Becoming the *'Battery of the Nation'* in Australia

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Australia's National Energy Market (NEM)

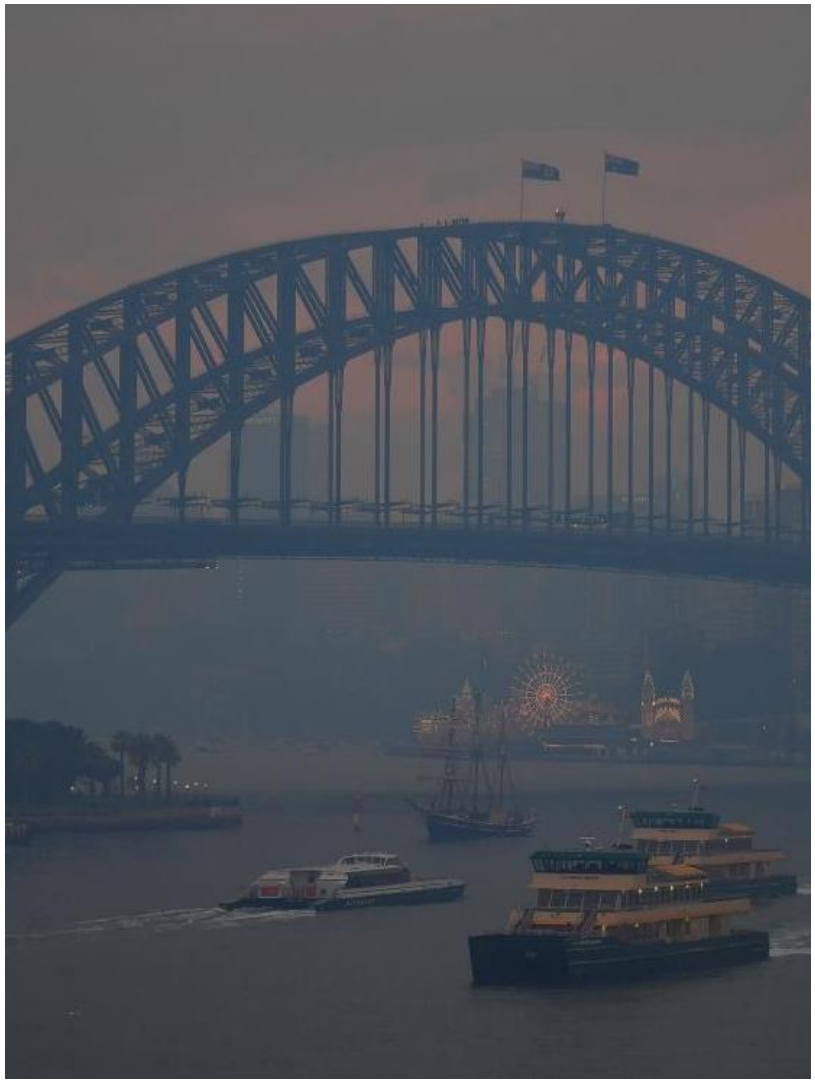
The Australian NEM:

- Spans 6 states and territories in Australia;
- Operational since 1998;
- Has approximately **40,000km** of transmission infrastructure;
- Supplies around **10,000,000 customers**;
- Has a total **generating capacity** of approximately **54,241 MW** (as at December 2017)
- Annual demand of ~180,000 GWh

Australia's Recent Bushfires

- Catastrophic bushfires have highlighted a **significant risk to energy security** in Australia;
  - Several lines were impacted/under threat;
  - Springvale coal mine/Mount Piper coal-fired power station almost burnt.
- **Snowy Hydro impacted** during fire events.
  - Transmission capacity significantly de-rated.
- **Snowy 2.0 construction schedule delayed** (some loss of equipment).
  - The operational township of Cabramurra suffered losses (**36 houses destroyed**)
  - **Work has re-commenced**, with focus on clearing access roads and continuing with road construction, excavations and site camp set up

Extreme weather conditions are providing insight into likely future needs to support the resilience of Australia's energy grid.



Source: www.news.com.au

Australia's Energy Future

Australia's energy mix is changing at an unprecedented rate. There will be 3 key components to support Australia's energy future:

1. Flexibility	2. Storage	3. Grid expansion
- Balancing the grid; - System support services.	- Shifting of bulk energy; - Minimising curtailment.	- Resource sharing; - Connect more VRE.

