

Electricity in Transition

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13-15 November 2018
Rotorua, NZ



Electrification of road transport... why?



Cost



Health



Environment



Energy security



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Electrification of road transport... why?



Cost

Night time residential electricity in Wellington: ~11c/kWh.

~20kWh required per 100km in a 'typical' battery electric car:

\$2.20 / 100km fuel cost

Petrol pricing in Wellington: ~\$2.20 / Litre

~10 Litres per 100 km in a 'typical' petrol powered car:

\$22.00 / 100km fuel cost



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Electrification of road transport... why?

Internal combustion engines at scale in cities aren't optimal.

Regulation on this is partly behind massive Chinese EV uptake.
See also: Britain, France, Germany...

In Aussie, it's a question of petrol engines in the cities vs coal and gas power stations in the country.

In NZ, generation is ~80% renewable (mainly Hydro), balance coal/gas/oil. No health downside, but supply may be an issue.



Health



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Electrification of road transport... why?

Global environmental considerations....



Environment

NZ greenhouse gas emissions are around 70.6 Mt CO₂-e.

20% of this (~13 million tonnes / year) is from road transport.

But locally....

What about environmental impacts of more hydro?



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Electrification of road transport... why?

NZ imports most of its oil (about 70% of use)



Annual NZ diesel and petroleum use is around 6.2 billion litres.

This is around 15-20 tanker movements per month.

Consider a future where this isn't necessary....

Energy
security



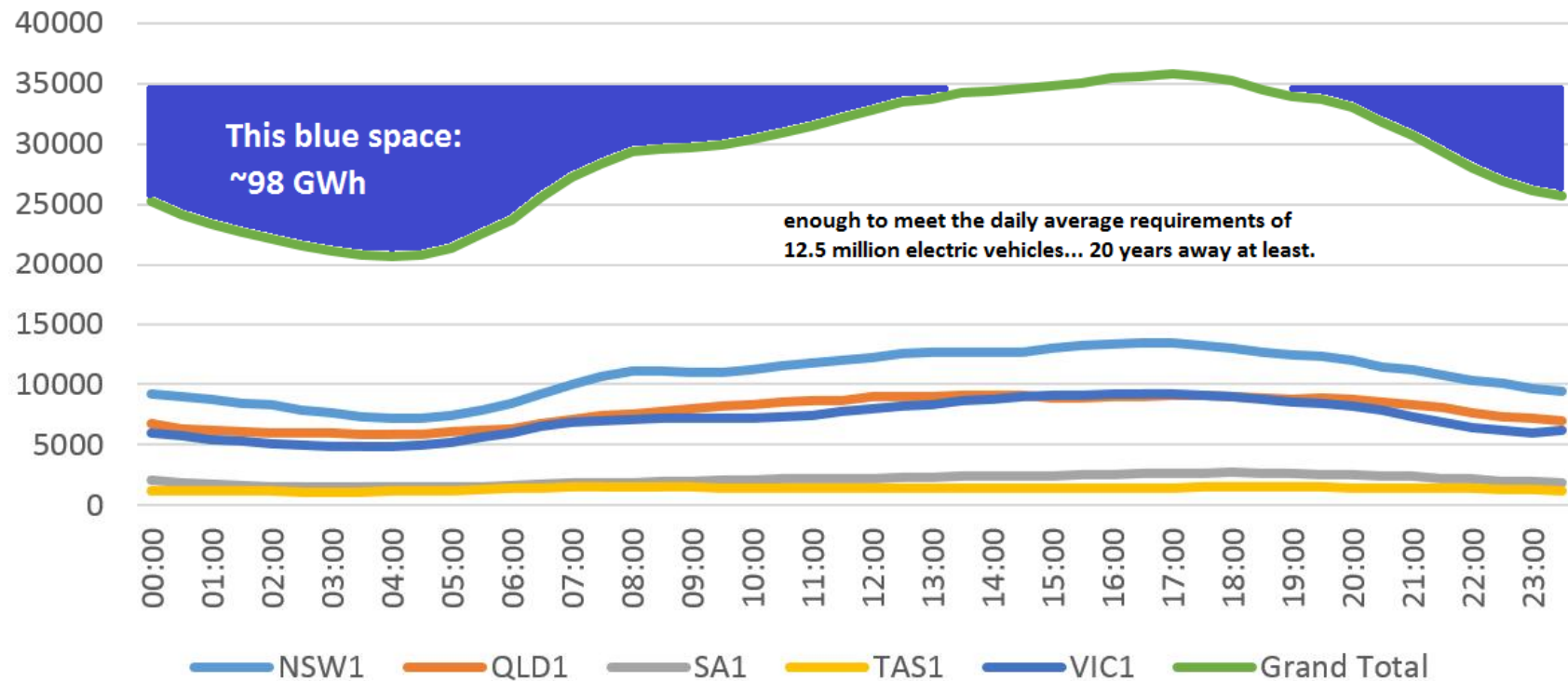
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Can the grid take the load in Aussie?



