

Water consumption in a renewable NEM

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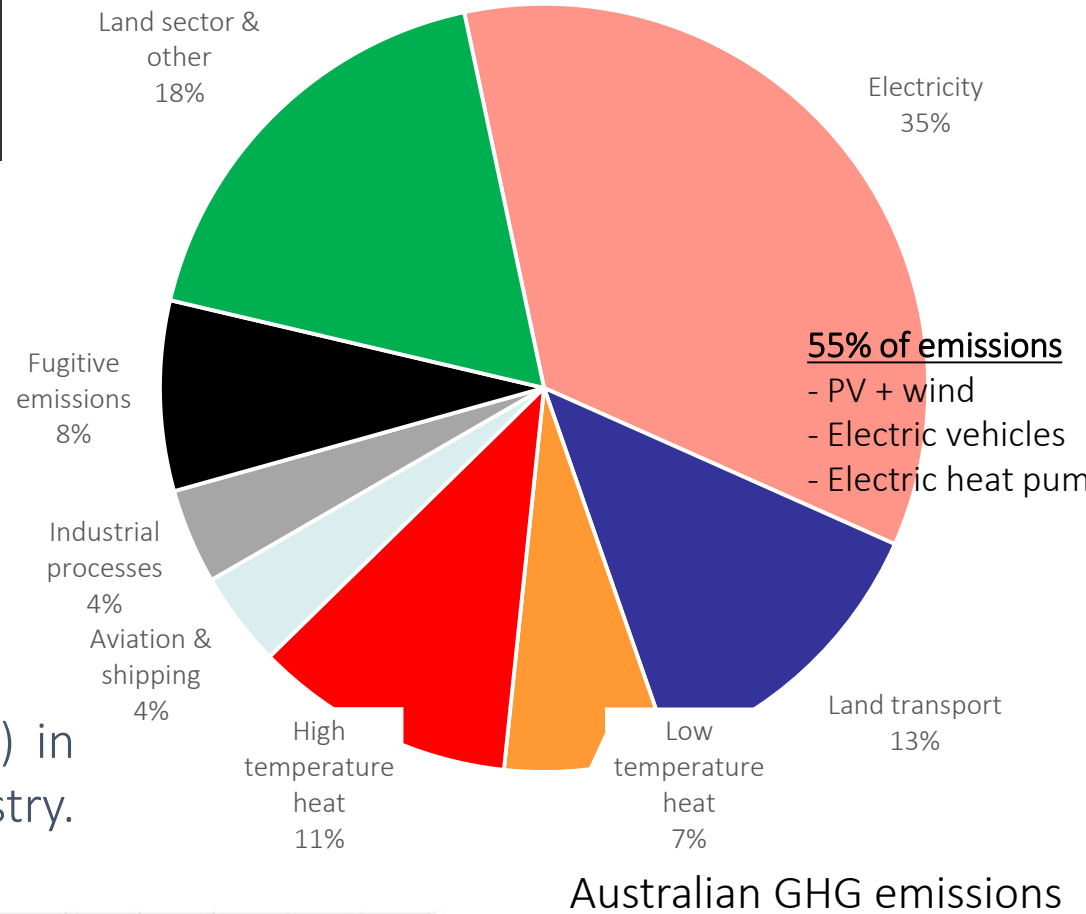
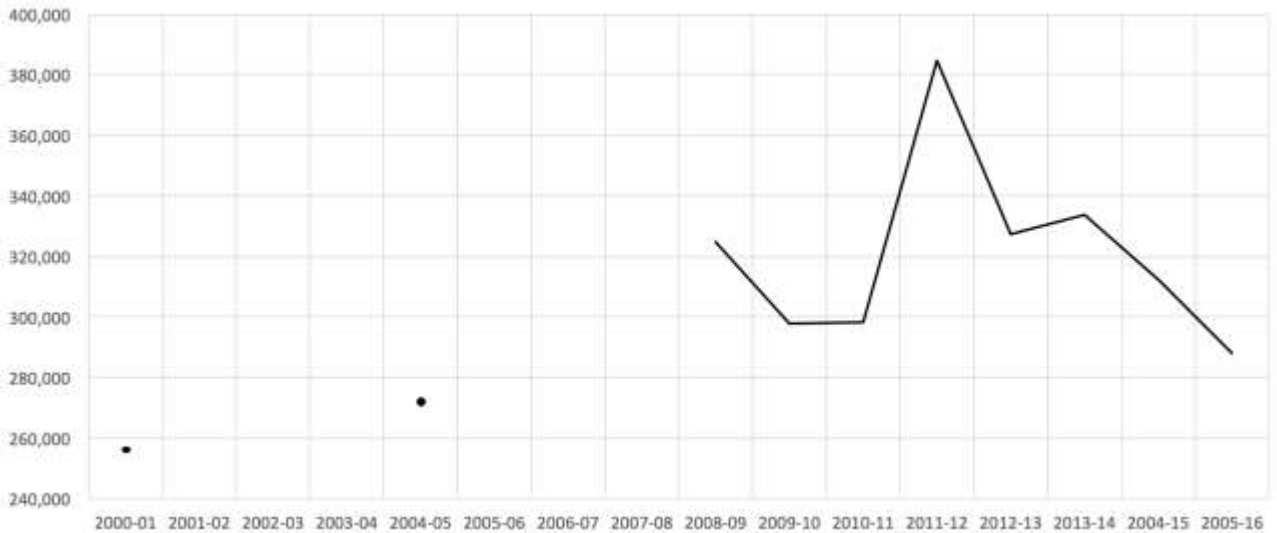


