

# International keynote: Australia's electricity revolution

“Downstream 24”

Lower Hutt, Wellington

6 March 2024

Professor Bruce Mountain



**Victoria  
Energy Policy  
Centre**



**VICTORIA  
UNIVERSITY**

MELBOURNE AUSTRALIA

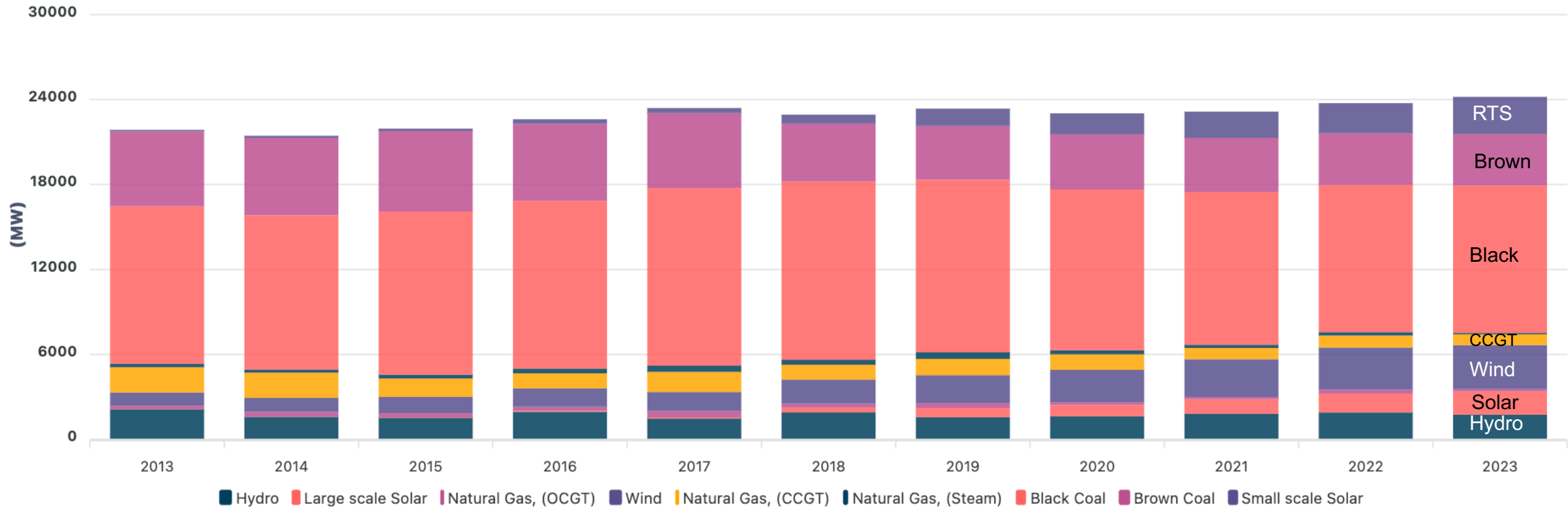
# Outline

- ▶ Supply
- ▶ Demand
- ▶ Price
- ▶ Investment
- ▶ Retail
- ▶ Policy and strategy

# NEM-wide energy aggregate shows the main shift has been from “baseload” gas and brown coal to wind and rooftop solar



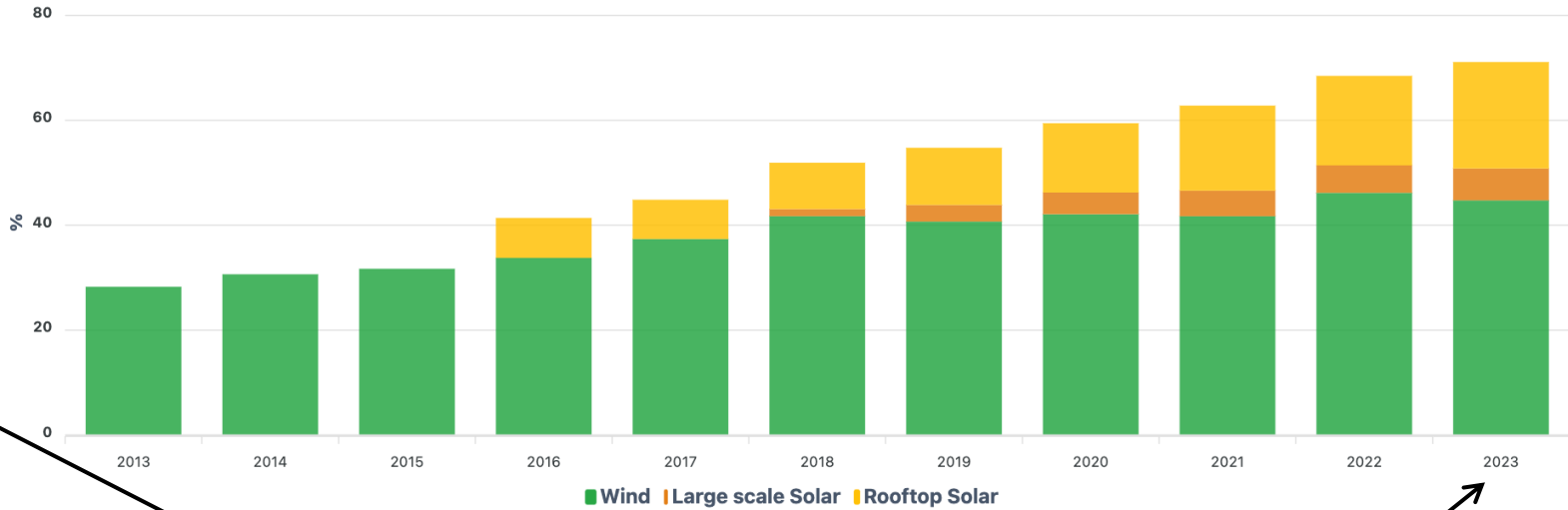
Generator Dispatch - Annual , NSW-QLD-SA-TAS-VIC



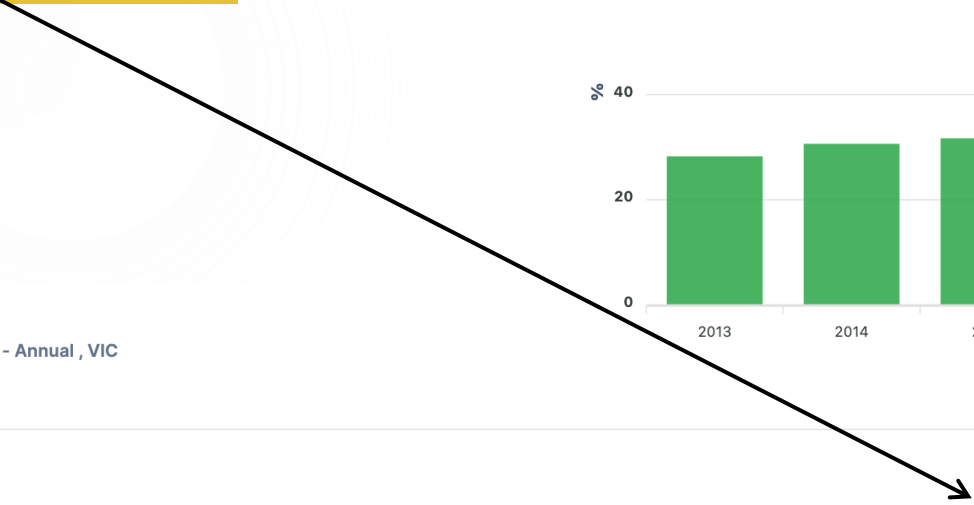
# RE now 71% of South Australia's end-use consumption (twice as high as Victoria and Portugal – the highest country globally)