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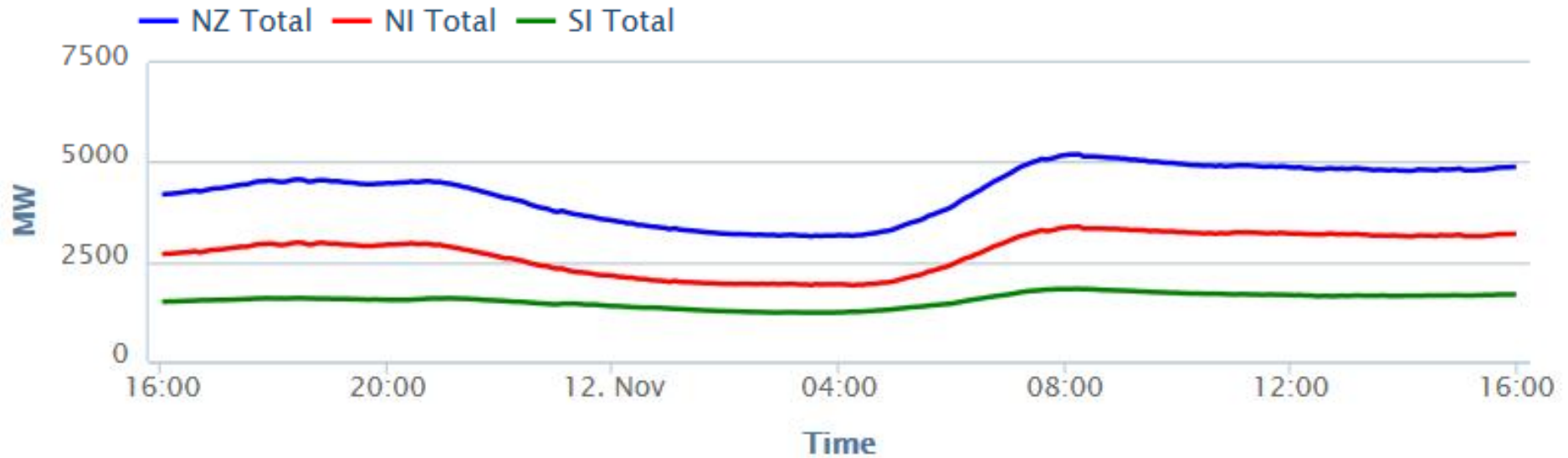


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Can the grid take the load in NZ?

