A large pumped storage scheme for seasonal reliability of national power supply?

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Acknowledgements

We thank Contact Energy Ltd and Meridian Energy Ltd for kind provision of generating and discharge data and financial support.
The dry-year issue

- Most of NZ power will remain hydro
- Only 4,000 GWh storage capacity
- Insufficient storage to use wet years to offset low inflows later

![New Zealand Hydro Storage 2003-04](image-url)
Stand-by coal-fired stations?

• Expensive to maintain
• No guarantee of new gas finds

Increase storage capacity?

• Capacity increase of about 10,000 GWh
• Not possible with existing lakes
• Pumped storage as an alternative?
Conventional pumped storage

(Small water volumes shifted between upper and lower reservoirs)

- Load-following for thermal stations
- Frequency control and voltage support

Turlough Hill Pumped Storage Scheme, Ireland
The Saurdal seasonal pumped storage scheme (Norway): A model for New Zealand?

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<tbody>
<tr>
<td>Energy storage</td>
<td>7,760 GWh</td>
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<tr>
<td>Reservoir level range</td>
<td>125 metres</td>
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<td>Upper Reservoir area</td>
<td>82 km²</td>
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<tr>
<td>Tunnel length</td>
<td>10.5 km</td>
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Location of Onslow-Manorburn basin (Central Otago)
Onslow Dam

Clutha River

Lake Roxburgh

Tunnel

Onslow Dam

Manorburn Dam

Alexandra

Reservoir area: 120 km²
Energy storage: 12,000 GWh
Level range: 80 m
Tunnel length: 20 km
Head range: 590-720 m

Proposed Onslow-Manorburn seasonal pumped storage scheme

Southern portion of Lake Onslow

800-metre contour

Onslow Dam
Northern portion of Lake Onslow

Proposed northern dam site

Upper Manorburn reservoir
Simulation

- As if scheme was in operation 1990-2003
- Seek to smooth Clutha + Waitaki power yield through dry periods
- Move existing hydro lakes toward mid-range levels (spill reduction)

Pumped storage daily water uptake or release to Clutha River (1990-2003)
Pumped storage daily water uptake or release to Clutha River (1992 dry year)

Pumped storage daily power generated or used for pumping (1990-2003)

Mean: -84 MW
Simulation result: Clutha + Waitaki power yield maintained (1990 – 2003)

Cumulative energy gain from alternative lake operating mode (1990-2003)
Water levels of simulated Onslow-Manorburn Reservoir (1990-2003)

Maximum water level variation: 50 metres

Recorded and simulated Lake Pukaki water levels (1990-2003)
Lake Rotoaira (0.5 metre operating range)

Lake Moawhango, 15 metres operating range
Related Benefits of the Onslow-Manorburn Scheme:

- Spinning reserve and frequency-keeping
- Supporting wind energy and small hydro
- Some reduction in Lower Clutha flood peaks
- Water supply for Dunedin city

Onslow-Manorburn pumped storage: Conclusions

- Energy-neutral
- Could buffer hydro power output through future climatic variations
- Reduced hydro lake seasonal fluctuations
- But would it fit into the market?