Tasmania's hydro scheme can support this transition by becoming the *Battery of the Nation*

The Battery of the Nation initiative

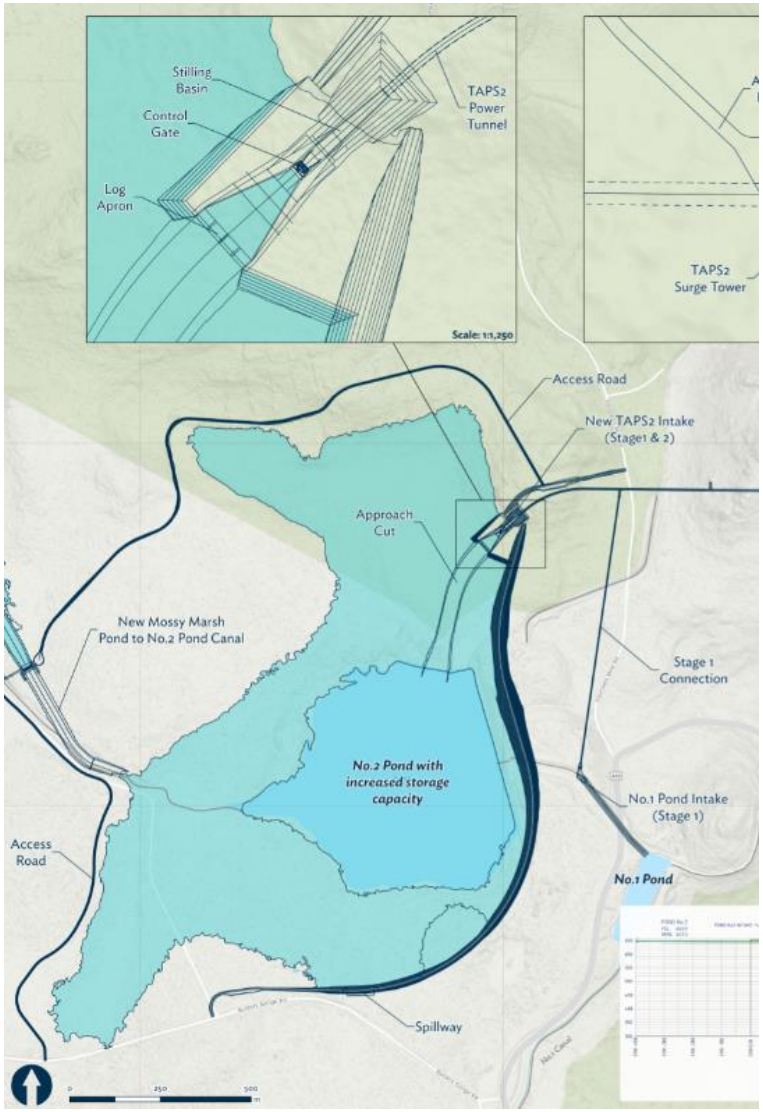
Mat Creese, Manager Operational Contracts at Hydro Tasmania

Hydro Tasmania

- A **well-established hydropower system** and significant opportunity to repurpose
- > 400MW of **latent hydropower capacity** waiting to be unlocked
- Over 2,500MW of **cost competitive pumped hydro** potential - all with storage durations > 11 hours
- 1000s of MW of potential **new wind development**
- Demand and natural resource (wind) characteristics that **complement the rest of Australia**
- **Further interconnection** between Tasmania and the State of Victoria is essential.
- TasNetworks are developing a case for a **750/1,500MW link (Marinus Link)**

2020 Priorities/Challenges

1) **Interconnection**
   - MarinusLink assessment/approvals
   - Benefits and cost-allocation
2) **Potential role of Tasmanian Hydro**
   - Conventional hydro (upgrades/refurb)
   - Pumped Hydro site assessments (3 sites)
3) **Understanding challenges and opportunities**
   - BotN assessments and white papers
   - Market reform in Australia



Marinus Link

- **1500 MW (2 x 750MW)** between Tasmania and Victoria by 2027/28.
- Federal government providing financial support for ongoing assessments:
  - **$20M feasibility and business case assessment** from the Australian Renewable Energy Agency (ARENA)
  - **$56M Commonwealth funding** to fast track the **Design and Approvals phase**
- Analysis to date indicates that **significant market and other socio-economic benefits** can be achieved by developing Marinus Link
- Cost-allocation methodology for Marinus Link a key issue to resolve (significant coal retirements expected in Victoria / Tasmania nearly energy self-sufficient)

Marinus Link will: (1) enable significant further wind generation; (2) support the refurbishment of existing hydro assets; and (3) support new pumped hydro developments.