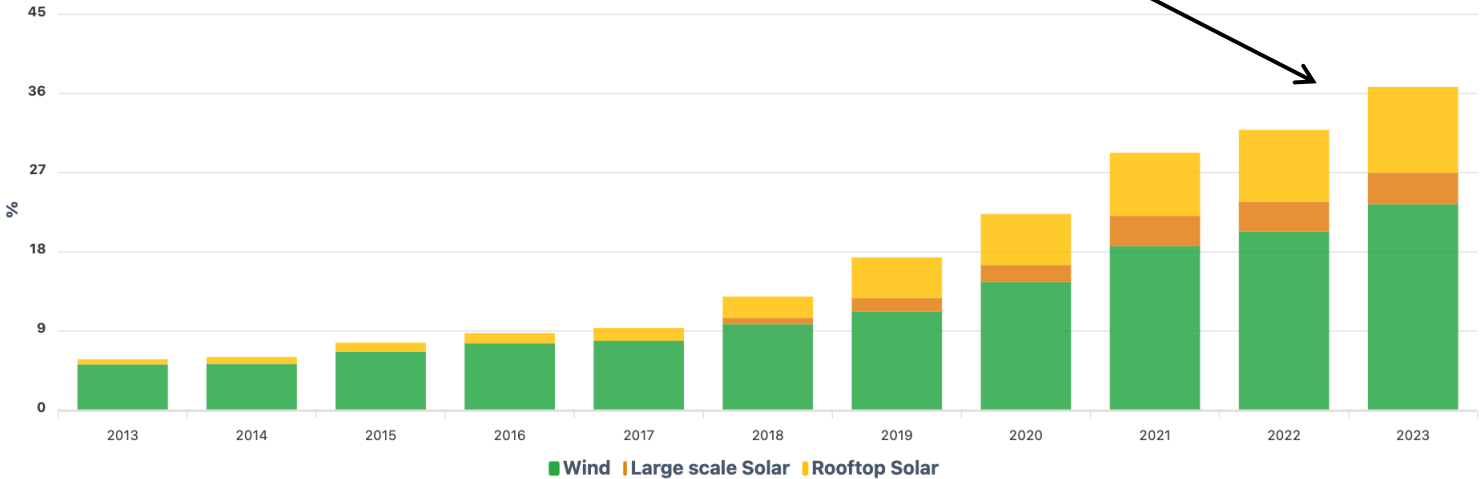
Percentage of Regional User Demand - Annual, SA



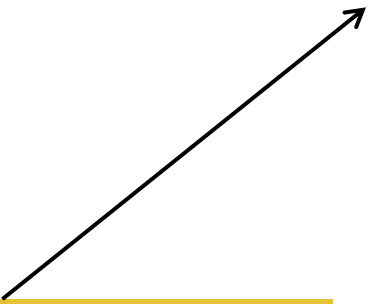
Victoria 36% in 2023



Percentage of Regional User Demand - Annual, VIC



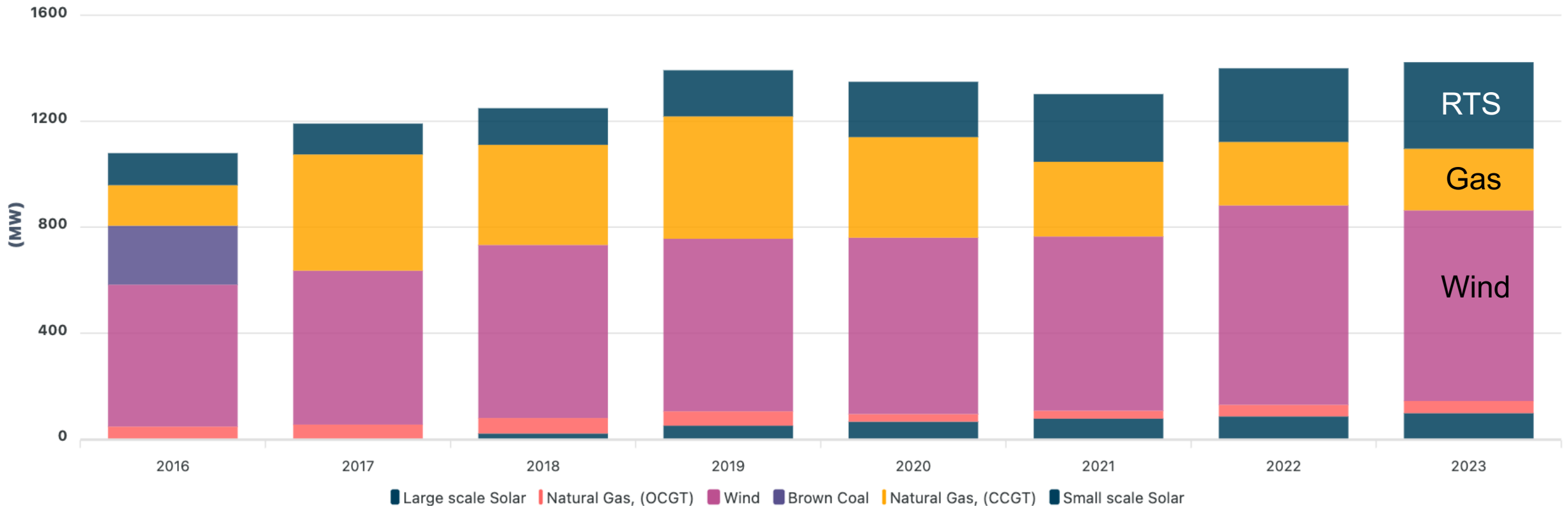
South Australia, 71% in 2023



# In South Australia, gas took coal's place when coal closed in 2016, but gas has been quickly replaced by rooftop solar (mainly)



Generator Dispatch - Annual , SA

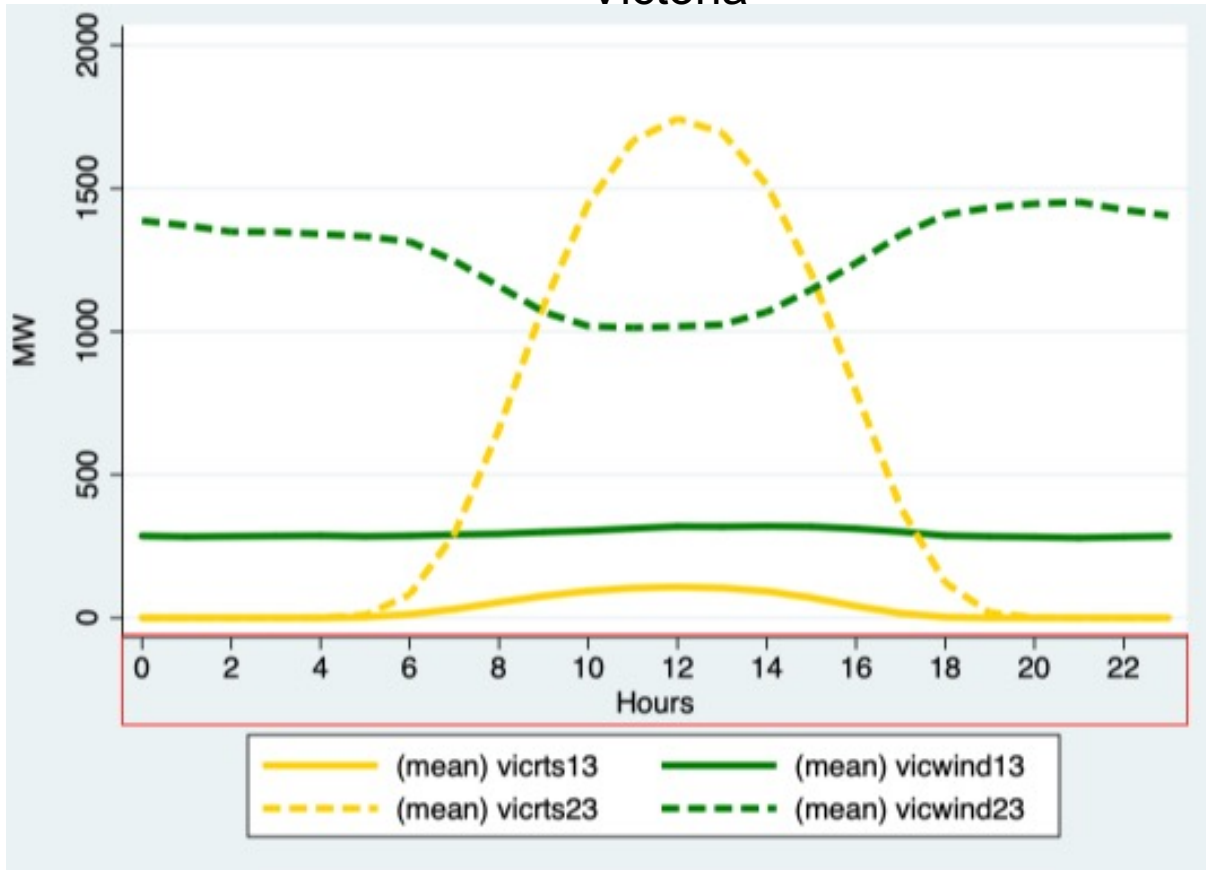


RTS is now second largest (energy) source of RE in SA & Victoria (annually) and by far largest in summer from 9am to 3pm