Updated: 12 Nov 2018 16:00



<https://www.transpower.co.nz/power-system-live-data>



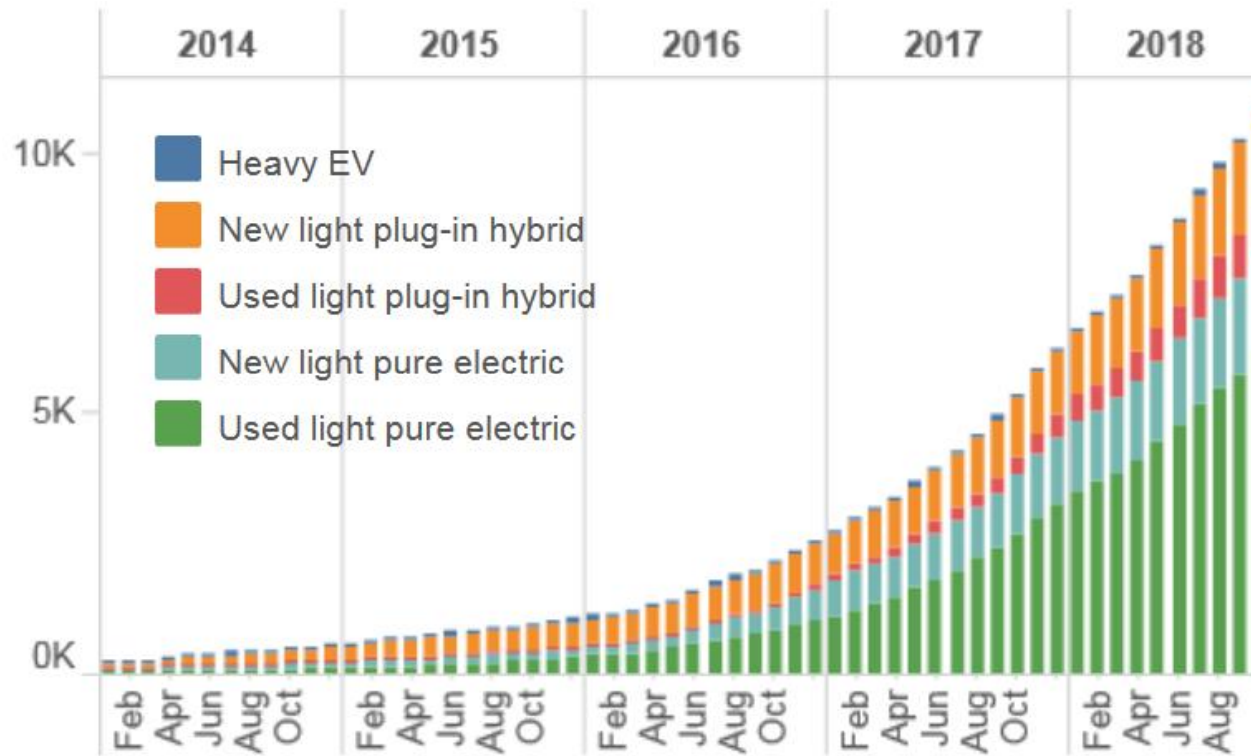
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Electric vehicle uptake in NZ so far...



<http://www.transport.govt.nz/research/newzealandvehiclefleetstatistics/monthly-electric-and-hybrid-light-vehicle-registrations/>



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Electrification of road transport... how?



Toyota Mirai – Hydrogen



Nikola 2 – Hydrogen



Tesla Model 3 – Lithium



Tesla truck – Lithium

Challenges:

