EPECentre
ELECTRIC POWER ENGINEERING CENTRE

UC
UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

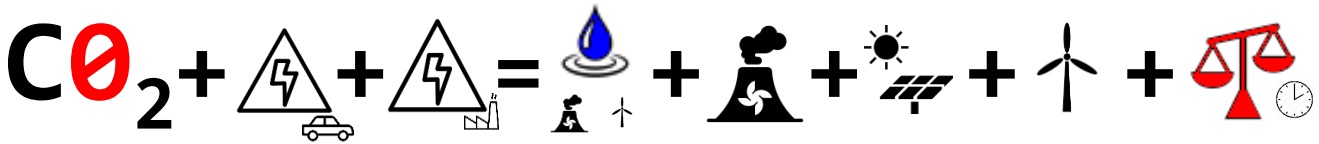
PHES NZ

OERC symposium

By Dougal McQueen

Nov 2018

Maintaining balance



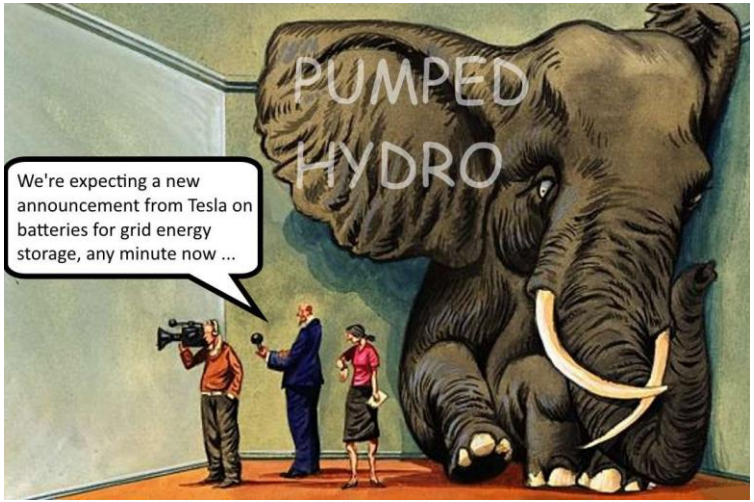
1550 MW / 368 GWh 100% (Mason, 2013)
5000 MW 2050 (Transpower, Te Mauri Hiko)

Daily, synoptic, seasonal

Stability (inertia, reserves, black start)

1 MW - 2 MWh (longevity, capacity)

Elephants



https://scottishscientist.wordpress.com/2015/04/15/worlds-biggest-ever-pumped-storage-hydro-scheme-for-scotland/

http://pickeringpost.com/story/the-green-elephant-in-the-snowy-mountains-/8517

Pump Hydro Energy Storage

95% of active storage worldwide

75% round trip eff.

Lowest cost

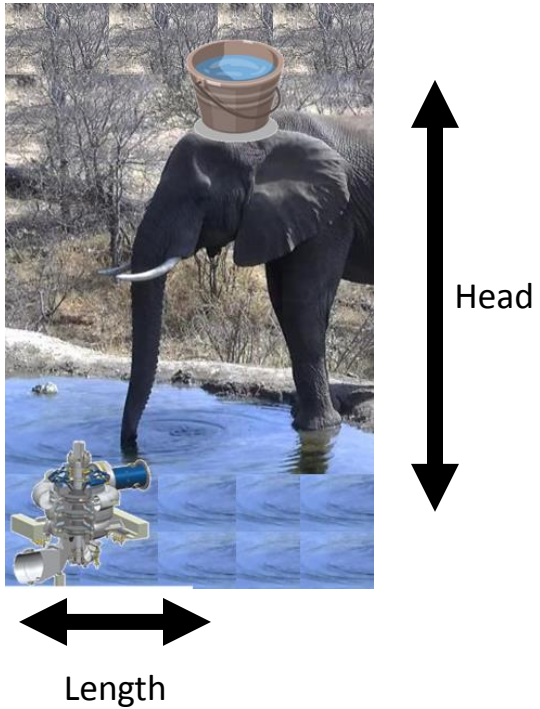
Economic at scale

Capable (synchronous)