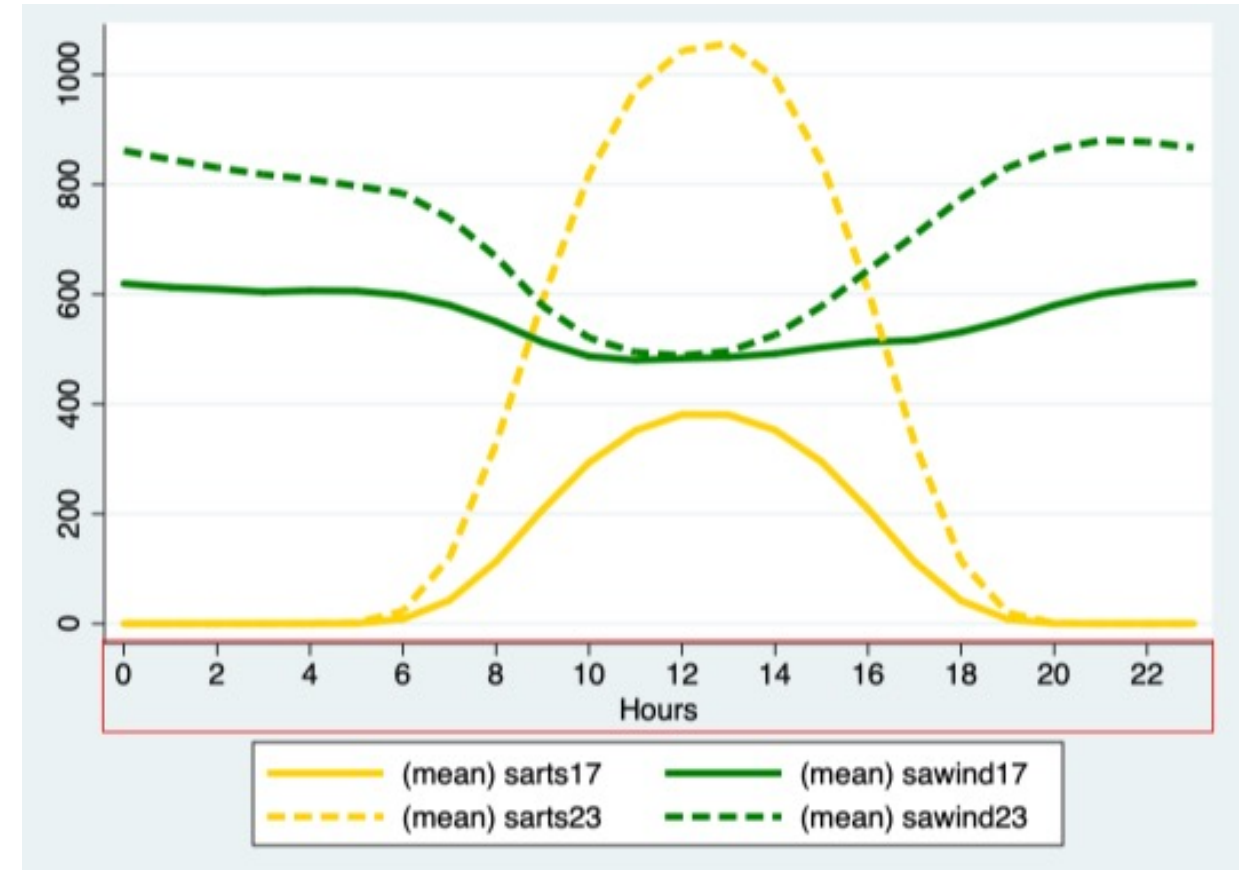
		Annual	Summer	Winter	9am to 3pm (summer)	12pm to 1pm (summer)
SA	RTS as % of grid-demand	24%	33%	13%	106%	135%
	RTS as % of end-use demand	20%	25%	11%	51%	57%
Victoria	RTS as % of grid-demand	11%	16%	6%	35%	42%
	RTS as % of end-use demand	10%	14%	5%	26%	30%

# Rooftop solar now crowding out wind in Vic (left) and SA (right)

## Victoria

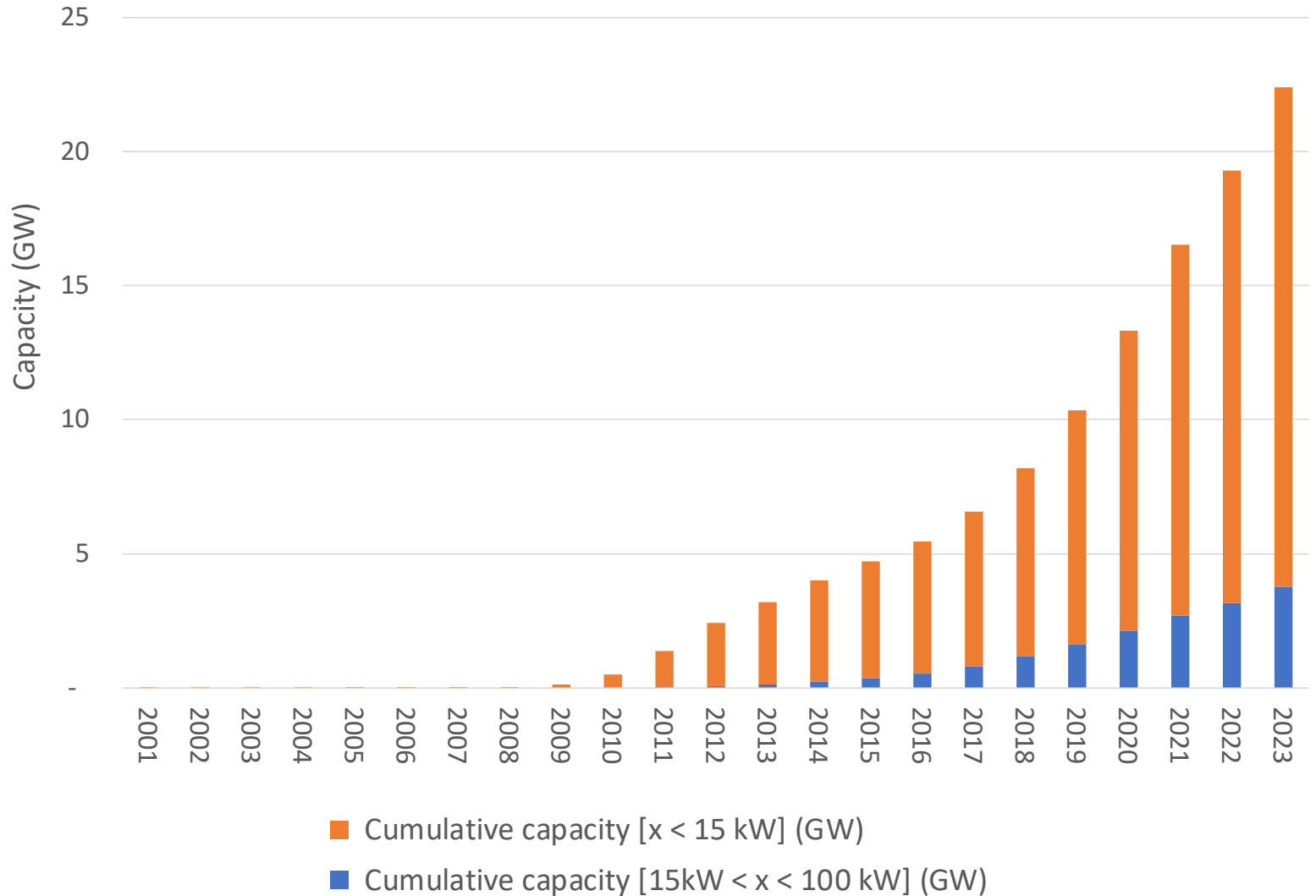


## South Australia



# Good solar irradiance, high retail electricity prices, rapidly declining PV costs and supportive policy has taken Australia to first place globally in per-capita rooftop solar

