

**Q&A Webinar: Pumped Hydro - the biggest batteries on earth! Australian Water School - Wednesday, 6 October, 2021**

Question	Answer(s)
The poll required a selection for the last question. As none of these related to me I clicked a random selection. Mis-leading results could occur for this question.	thanks for letting me know, sorry that's painful!
For arid and semi arid areas where there will not be even enough water for drinking and agriculture, storing water inside the storages and losing in froms of evaporation and infiltration is the right approach?	My apologies, to Mark Cordell.  Evaporation is certainly a challenge for schemes in arid or semi-arid regions where the annual evaporation exceeds the annual rainfall. This means that sources of top-up water will be an ongoing maintenance issue. This then raises the challenges of competing uses for water, such as water supply. Not an easy solution.
Hydropower is a great way to obtain relatively clean energy; nonetheless, droughts can prove to be a severe challenge. How does the panel think that pump storage can beat droughts such as the Millennium Drought?	
Due to climate change,there is hydrological fluctuations in water and sediment inflow.This affects the hydraulic performance of the reservoir storage.How do we tackle such site-specific issues?	Because the upper reservoirs can be located offline from main channels, inflow of sediment can be less than in an inline reservoir. For lower reservoirs or inline structures, sediment flushing or other mitigation should be incorporated.
Has there been any investigation as to whether pumped-hydro power would be eligible for Australian Carbon Credit Units where implemented in-lieu of fossil fuel power generation?	Has there been any investigation as to whether pumped-hydro power would be eligible for Australian Carbon Credit Units where implemented in-lieu of fossil fuel power generation?
To Mark Wilson: What are main challenges in Australia for Pumped Storage projects in mining pits ??	One of the main problems is that mining areas are typically located far from the demand associated with population centres  The Technology Brief 'Retrofitting PSH on open pit mines' provides a table of issues and challenges that will need to be resolved. These generally focus on the technical challenges.  Financially, mine pit developments are being driven by private investments and it is the uncertainty in policy and the revenue streams that are the main hurdles to be overcome.
Can you speak to any advancements in the industry to assist in derisking projects in the development phase?	
What is the main barrier for pumped hydro projects at the moment? Finance, Government policies, Technology?	The technology is tried and tested - multiple examples throughout the world.  I would say a key barrier is policy and that feeds into the revenue stream - how will the pumped storage scheme receive its income - the historical reliance of arbitrage to unpin the financial viability of a project is decreasing.
How long did it take to achieve planning approval for Red John from the time the site was chosen to develop?	it took 5 year
In Australia, most of our water resources are fully developed and regulated under robust water management frameworks with clearly defined and secure water access rights for existing water users. How does the panel consider PSH can operate harmoniously within these constraints and is there an opportunity to utilised recycled water?	In Australia, most of our water resources are fully developed and regulated under robust water management frameworks with clearly defined and secure water access rights for existing water users. How does the panel consider PSH can operate harmoniously within these constraints and is there an opportunity to utilised recycled water?  I do not know about the situation in Australia, but I think: It will be great with recycled and wastewater
What are the factors to be be considered in the benefit-cost analysis of pumped storage projects?	CAPEX, cost per MW/h, geography, planning environment, environmental designations, proximity to grid, likely grid costs and connection dates, energy system operator needs, political support
To Mark Wilson: you've opted for fixed speed pumping units. Did you consider variable machines to provide a greater range of services, and why were they not selected?	Whilst our position isn't set in stone, we have a growing sense that fixed speed turbines represent the most practical and cost effective utilisation of PSH. Variable speed turbines of course offer the maximum flexibility, but this has to be weighed against the additional cost and complexity that such an arrangement brings. We may be reaching a point where batteries are better placed to provide that flexibility and have PSH focus on the heavy loads.

Is it better to have PHS near the loads or at optimal topography	Thinking in NZ context, Onslow is far from the loads of Auckland Hamilton and Tauranga
'@Mark Wilson, is the carbon saving based on lifecycle analysis or just comparing with the replaced diesel? Thank you.	The carbon savings are based on the potential offset from the project i.e if the energy stored had been lost, what is the carbon cost to need to generate again.
have many hydro pumped storage systems been implemented using the sea as a water source?, this overcomes drought issues etc?	This is an option but not the first option
Can the mass rollout of in-stream hydro and micro-hydro (in pipes etc) provide similar grid stabilisation services?	
In comparison to lithium-ion batteries, and broadly other storage technologies, where do you foresee the competitiveness of pumped storage in the next 10-20yrs and beyond?	Pumped storage hydro has existed for 100 years. We believe PSH naturally lends itself to large-scale, long-term storage with batteries operating in the short-term, fast response space. We live in a fast changing world, however, PSH is a tried and tested technology that we know can provide the balancing and stability services to allow the efficient and reliable operation of carbon free energy systems.
Is "Pump-around" a feasible technology to use at existing hydro plants as a way of stabilising the grid for an excess of wind/solar?	There are certainly examples around the world where pump-turbine units (or even just pump units) have been retrofitted to existing conventional hydropower projects - not suitable for all situations as storage is required both upstream and downstream of the existing dam.
Peter Stitt	
A problem in Australia is that most of the good sites have been tied up in National Parks. Please comment	
So, at small scale, it has been shown how "inefficient" the pumped hydro concept can be. Has the "efficiency" been calculated for the Red John and Snowy 2.0 projects?	Modern PSH plant have an operational efficiency of approximately 80%. Large PSH projects are significantly more cost effective than the equivalent cost per MWh of, for instance, lithium-ion batteries to provide similar levels of storage capacity. There are interesting developments underway for small scale PSH using storage tanks and high-density liquids.
'@Mark Wilson, has the saved carbon been traded under EUETS? Thanks.	
Pumped storage using sea water, corrosion ... would be feasible in the future ??	Yes. Such a scheme exists at Okinawa, Japan