



# An Atlas of Pumped Hydro Energy Storage

20151ERP031, G00857

## Public dissemination report

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**Lead organisation:** Australian National University

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**Project commencement date:** 1/7/16

**Completion date:** 30/6/18

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**Date published:** 2/8/18

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# Summary

This project is entitled Short Term Off-River Energy Storage (“STORES”). The aim is to substantially reduce barriers to pumped hydro energy storage and thereby to support increased deployment of variable wind and solar energy. It received ARENA funding of \$609,000 over 2 years.

STORES project helps people find potential pumped hydro sites, and reduces the time and cost of pre-feasibility evaluation:

1. Site-search: find tens of thousands of potential pumped hydro energy storage sites in Australia; and
2. Grid balancing: hour-by-hour balancing and cost modelling of the National Electricity Market (NEM) and other regions with high renewable electricity penetration supported by storage. Grid balancing integrates site searching and the cost model with solar, wind and demand data

STORES had a substantial impact on Australian energy policy. Prior to STORES-1 there was little appreciation of the great potential of off-river pumped hydro energy storage to support high penetration of variable wind and solar. Largely because of our work this is now common knowledge.

Our initial site-survey of the Australian landmass found 22,000 good sites (>300m head, >1GWh of storage) which is about 1,000 times more than required to support a 100% renewable electricity system. Most inhabited areas of Australia have good pumped hydro sites nearby. The associated press release garnered an audience of 5 million (Isentia). An associated Conversation article is at <https://theconversation.com/want-energy-storage-here-are-22-000-sites-for-pumped-hydro-across-australia-84275>

We showed that the cost of hourly balancing of a 100% renewable NEM (storage, stronger interstate connection, spillage of PV and wind energy) is only \$20-25/MWh over and above the cost of energy generation. It had not been widely understood that the moderate cost of pumped hydro means that the required storage is affordable, and that the overall balancing cost is modest. The associated press release garnered an audience of 7 million (Isentia). Associated Conversation articles are at <https://theconversation.com/solar-is-now-the-most-popular-form-of-new-electricity-generation-worldwide-81678> and <https://theconversation.com/whats-the-net-cost-of-using-renewables-to-hit-australias-climate-target-nothing-88021>

## Project impacts

We were very successful in translating outputs from the project into the public arena. Prior to STORES there was little appreciation of the great potential of off-river pumped hydro energy storage to support high penetration of variable wind and solar. Largely because of our work this is now common knowledge. We created impact and shifted the national energy discourse.

- Many meetings with Ministers, shadow ministers and members of Governments
- Hundreds of phone calls and emails were received in relation to the project, including many with complementary comments such as *“We have been looking at the development of a Pumped hydro in South Australia when I came across your work. I have been looking at the sites identified and must say thank you for this invaluable resource”*
- Discussions and meetings with many organisations
- Since June 2017 our website (<http://re100.eng.anu.edu.au/>) received 7,400 visits and 4,400 unique downloads of site data and papers, which indicates substantial interest
- Engagement of the STORES team in 200 outreach activities
- 3 published papers
- Readership of 120,000 from associated articles at <https://theconversation.com/au>
- 35 conference presentations (mostly invited and keynote presentations)
- 10 substantive articles
- 30 substantial engagements with Governments
- A Eureka Prize finalist nomination
- Two ANU Media and Outreach Awards: (i) Impact award for reach and influence and (ii) Award for improving the quality of public debate.

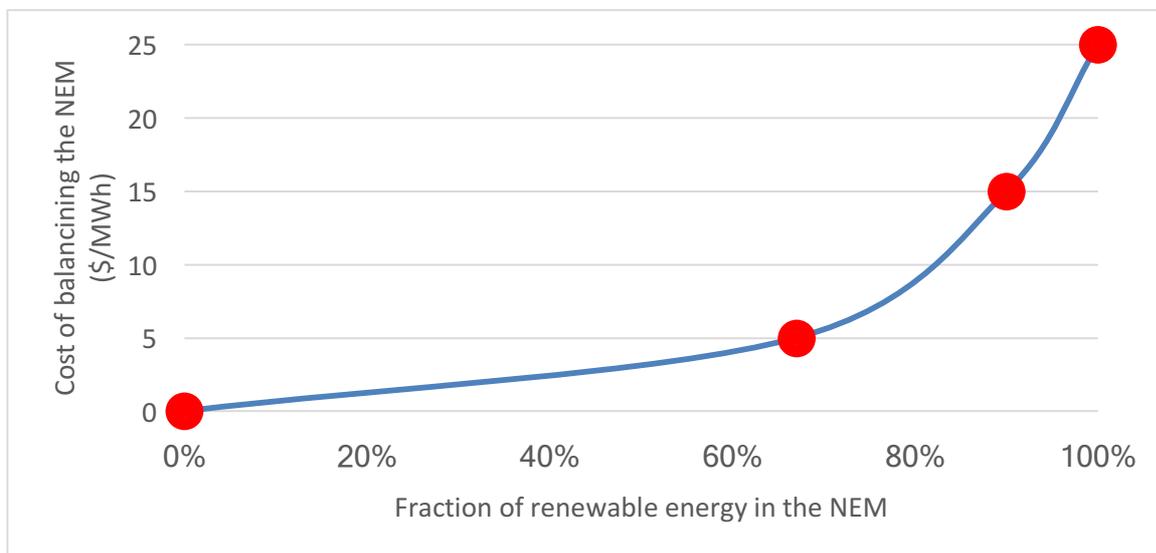


Figure 1: Cost of hourly balancing of the NEM (\$/MWh) as a function of renewable energy fraction