## Cumulative rooftop PV capacity

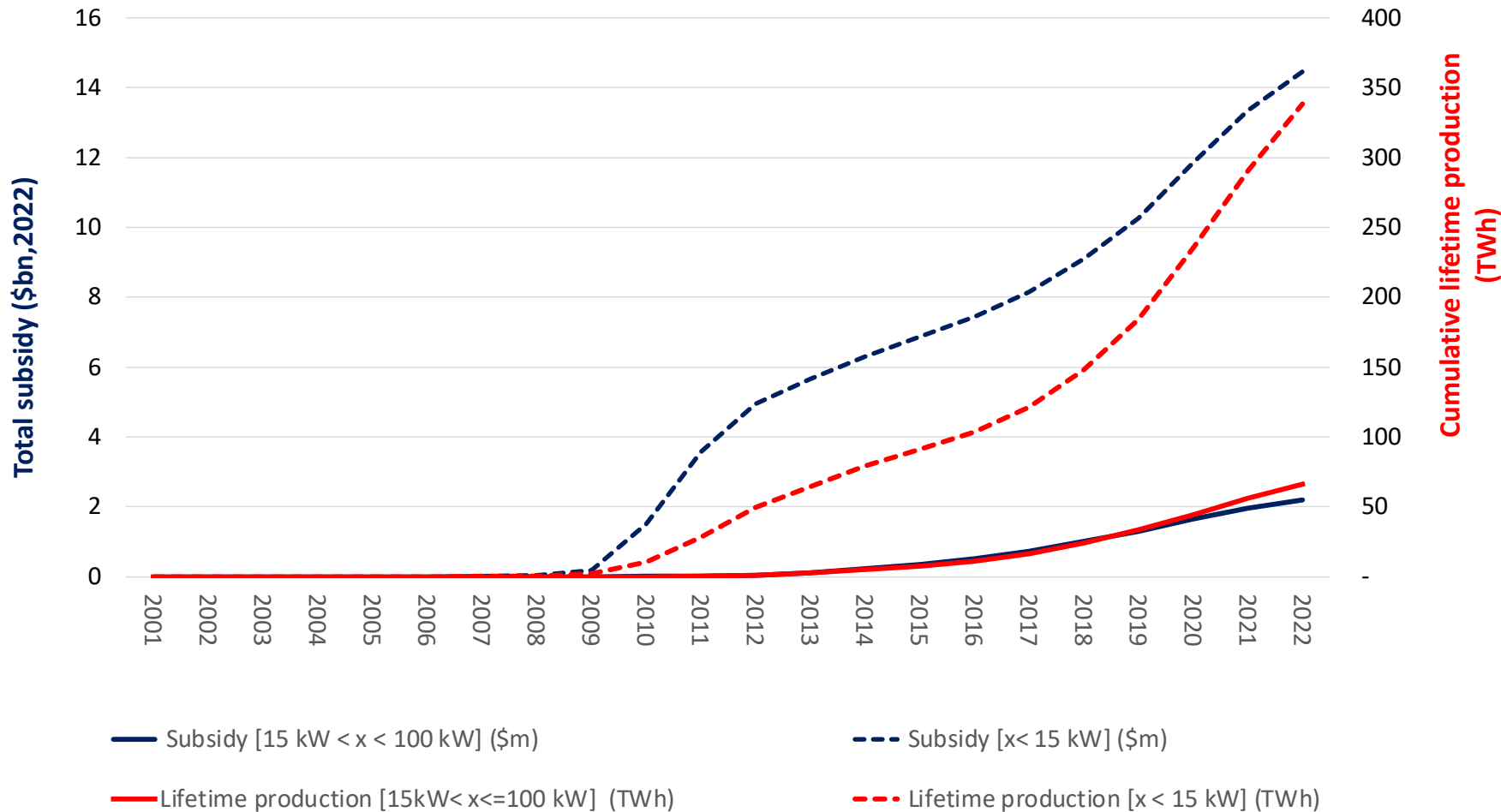


- About than 1 in 3 eligible homes have rooftop solar. End 2023 ~ 820 watts per capita (Hawaii next highest (541 w/capita) then California (364/capita))
- RTS = 23.2 GWh in the NEM in 2023; ~ 11% of grid-supplied electricity, slightly less than wind
- Commercial and industrial rooftop solar now growing quickly.



# Policy support, technology change and competitive installation market has driven huge amounts of private investment in RTS

## Cumulative subsidy & lifetime production



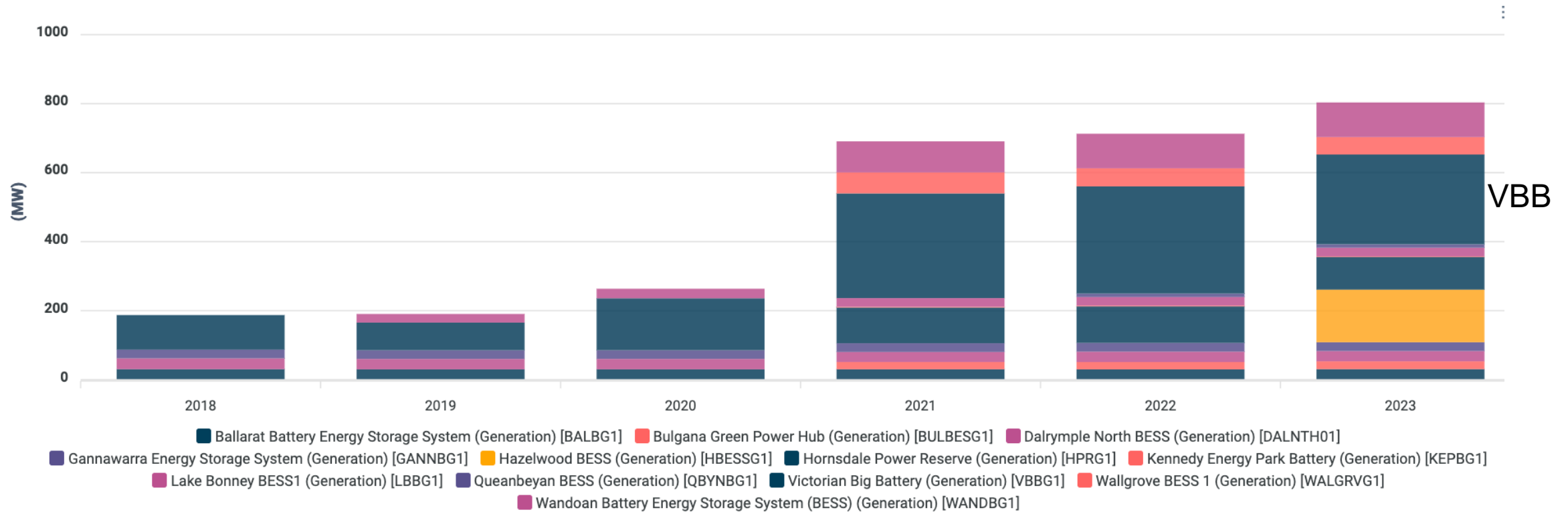
To end 2023 cumulative total subsidy for small systems (<15 kW) was \$14.5bn and large systems (>15 kW, <100kW) was \$2.2bn.

Policy support has leveraged ~ \$50bn investment in rooftop solar (about 75% from households).