	Consumption	Withdrawal
Thermal power station with cooling tower	Water from cooling towers evaporates into atmosphere, water used for ash and dust suppression	Same as consumption
Thermal power station with once through cooling	Some cooling water evaporates from reservoir	Most cooling water is returned to reservoir
Pumped hydro energy storage	Initial fill and top up to replace evaporation loss is consumed, and not available for other processes	Same as consumption
Hydroelectricity	Water lost to evaporation	Run of river hydro where water is diverted but then returned to the river



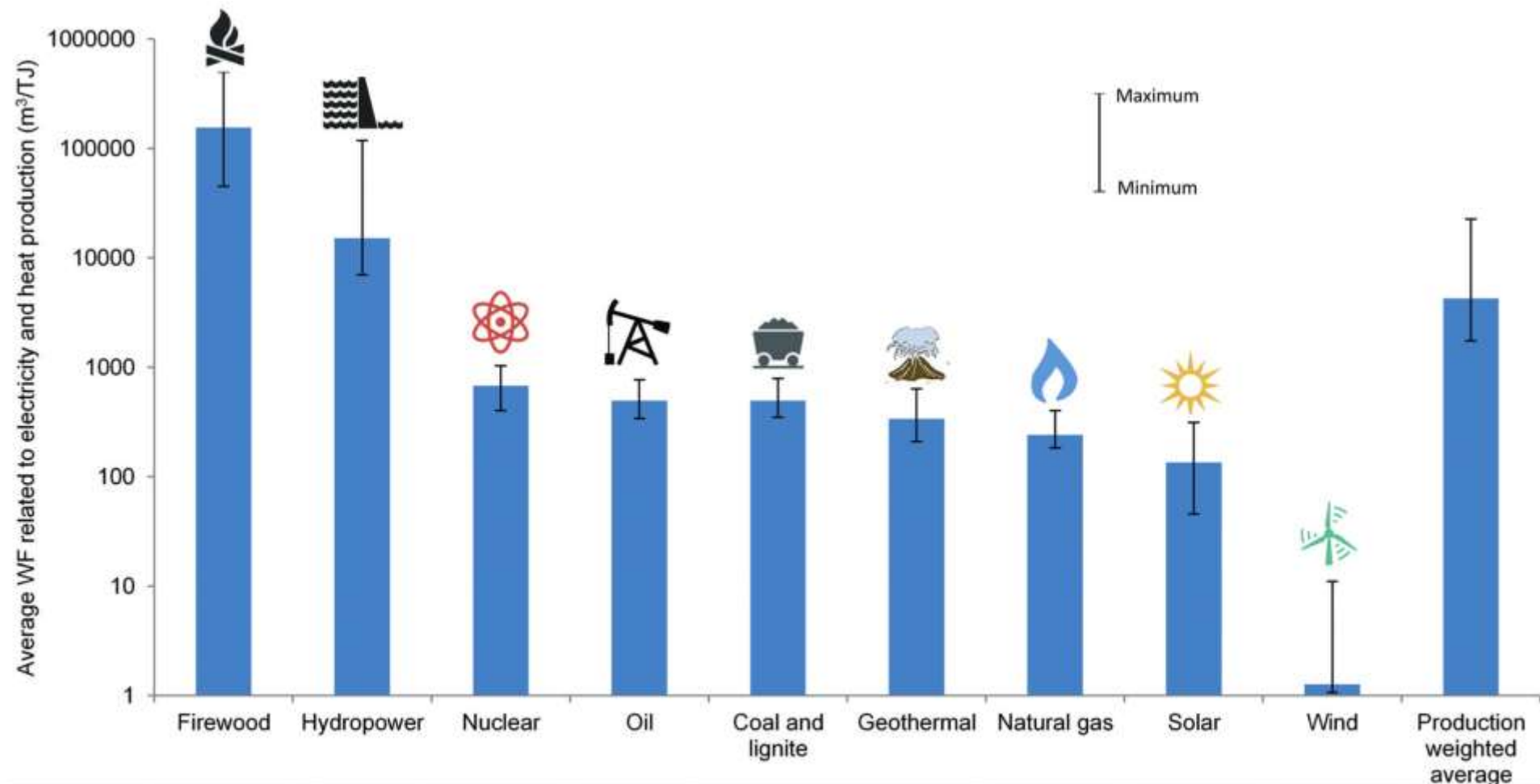
2015/16 – 1.7% of total Australian water consumption

