Pumped hydro and pumped up prices: the case of Australia's largest pumped hydro generator

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Outline

- AI declaration
- Introduction and Context
- Background to Tumut 3
- Analysis
- The scope for Tumut 3 to reduce electricity prices
- Discussion and conclusions

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AI declaration

- This slide deck as been developed by ChatGPT -03(Plus), to the following instruction:

"I have attached a research paper and 2 page powerpoint document. Develop a 20 slide powerpoint slide deck based on the material in the research paper, using the outline set out in page 2 of the powerpoint slide deck."

- ChatGPT (free version) assisted in providing some Stata code used in the analysis.

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Introduction and Context

The Storage Imperative

- Rapid growth of variable renewables in Australia
- Government-backed 2,200 MW Snowy 2.0 project
- Snowy claims: 87 % capacity factor, $75/MWh margin
- Study tests plausibility using existing 1,800 MW Tumut 3

Key Questions

- How is Tumut 3 currently utilised & priced?
- Does operation reflect market power?
- What price effect if Tumut 3 bids at avoidable cost?
- Implications for Snowy 2.0 business case

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Background to Tumut 3

Tumut 3 – Plant Snapshot

- Commissioned 1973; refurbished 2012
- 6×300 MW generating units; 3×200 MW pumps
- Upper reservoir: 33 h full-load storage
- Switching pump→gen: ~15 min; ramp 60 MW/min

Data & Sources

- 5-minute NEM dispatch & price data (2015-24)
- Australian Energy Market Operator (NEMWeb)
- Hydrological inflows & technical parameters
- Author's Stata code (GitHub: Tumut-3-and-Snowy-2)

Decade-Long Utilisation Trends (2015-24)

- Average pumping ↑ from 1 MW to 93 MW
- Average generation ↑ modestly (37→96 MW)
- Pumped-hydro share ≈ 25 % of Tumut 3 output
- Gross margin rose to $494 m in 2024

Price Spread

- Volume-weighted pump price: $16–159/MWh
- Generation price: $126–645/MWh
- Spread widening—strong arbitrage opportunity
- Yet utilisation only ≈ 20 % of capacity

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Analysis

Dispatch Order Findings

- Tumut 3 runs after Snowy hydro, before OCGT
- Even at $239/MWh avg price, load < 33 % capacity
- At $1,382/MWh, avg load 77 % capacity
- Suggests strategic withholding

Market Power Indicators

- Snowy Hydro controls hydro, Tumut 3 & Colongra OCGT
- Low Tumut 3 output coincides with high-price gas dispatch
- Colongra run only ¼ of competing Uranquinty OCGT
- Portfolio incentive to lift regional prices

Quartile Analysis Method

- Daily Tumut 3 generation split into quartiles (2023-24)
- Compare pumping & generation volumes, prices, margins
- Controls for hydrological inflows & round-trip losses

Quartile Results – Headlines

Top quartile margin: $492/MWh, utilisation 21 %
Bottom quartile margin: $73/MWh, utilisation 11 %
Pumping volume nearly flat across quartiles
High margins not exploited → market power likely

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Using Tumut 3 to Reduce Electricity Prices

Counterfactual Scenario

- Re-bid Tumut 3 at avoidable cost ≈ $49/MWh
- Increase pumping by 59 MW (9 am–4 pm)
- Displace OCGT, high-priced CCGT & imports
- Assume other bids unchanged

Which Supply Is Displaced?

- OCGT fully above Tumut 3 avoidable cost
- CCGT & imports regressed vs price to find cut-off
- Need extra 140 MW average generation 5-8 pm
- Transmission constraints deemed minor

Price Impact – 2023-24

- Spot price when Tumut 3 generating: ↓ 45 % (243→134)
- Avg 5-8 pm price: ↓ 40 % (281→170)
- Whole-period avg price: ↓ 33 % (114→76)
- Small volume shift, large consumer benefit

2023 vs 2024 Outcomes

- 2023 avg price drop: 96→61 $/MWh
- 2024 avg price drop: 131→91 $/MWh
- Bigger absolute effect in 2024 due to extreme peaks
- Consistent directional results

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Discussion and Conclusions

Key Conclusions

- Tumut 3 under-utilised; likely strategic withholding
- Full-cost bidding could cut NSW peak prices ~40 %
- Current market power undermines Snowy 2.0 forecasts
- Competition in storage critical to efficient transition

Snowy 2.0 Business Case

- Snowy projects 87 % CF at $75/MWh margin
- Tumut 3 runs 20 % CF despite 5× higher margins
- Implausible without major market reform
- Further transparency & modelling disclosure required

Policy Implications

- Market structure determines storage value (Andrés-Cerezo & Fabra)
- Public funding of Snowy 2.0 may entrench dominance
- Restructuring, regulation or divestiture options
- Need to balance consumer prices vs decarbonisation subsidies

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Next Steps

- Deeper transmission-constraint modelling
- Assess battery growth interaction with pumped hydro
- Explore regulatory pathways to curb withholding
- Questions & Discussion

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