Rooftop solar has attracted much more private investment than large scale solar, and about as much as wind

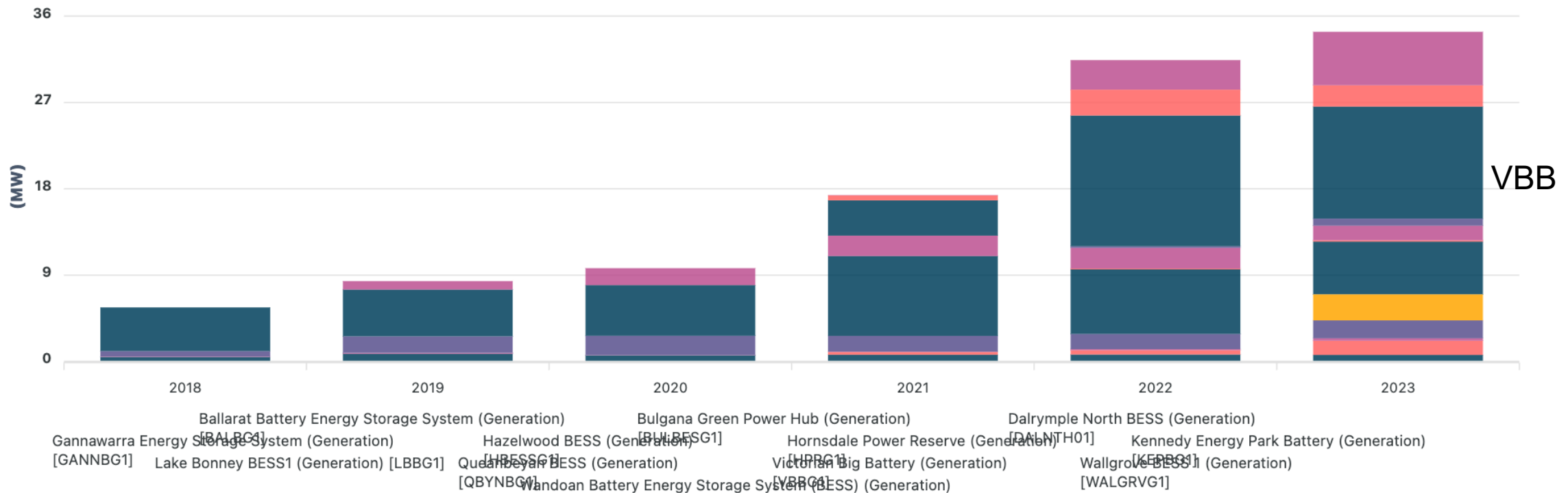
# Battery peak production is now important for fast frequency response and grid support

Maximum Generation - Annual , NSW-QLD-SA-TAS-VIC



# Batteries are still minor part of average supply (32 MW v 24,050 MW NEM average demand (average storage duration of around 1.5 hours))