ABS data for water consumption (ML) in Australian electricity and gas industry. Does not include hydroelectricity.

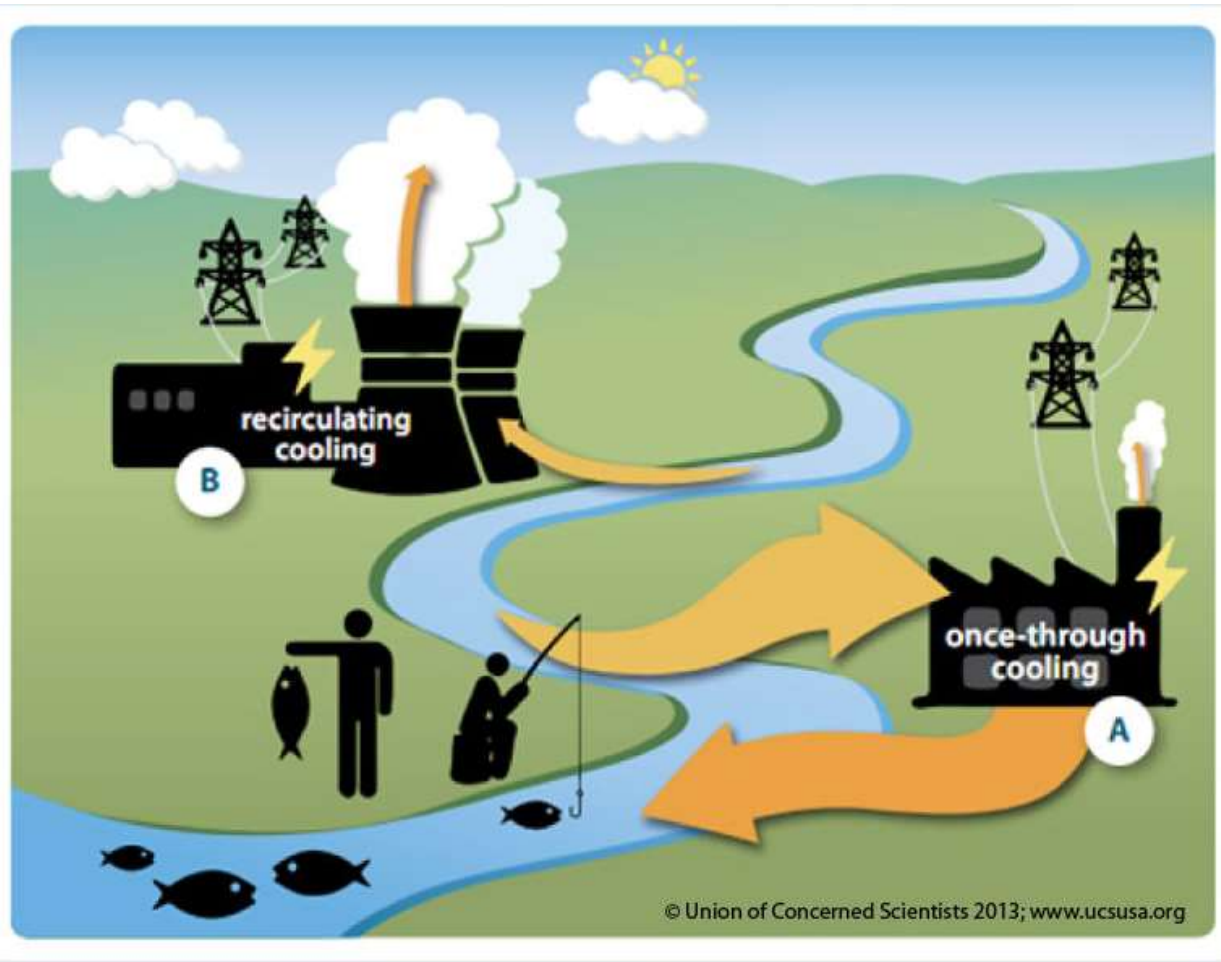


Australian GHG emissions

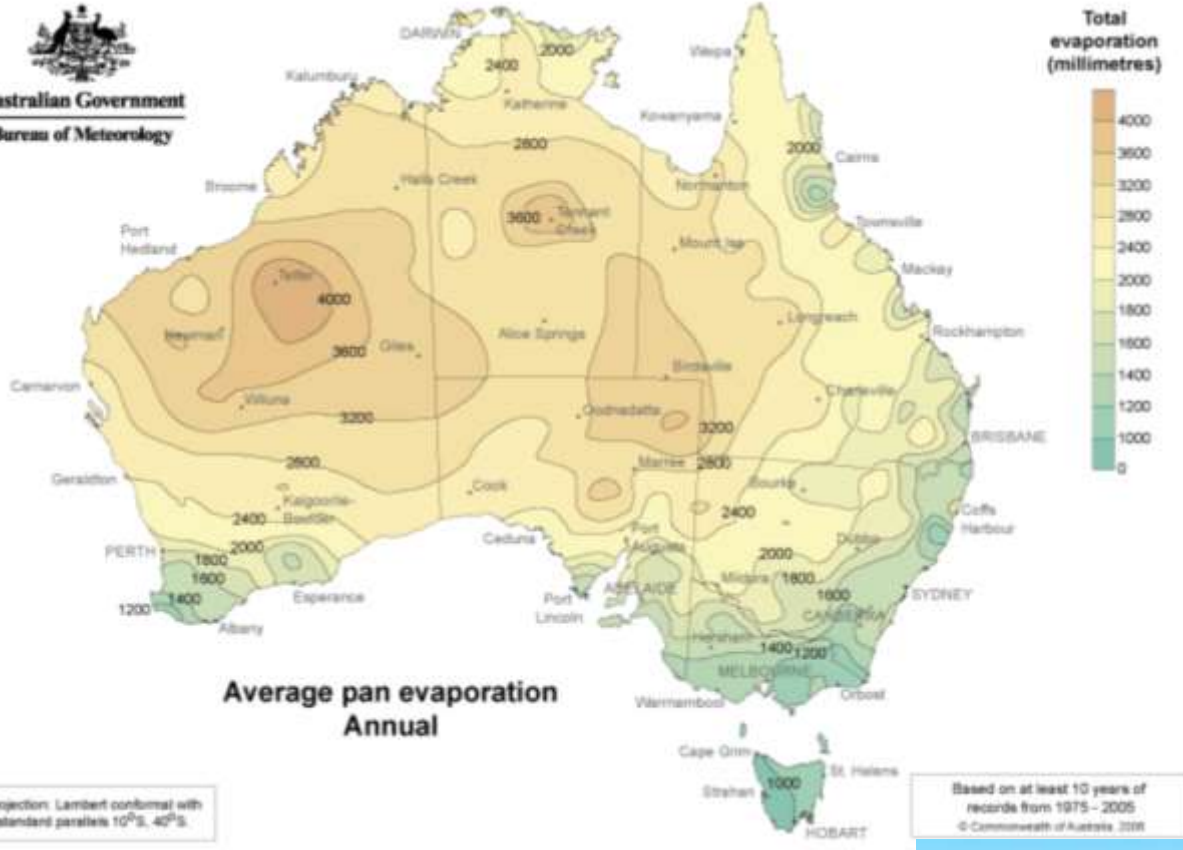
Water consumption by technology



Operation	400	15100	610	440	440	340	240	50	0.2	2410
Construction	0.4	0.3	0.3	1.1	1.1	2.1	1.1	90	1.1	1.0
Fuel supply	156000	0	68	55	54	0	6	0	0	1830



- Convert thermoelectric plants to dry cooling + change water sources to non-potable
- Tidwell 2014 found median LCOE increase of \$US3.53/MWh for entire US
 - But amortized costs over 30 years
 - Total range \$US0.20-20/MWh



Evaporation

Goat's Hill PHES





Fuels	GWh
Bagasse	1,810.4
Wood, woodwaste	248.4
Municipal and industrial biomass waste	42.8
Sulphyte lyes (black liquor) and biofuels	416.7