Recharging rate

Infrastructure

Vehicle mass

Energy efficiency

Total cost of ownership



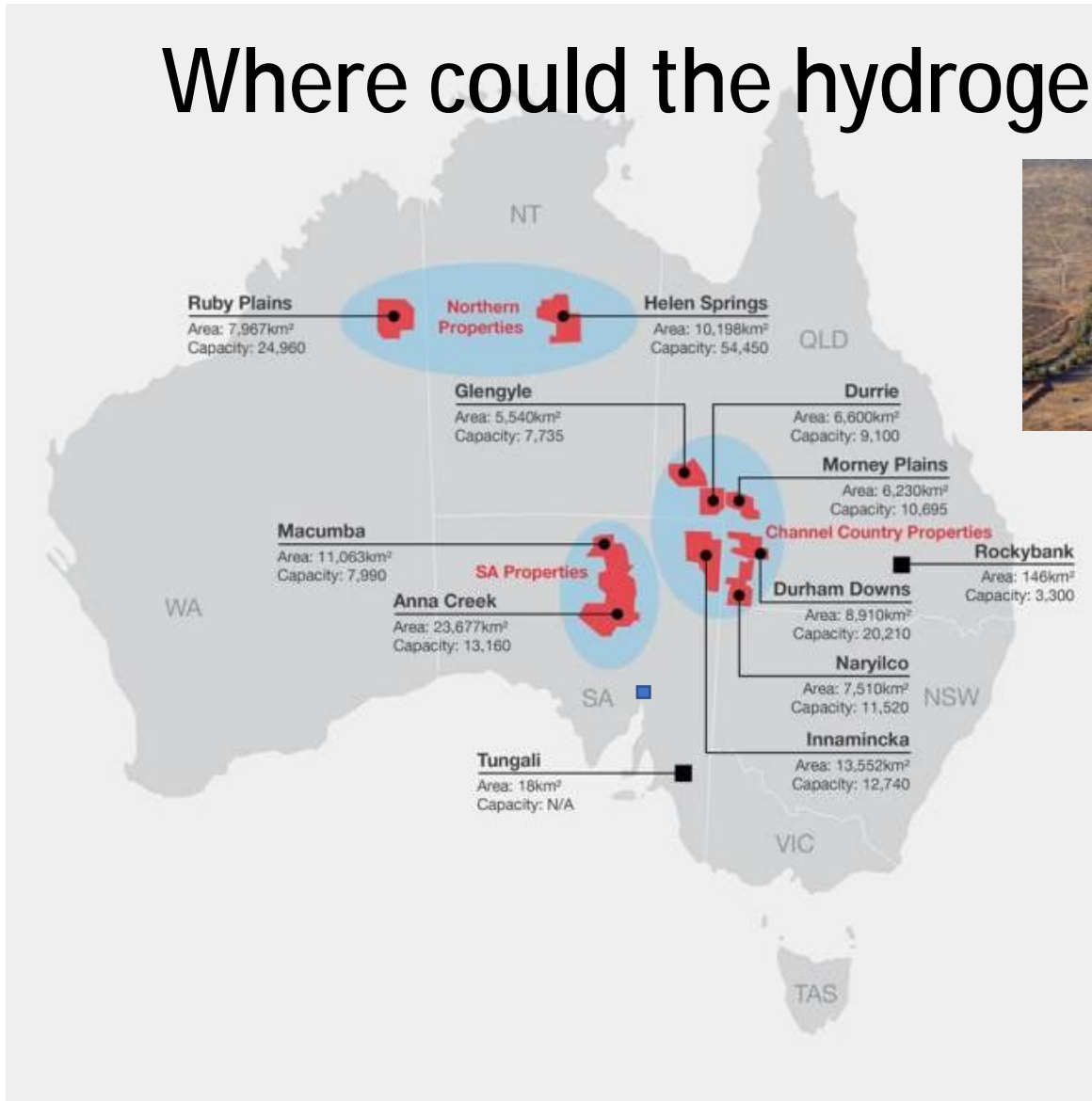
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Where could the hydrogen come from?



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Penetration of Variable Renewable Generation

- South Australian electrical energy use, by the numbers, 2016/17:
 - 13,800 GWh used in the year.
 - 80%: Local generation: 40% wind, 50% gas, 9% rooftop solar.
 - 20%: 650MW Interconnector from Victoria (up from 14% previous year)
 - Highest wholesale electricity pricing *in the world*
 - \$108/MWh, on par with NZ retail price of 11c/kWh...
 - Emergent reliability problems at peak demand times (summer 16/17)
- Political dimension... state & federal politics fought on energy.



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Penetration of Variable Renewable Generation

'Fix it in time for next summer so we don't lose the election!'

-State political leadership, probably...

- Tesla battery (100MW/129MWh)... what else was done?
 - Diesel generators, for future conversion to gas (~250MW)
 - Market operator negotiations (commercial / industrial demand response)
- To avoid our negative experiences, read:
 - Finkel Report (June 2017)
 - AEMO's South Australian Electricity Report (November 2017)

Variable renewables are great, provided they're supported with storage.