Resilient

Scheme Types

1. Existing reservoirs
2. New upper reservoir
3. Brown fields
4. New upper and lower reservoirs



Projects & proposals

Name	Date	Reference	Capacity [MW]	Storage [GWh]	Head [m]	Length [km]	H/L
Bath County	1985	USA	3030	24	400	1.8	0.22
El Hierro	2016	Spain	11	0.6	653	2.4	0.28
Edolo	1985	Italy	1000	53	1265	9.7	0.13
Kiev	1972	Ukraine	235		70	0.5	0.14
Lake Onslow / Teviot	2006	Bardsley		12000	650	20	0.03
Wanaka / Hawea	2012	Bardsley		211	65	2	0.03
Pukaki / Tekapo	2018	NZ Prod. Com.					
Stewart Island	2016	Mason		0.03	75	0.5	0.15

Type 1

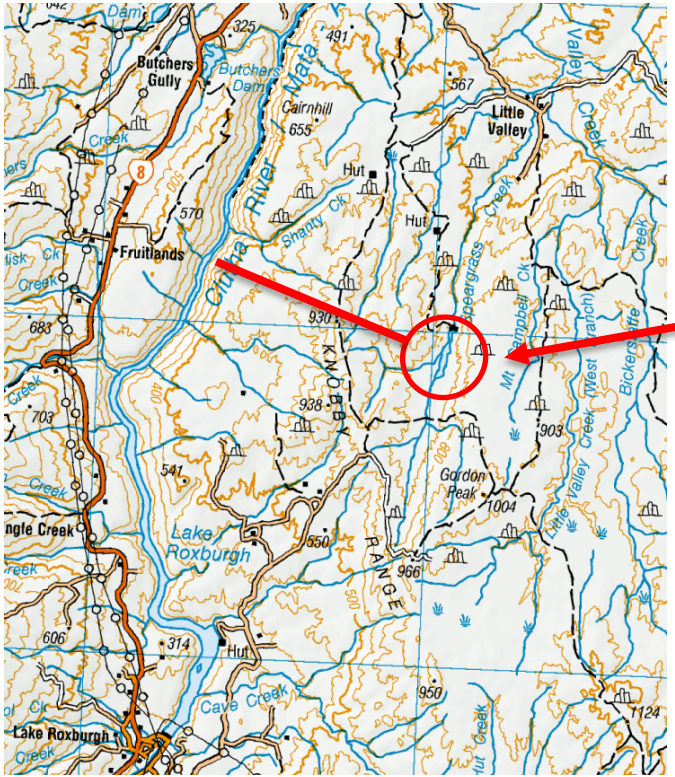
Search pairs of LINZ water bodies. Filter DOC, small, H/L (0.066)

Lower reservoir	Upper reservoir	Storage [GWh]	Range [m]	Length [km]	Head [m]	H/L	Barrier
Wakatipu	Lake Johnson	0.28	5	1.2	91	0.08	Low H/L
Wakatipu	Lake Luna	2.2	5	4.2	502	0.12	Remote
Wakatipu	Lake Dispute	0.57	5	1.1	160	0.14	Recreation area
Wakatipu	Lagoon Creek	1.0	5	1.2	116	0.09	Remote
Lake Sumner	Lake Mason	1.0	5	2.2	151	0.07	Remote
Loch Katrine	Lake Mason	1.0	5	1.9	153	0.08	Remote
Lake Aviemore	Lake Benmore	17	1	0.2	93	0.40	Existing power scheme
Lake Roxburgh	Speargrass Creek	1.4	5	7.3	514	0.07	Small storage
Lake Roxburgh	Butchers Dam	0.6	5	1.5	159	0.11	Recreational area
Karapiro	Arapuni	3.6	3	0.1	58	0.43	Existing power scheme
Waikaremoana	Waikareiti	0	0	2.6	310	0.12	Kaitiakitanga

Lake Johnson

Frankton
110 kV
N-1 risk winter 2019

Speargrass Creek



Speargrass

Onslow 20 km

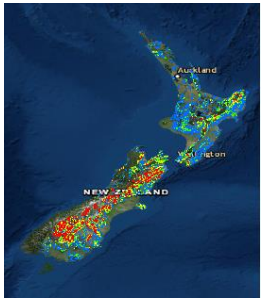
Type 2

ANU PHES Atlas 22000 sites (Blakers et al., 2017)