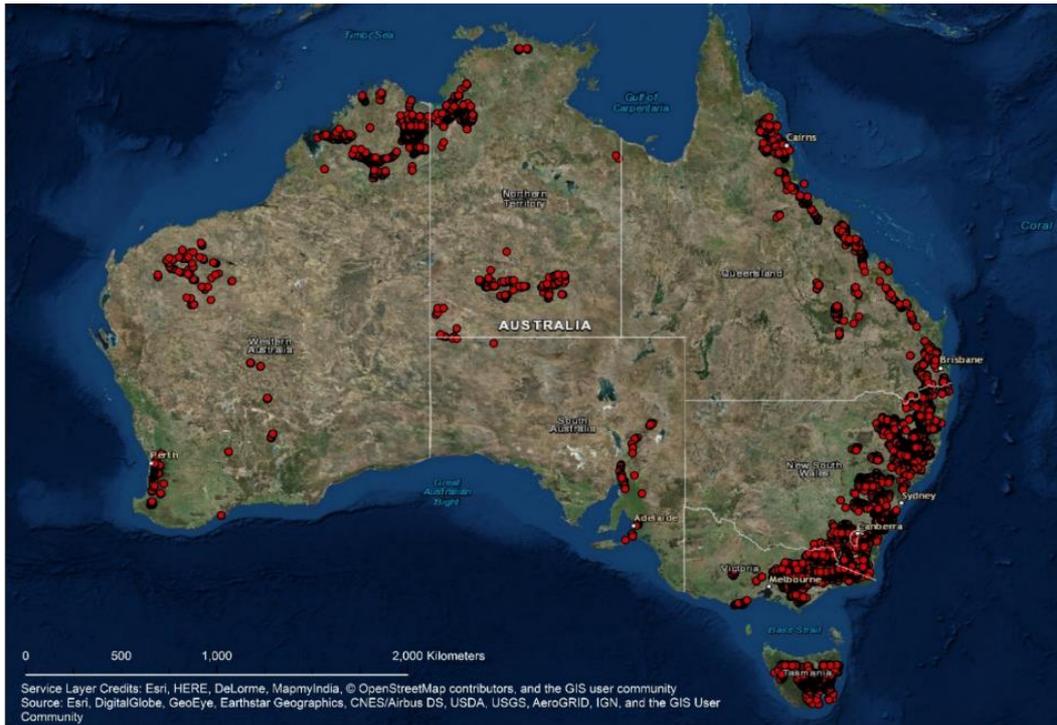


Figure 2: 22,000 potential pumped hydro sites in Australia (<http://re100.eng.anu.edu.au/research/phes/>)

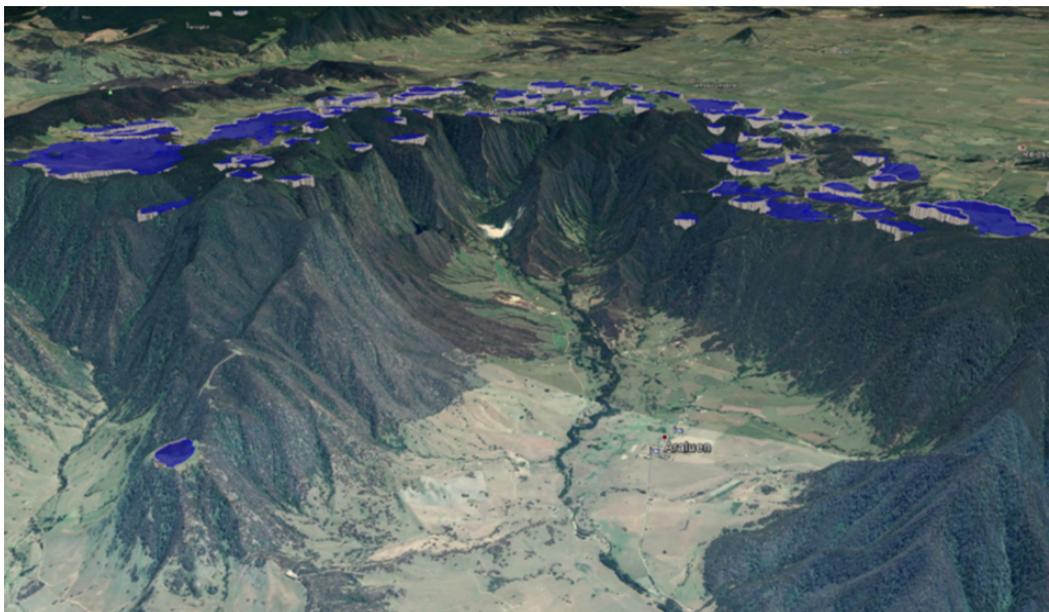


Figure 3: Group of potential upper reservoir PHES sites at Araluen near Canberra. The largest of the reservoirs depicted has enough storage to support a 100% renewable electricity grid for NSW.