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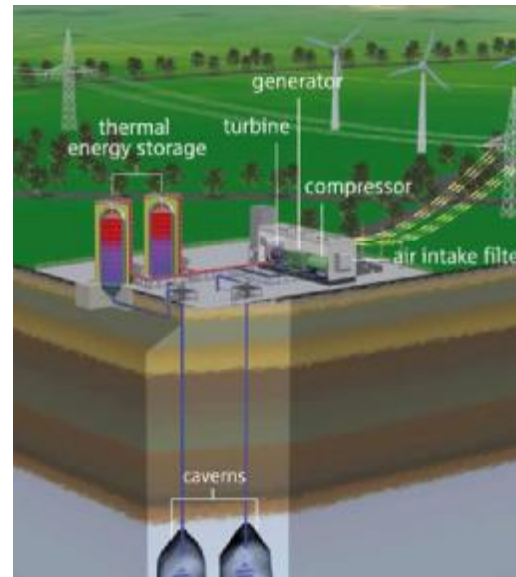
Electrical energy *storage* methods



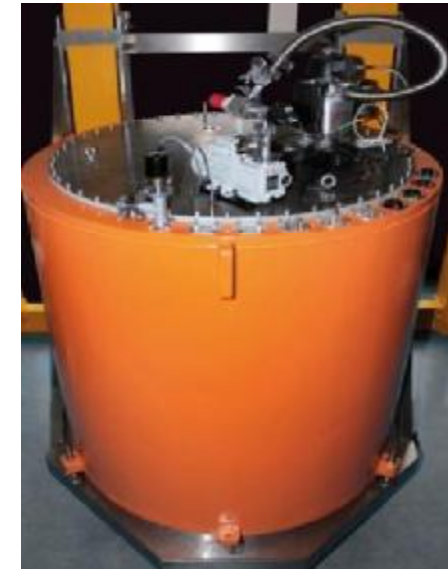
Pumped hydro



Chemical Batteries



Compressed Air



Flywheels



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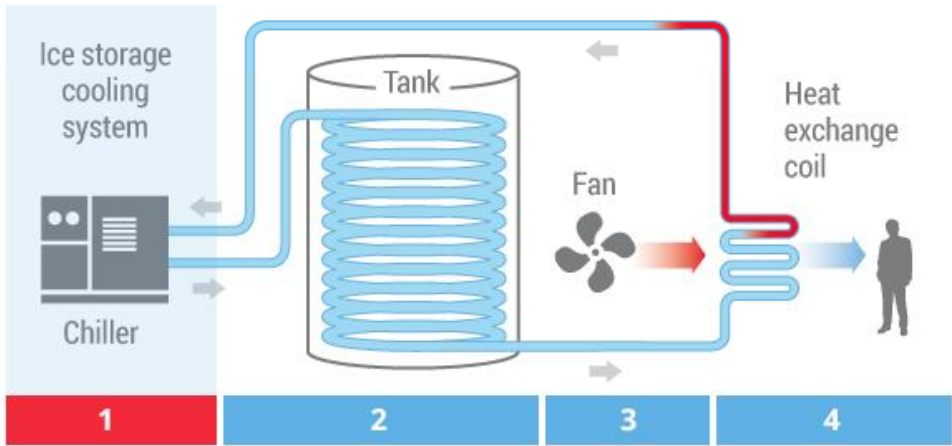
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Electrical energy *time shifting* methods



Concentrated Solar Thermal



Thermal Storage



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Electrical energy *storage* cost comparison



Snowy 2.0: \$8,000 million
Power output: 2,000 MW
Storage: **350,000 MWh**
Lifetime: 80+ years



x 50,000
homes

South Australia VPP: \$800 million
Power Output: 250 MW
Storage: **650 MWh**
Lifetime: 10-15 years

At scale, pumped hydro is ~50x cheaper storage up front, ~250x cheaper long term



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