Generator Dispatch - Annual , NSW-QLD-SA-TAS-VIC

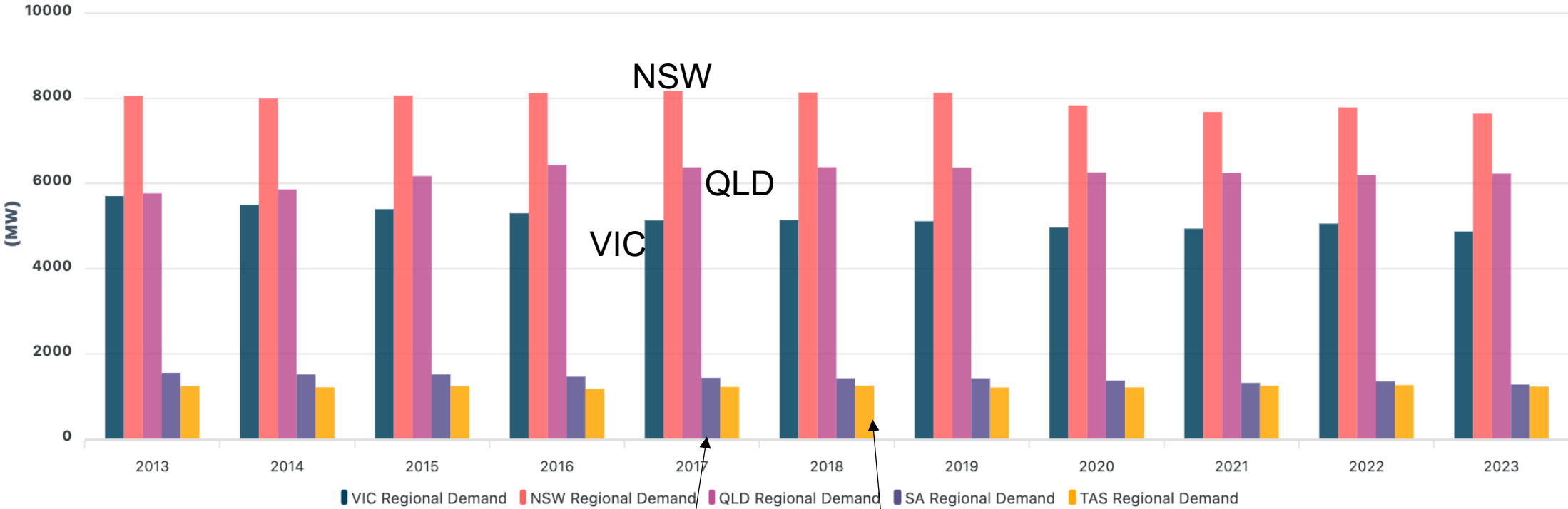


# Demand

# Average demand (on the transmission grid) is declining everywhere except Queensland (LNG industry)



Average demand - Annual , VIC-NSW-QLD-SA-TAS



NSW

QLD

VIC

SA

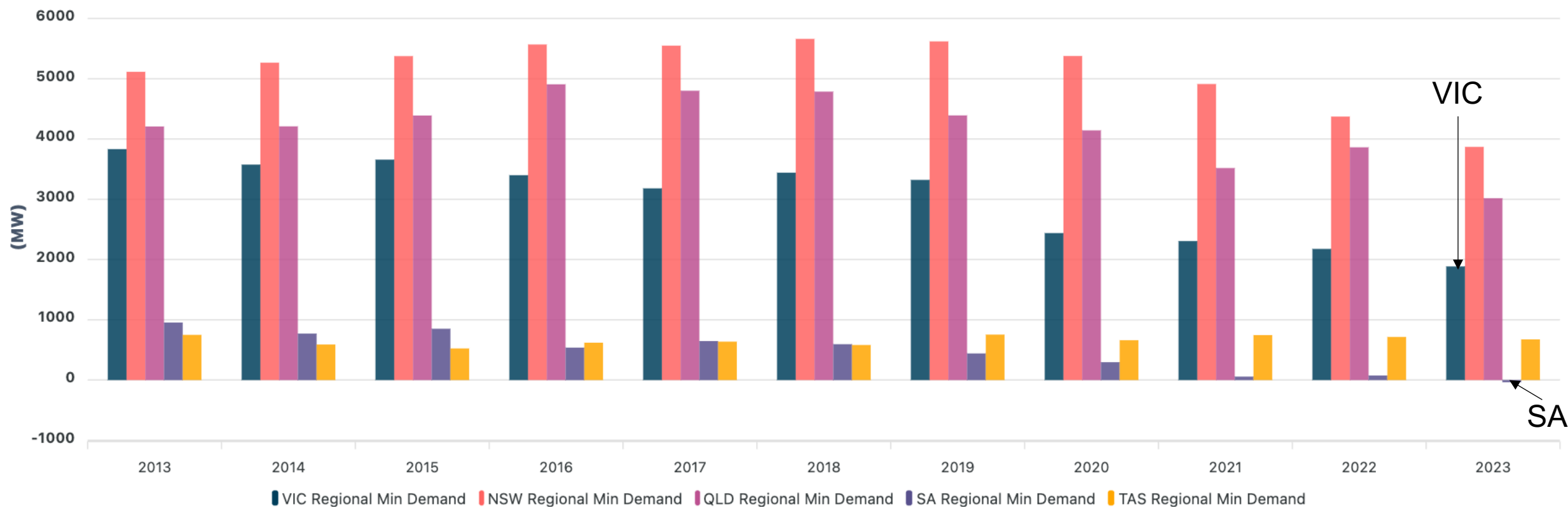
TAS



# Minimum demand declining in all states, look at South Australia and Victoria !



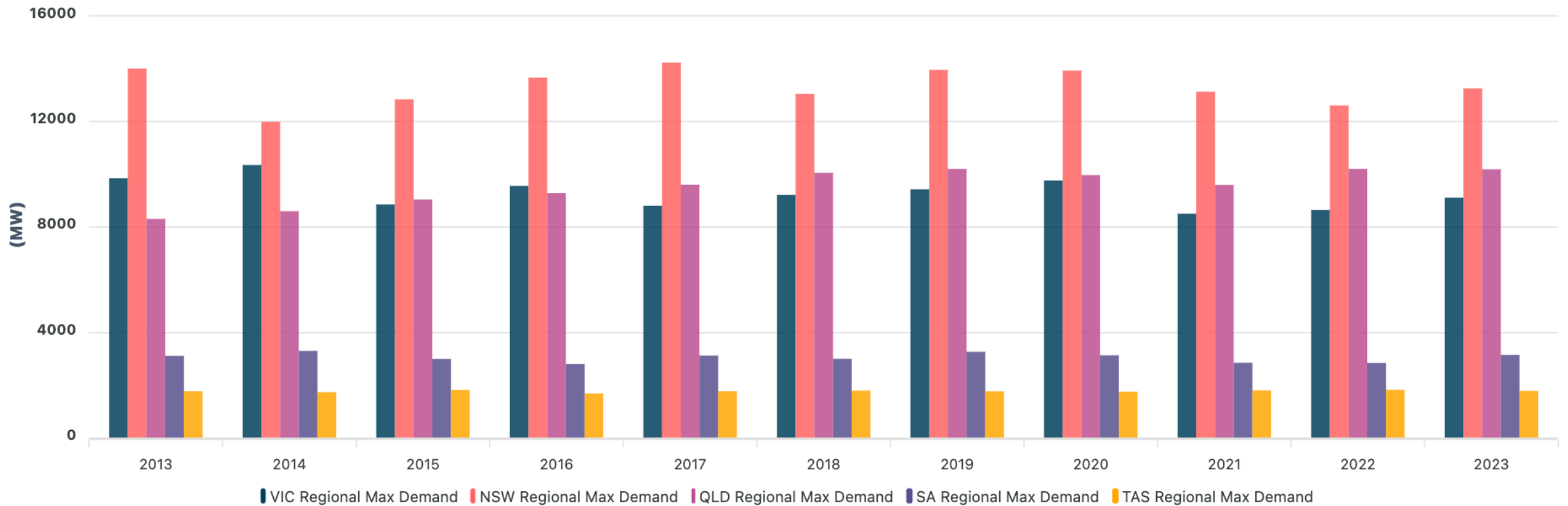
Minimum Demand - Annual , VIC-NSW-QLD-SA-TAS



# But maximum demand stable (rising in Queensland)



Maximum Demand - Annual , VIC-NSW-QLD-SA-TAS



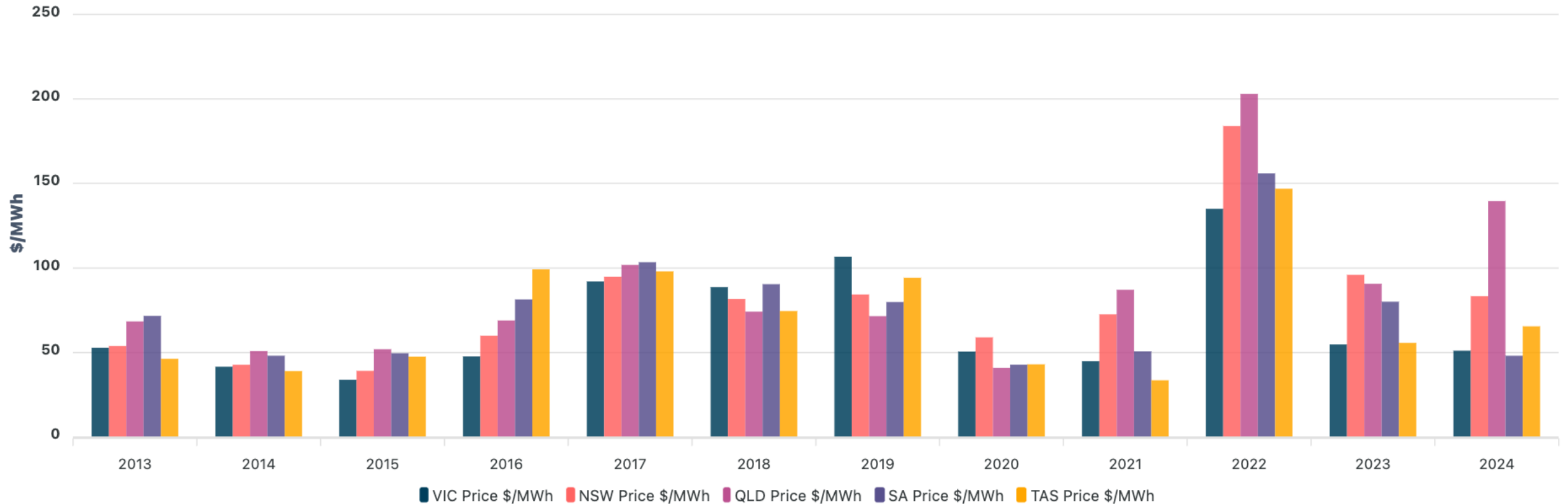
# Prices



# Average prices starting to diverge between VRE/RE dominant states (SA, VIC, TAS) and coal/gas dominant states (NSW/QLD)



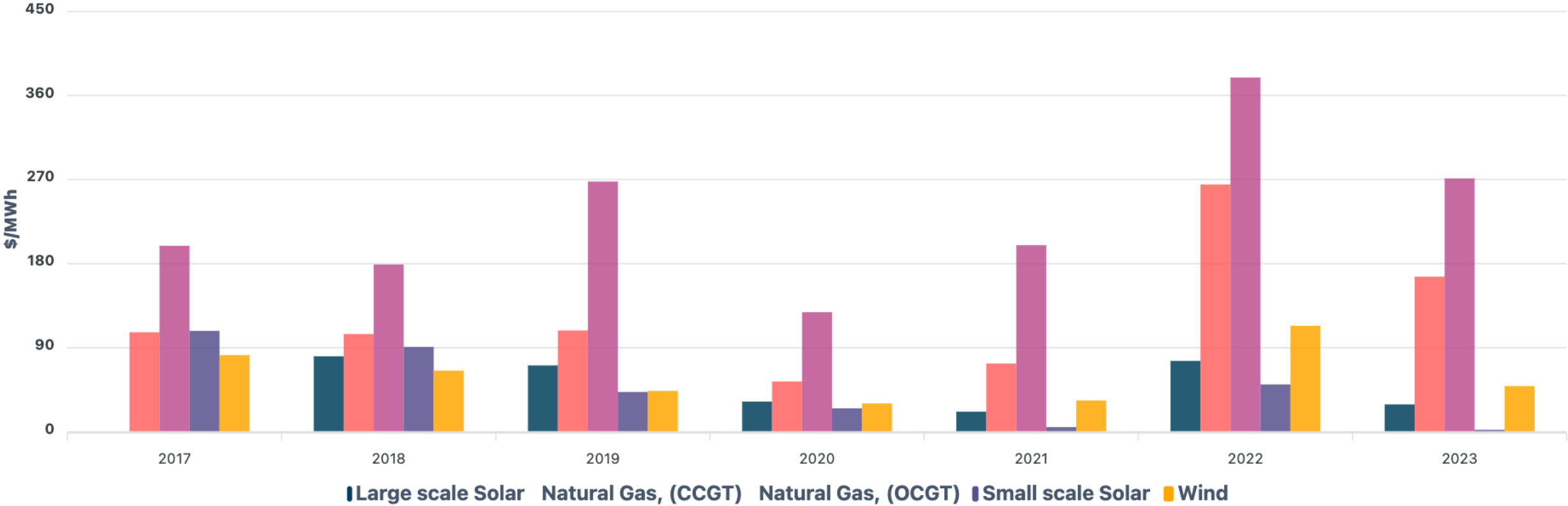
Regional Wholesale Price - Annual , VIC-NSW-QLD-SA-TAS