Landfill biogas	1,060.7
Sludge biogas	211.0
Total bioenergy	3,789.9



	2008-09 GWh	2009-10 GWh	2008-09 m ³ water	2009-10 m ³ water
Non-renewable fuels				
Black coal	118,533	114,112	165,736,883	143,600,744
Brown coal	56,981	56,068	101,335,722	99,711,865
Natural gas	21,231	26,447	18,802,085	23,421,109
Oil products	884	615	1,575,644	1,096,286
Other a	1,427	1,971		
Total non-renewable	199,056	199,213	287,450,334	267,830,004
Renewable fuels				
Bagasse, wood b	1,763	1,762	2,539,296	2,536,992
Biogas b	903	885	1,300,320	1,274,688
Wind	3,149	4,388	2,267	3,159
Hydro	11,869	13,549	720,267,800	720,267,800
Large-scale solar PV	-	-	-	-
Small-scale solar PV	136	363	24,552	65,340
Geothermal	1	1	612	612
Total renewable	17,821	20,947	724,134,847	724,148,591
Total	216,877	220,160	1,011,585,181	991,978,595



	2008-09	2009-10	2008-09	2009-10
	GWh	GWh	m ³ water	m ³ water
Renewable fuels				
Bioenergy	887	1,147	1,277,226	1,651,483
Wind	170,995	165,468	123,116	119,137
Hydro	17,891	20,348	720,267,800	720,267,800
Large-scale solar PV	12,525	12,586	2,254,469	2,265,486
Small-scale solar PV	22,805	23,139	4,104,840	4,165,059
Pumped hydro	16,537	16,200	55,599,041	55,599,041
Total	241,639	238,888	783,626,491	784,068,006
Total excl. legacy	222,862	217,393	62,081,466	62,148,723
Total excl. leg & incl. EvapSup			24,099,952	24,167,210

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- PV + wind + PHES results in a substantial decrease in water consumption
- Evaporation suppression can lower this even further
- The LCOE for this electricity generation and storage mix is comparable to the status quo – decarbonise and lower water consumption for the same cost!