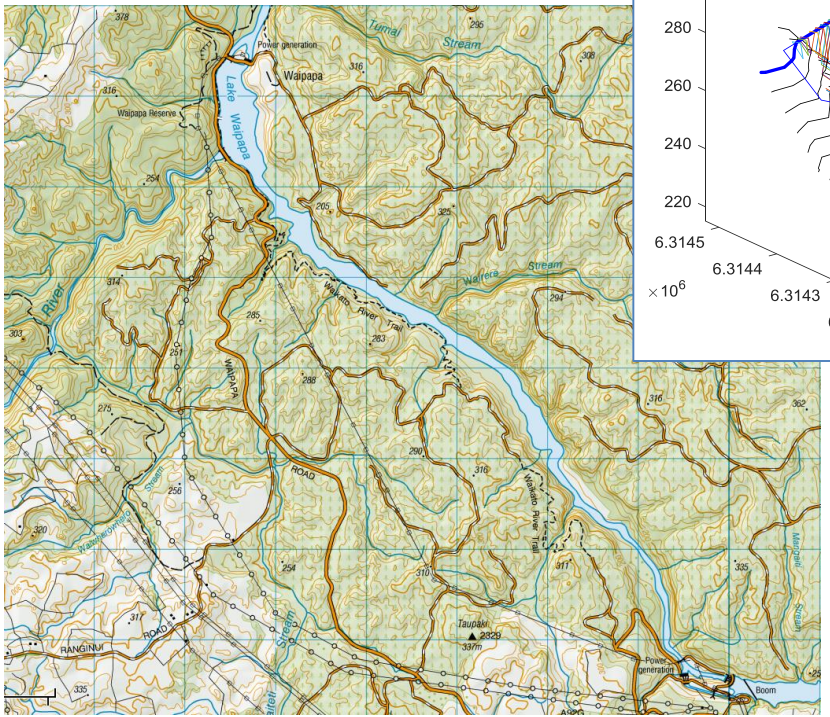
Topographic resource (sparse, large) >> need for speed

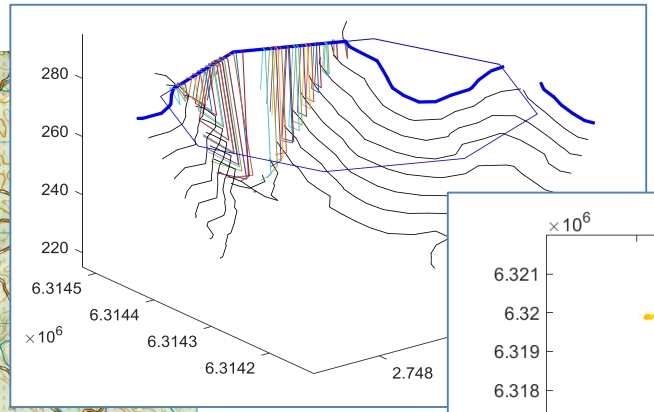
Wide range of project costs >> scope for optimisation

Polygon on contour map, move in evolutionary algorithm

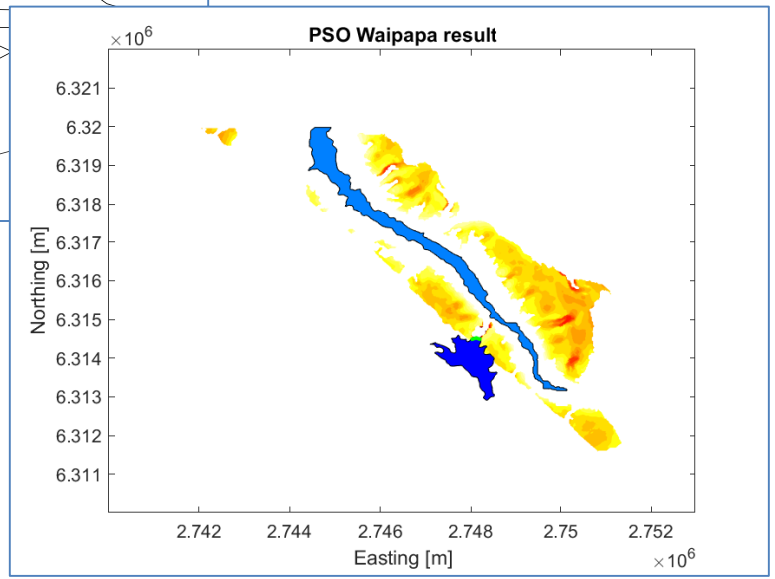


Type 2 search





H = 135m
V = 3 GWh
10000 m3
dam vol.



R & D

Faster

Engineering (geotechnical, morphological)

Cost model (civils, Water Resources Assessment Methodology: land use, littoral zone)

Type 4

Premium Funder

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