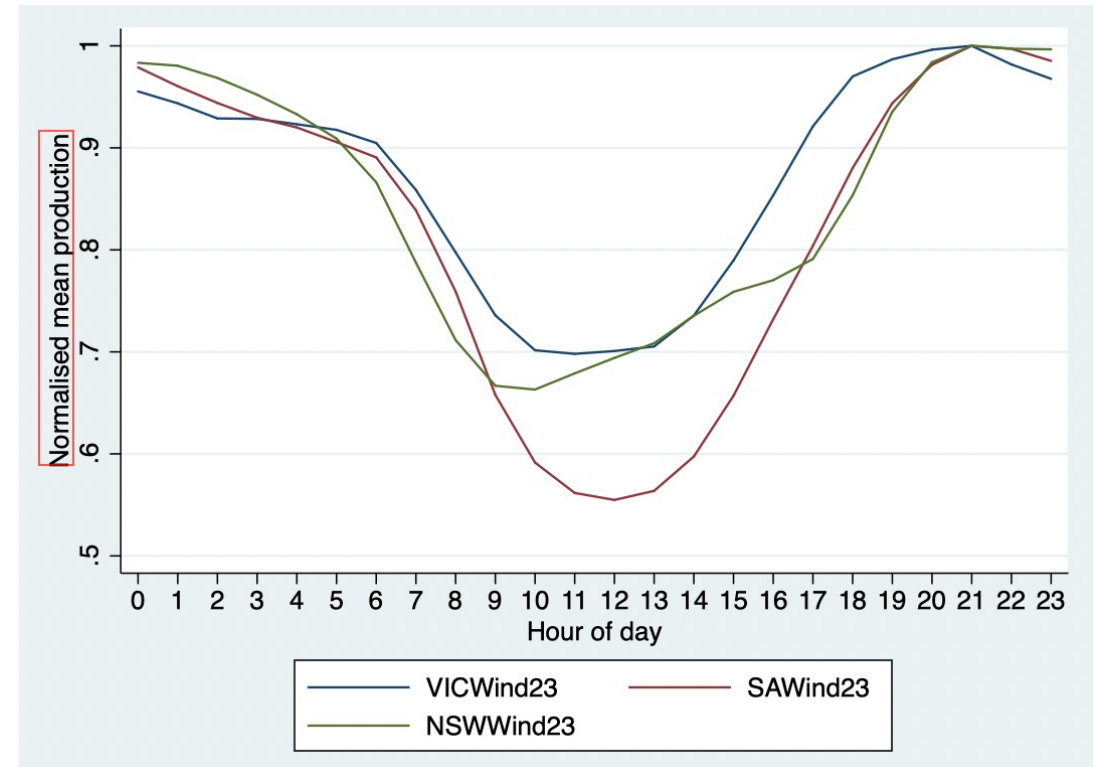
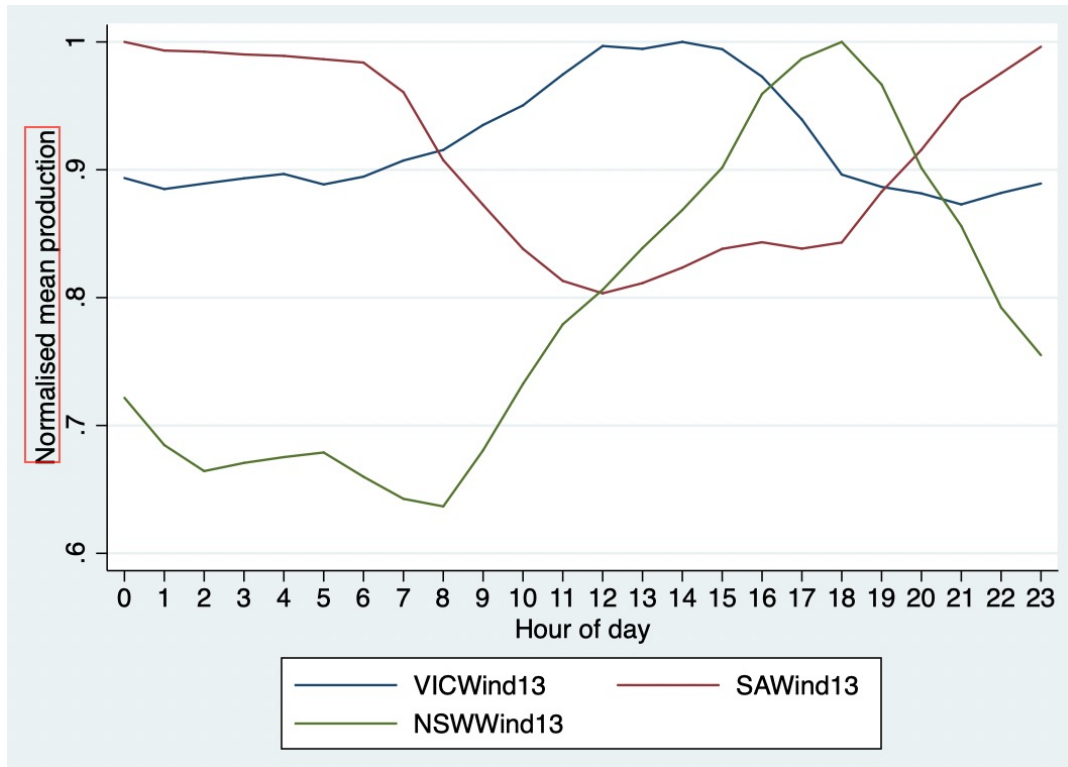
# Volume-weighted prices received by technology shows ever widening gap between VRE and gas



