored renewables at \$20 (AUD) per MWh (in US dollars; under \$15 per MWh).

This project – and hopefully more like it – make it very achievable for Queensland to meet its target of 50% renewables by 2030, by mopping up its superb daytime solar resource and making it dispatchable.

Image Credits: [Genex Power](#) and [ARENA](#)