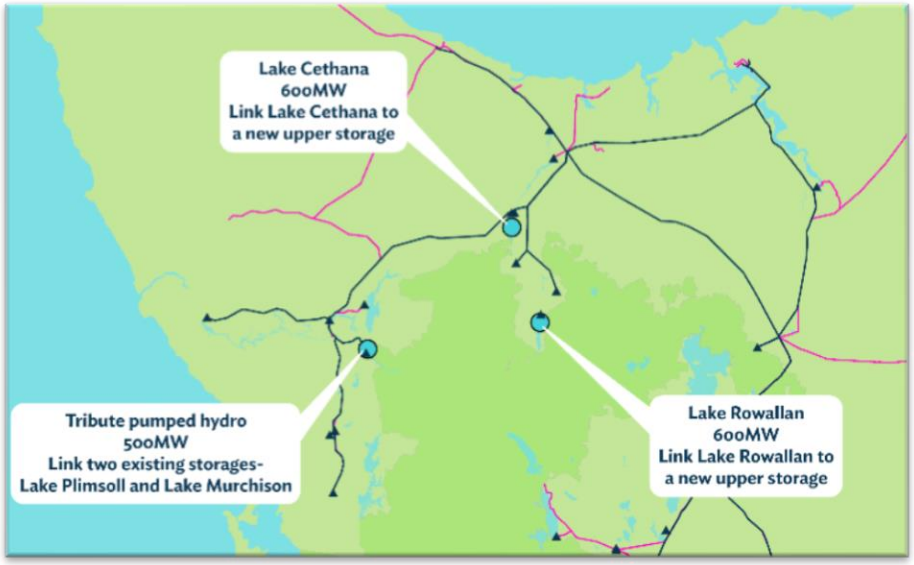
Source: TasNetworks (recreated from AEMO's Insights Paper (2019))

Opportunities

Existing Hydro – upgrades/refurb

Case Study: Tarraleah Power Station

- More than **double capacity** (90MW to ~200MW);
- Shift **from baseload to peaking** generation;
- ~30% increase in annual generation;
- **Reduce annual spill** (40GWh down to 15GWh)
- Supports flexibility of downstream stations.