Volume Weighted Average Price - Annual , SA



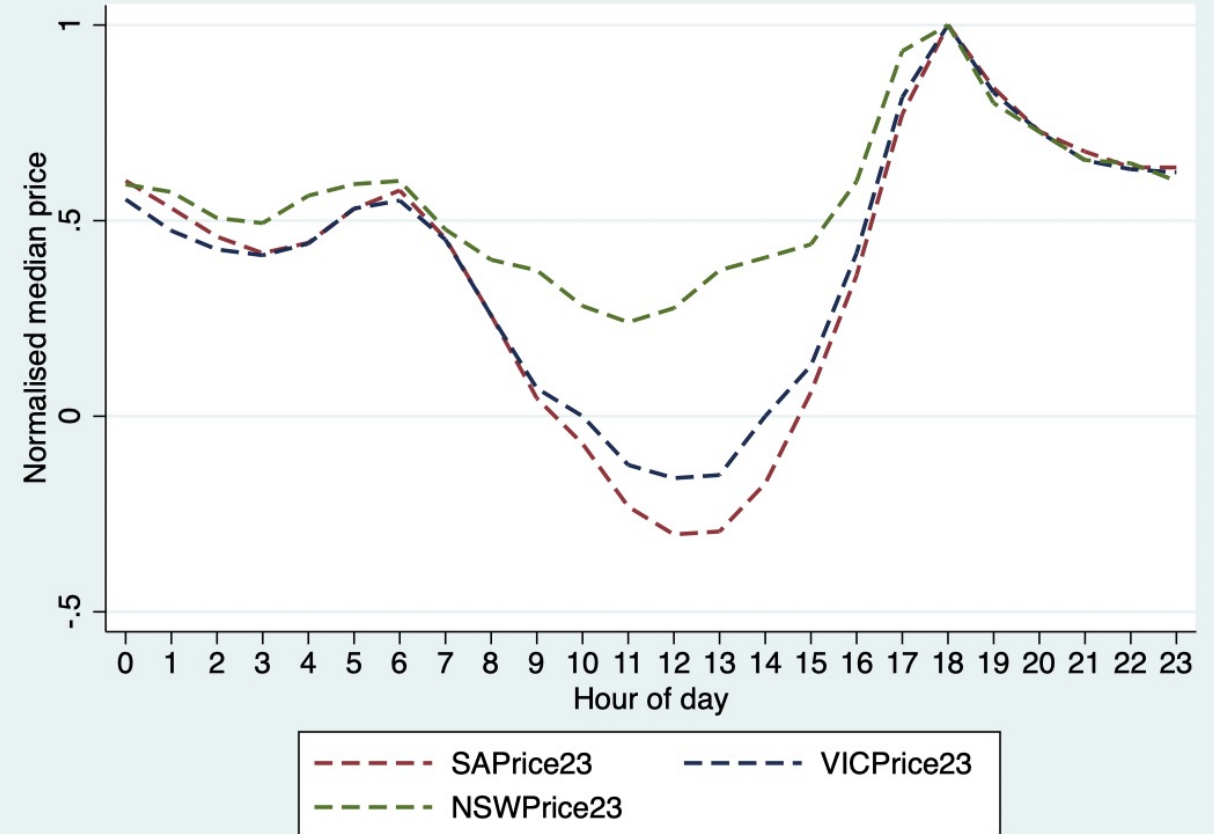
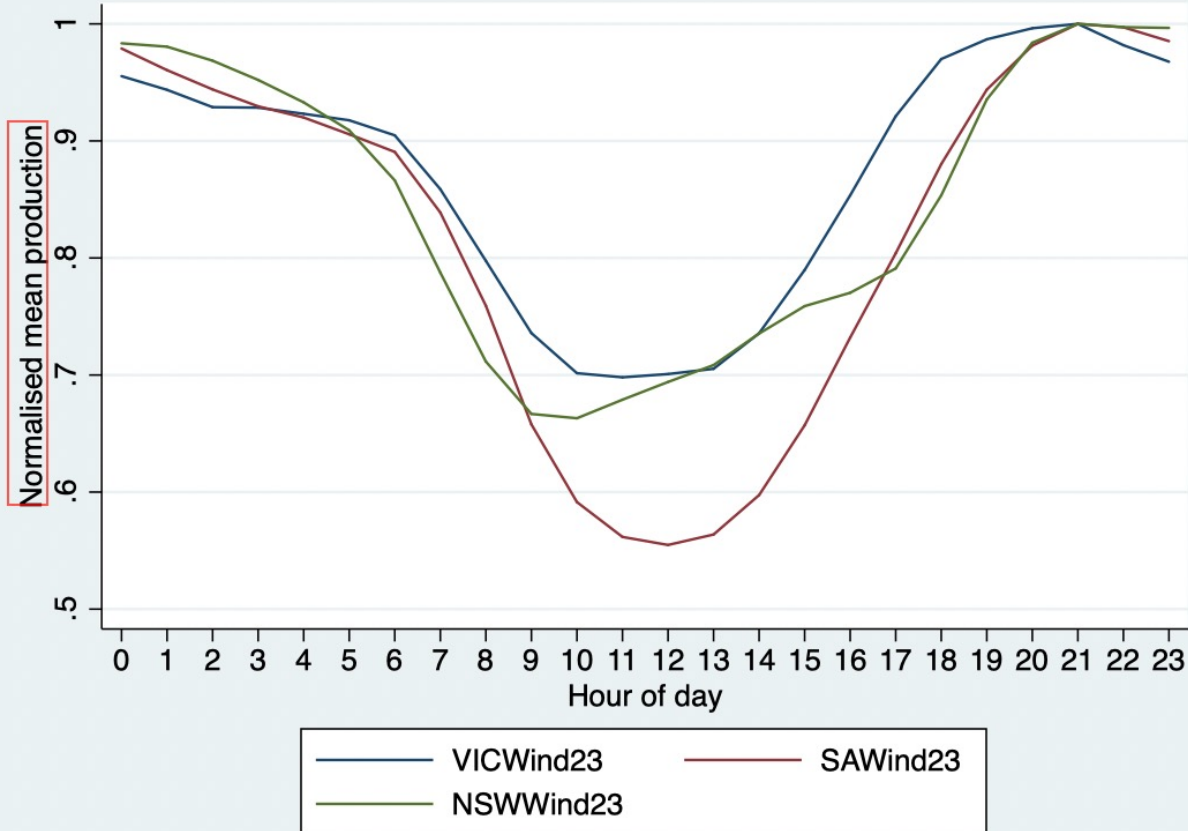
Before the rise of rooftop solar, there was some evidence of diversity in wind between VIC, NSW and SA. Now that has gone.



Looking at 2013 (left chart), prima facie evidence of regional diversity, may justify some interconnection. But by 2023 (right chart): wind farms now singing from same song-sheet.

Q: Why do the wind farms now sing from the same song-sheet?

A: They respond to prices



Wind farms (left chart) dispatching in response to prices (right chart). Wind diversity likely to reduce further as RTS grows and RET ends (no more LGCs to encourage production even when  $P_{spot} < 0$ ).

# Retail

- ▶ Briefly fully deregulated for about 75% of NEM end customers, now partially regulated again.
- ▶ “Default” offers; plus additional restrictions in Victoria
- ▶ Market concentration not much changed over history of NEM.
- ▶ Got through Ukraine invasion crisis without too much sweat (wholesale spike largely absorbed).
- ▶ “loyalty tax” still a common refrain including by competition authorities (but without much conviction)

# Policy and Strategy

# Investment summary

- ▶ In 12 years from start 2012 to end 2023:
  - + 7.5 GW wind (+61 farms), + 8 GW farmed solar (+105 farms), + 20 GW of rooftop solar (+2.1 million homes and businesses).
  - Total outlay in VRE of ~ \$82bn, \$.6.7bn per year.
  - \$20bn for interconnector expansion is largely locked away although mostly not yet incurred (about \$4bn already incurred).
  - \$1bn in battery and \$5bn in pumped hydro already incurred.

# RE targets

- National: 82% (production) by 2030 (faster rate of change than targeted in any other OECD/G20 country).
- Also various (mostly conditional) state targets/aspirations:
  - SA: “100% net” by 2027
  - TAS: 200% (of TAS demand) RE by 2040
  - VIC: 95% (as % of Vic production) by 2035
  - NSW: +12 GW of VRE by 2030
  - QLD: 80% RE by 2035
- Achieving national target will require average annual VRE expansion at ~ 3X the average rate from 2012 to 2023, and massive storage expansion.



# Policy support mechanisms

- ▶ Small scale ~ 25% of capital cost, being phased out.
- ▶ Large scale certificate scheme ends in 2030.
- ▶ Cwlth promised “Capacity Incentive Scheme” (price cap/floor contracts with govt) for 23 GW of VRE (govt says \$52bn) and 9 GW (govt says \$15bn) of storage over next 4 years (8, six-monthly auctions and tenders, first one in April/May ‘24).
- ▶ Cwlth and several state governments also investing in storage mainly (PHES and battery) and VRE.
- ▶ “Re-wiring the nation”: Cwlth promise of \$20bn in loans/concessional equity in pursuit of cheaper capital for transmission expansion.

# Institutional arrangements

- ▶ Australian Energy Market Operator (AEMO) produces “Integrated System Plan (ISP)” (i.e. “central plan” with consequential “actionable” interconnector transmission expansion). Regulators say “not ours to reason why, ours to do or die”.
- ▶ State entities plan intra-region transmission expansion
- ▶ Mandatory spot market for scheduling and dispatch (little “merchant” participation)
- ▶ OTC and exchange contract markets for year-ahead spot price hedging (not driving investment)
- ▶ Swaps and now price cap/floor contracts (mostly with govt) to underwrite investment.

# Challenges

1. Fine words on VRE policy support, but market prices low: more dollars must come from govt. Will the polity walk the talk in “cost of living crisis”?
2. Private owners of NSW and VIC coal keen to exit - govt becoming owners of last resort: “privatise profits and socialise losses”. Coal generation mostly old and likely under-maintained.
3. Rate of VRE expansion declined over last two years. Many factors (investors/lenders waiting for contracts with govt, social licence, network connection, network capacity shortfall)
4. Increasing opposition from rural communities, particularly to transmission expansion.
5. Growing disconnect between “ISP” and market, undermining confidence in central plan (“the best laid plans of mice and men”).
6. Looking backwards, some things changed more quickly than expected. But much quicker change now sought by Cwlth/most state governments. Not obvious will be achieved.

Ngā mihi