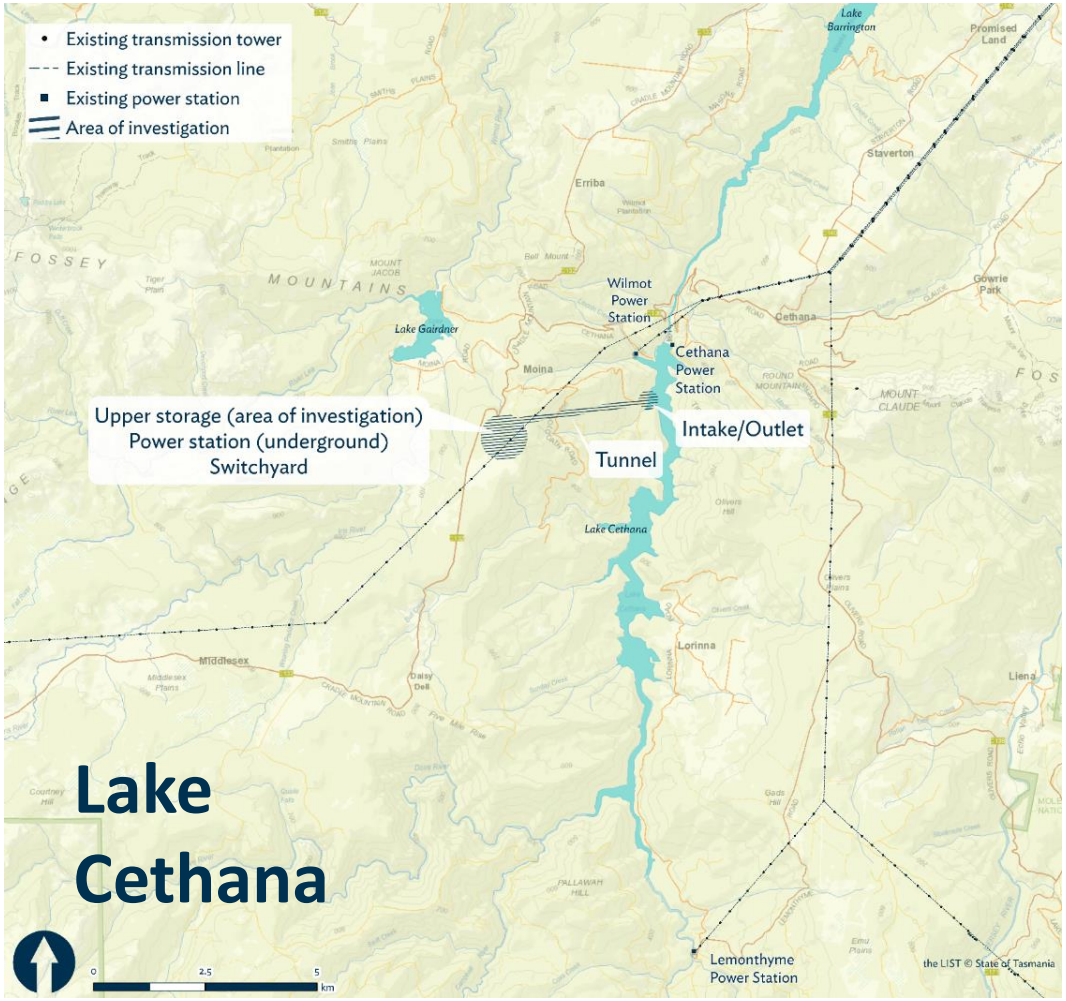


Pumped Hydro potential

- **~3400MW of potential capacity** across 6 sites.
- Pumped hydro costs are very competitive (~$1.5M/MW)
- Supports development of further on-island generation
- Flexible dispatch to support broader NEM region
- Can be designed/expanded in step with Australia's energy transition.

PHES Feasibility Studies

Key facts and estimates	Lake Cethana	Lake Rowallan	Tribute PHES
Capacity	600MW	600MW	500MW
Duration	11 hours	24 hours	31 hours
Upper storage volume	~ 5 Gigalitres	~ 14.7 Gigalitres	---
Upper storage area	50 – 70 Hectares	100 – 150 Hectares	Existing Lake Plimsoll
Water conveyance tunnel length	3,500 metres	2,800 metres	7,100 metres
Tunnel diameter	Up to 8.5 metres	Up to 9 metres	Up to 8.5 metres
Cost per MW to build	$1.50M/MW *	$1.65M/MW *	$1.83M/MW *
Construction cost estimate	$900M*	$990M*	$915M*



Geotechnical Investigations

Photos of geotechnical drilling underway at Lake Cethana PHES site

BotN White Papers (1)

To support the business case, seven white papers have been developed (or in stage of development)

1. Unlocking Tasmania's energy capacity

- Further interconnection (I/C) can support the transition of the NEM.
- With further I/C, minor operational changes could deliver ~400MW of spare capacity.
- Creates opportunity for new developments, such as pumped hydro and wind assets.

2. Energy vs. Capacity

- Introductory paper for people who are not energy specialists.
- Explores terminology such as 'firming', 'baseload', 'balancing', and 'flexibility'.
- Highlights differences in 'depth' of storage and durations of dispatch.

3. Implications for Victoria

- Supports Victorian Renewable Energy Target (50% renewables by 2030) – firming/storage
- Introduces competition – downward pressure on prices
- Can help ensure sufficient supply throughout peak periods.

BotN White Papers (2)

Hydro Tasmania

4. Imperfect forecasting

- Impacts of ***imperfect forecasting and uncertainty***, and increasing reliance on ***short-term weather forecasting***. Paper identifies that longer duration storages are more robust to forecasting uncertainty.

5. Adjusted modelling approaches for future market

- Potential ***alternate modelling approaches*** suited to the energy transition challenge. Focus will be placed on modelling techniques to adequately assess integration of high penetrations of VRE and storage.

6. Revenue and finance models for PHES

- Assess the maturity of ***revenue models*** and understanding of ***financing mechanisms*** to support pumped hydro developments in current market contexts.

7. Tasmanian system effects

- ***Operation and value of PHES*** in the Tasmanian energy system. The paper will incorporate ***hydrological and market modelling***.

Australia's Market Reform (WIP)

Alex Beckitt, Head of Strategic Policy at Hydro Tasmania

Hydro Tasmania

Post-2025 Market Design

- New market designs (Day-ahead, capacity etc.)
- Drive innovation/ Investment signal/ DER integration/ System Security/VRE integration

Recognise and reward the value of Hydropower the in future energy market

Integrated System Plan

- Centralised grid planning
- Renewable Energy Zones (REZ)
- Key transmission assets, new interconnection(s)

Support the necessary and efficient build-out of AUS grid

Underwriting New Generation Investment

- Support new dispatchable resources
- BotN shortlisted
- Collaboration with government officials to agree arrangements

Provide safety-net to underpin investment confidence

Delivering on future needs of the NEM

Hydro Tasmania

More than 15,000 MW of generation to retire before 2037.

~75% of future developments currently under consideration are VRE projects.

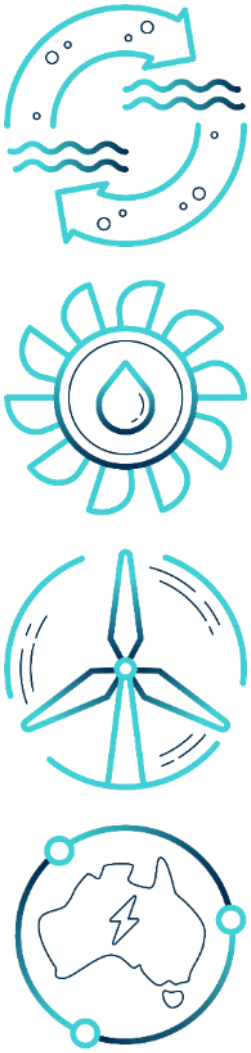
In light of this transition, Australia's energy grid and system services need to change – "***Business as usual" is not an option…***

A failure to develop new, flexible sources of generation could lead to extended periods of energy scarcity, producing increasingly high prices, to the detriment of consumers.

To avoid this risk, we need to demonstrate:

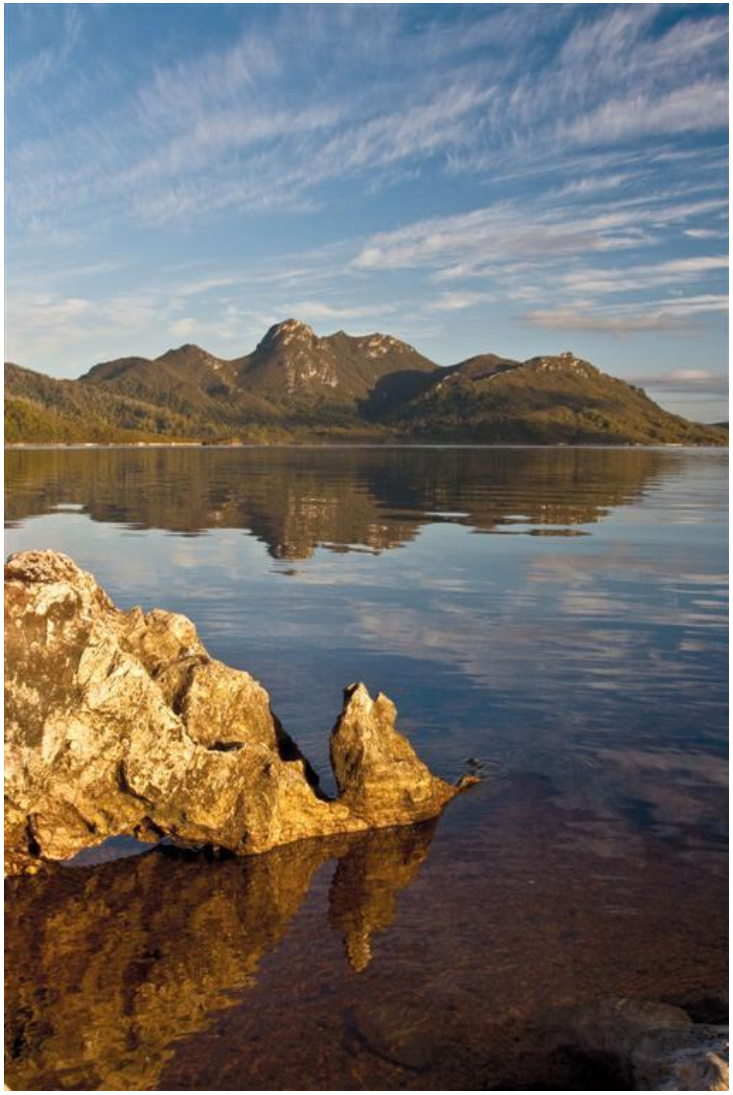
1. Demonstrate the **optimal role** of hydro in the future energy mix; and
2. Identify appropriate market structures to ensure the **ongoing profitability** of hydropower.

Collaboration with international hydropower peers is integral to alleviating this risk in the Australian energy sector



Conclusions (where to from here?)

- Throughout 2020, we are powering ahead in our ambitions to become the *Battery of the Nation*.
- Assessments have revealed that Tasmania *can* play an important role in Australia's energy future.
- Opportunities for collaboration to address key issues/questions:
  1. What flexibility services will be required, and when?
  2. How can markets evolve to shift primarily from cheap bulk energy and scarcity pricing/peaking?
  3. How are markets (policy/regulation) evolving to value flexibility, system services, and storage?
  4. How do we properly value energy and capacity and system capability?



Thank you

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