

Policy, strategy and economics considerations in integrating high shares of renewables: Some comments from Australia

Managing New Power Market Reforms and Regulation in Africa

UCT Power Markets Lab, Graduate School of Business.

1 November 2024

Professor Bruce Mountain



**Victoria
Energy Policy
Centre**



**VICTORIA
UNIVERSITY**

MELBOURNE AUSTRALIA

Outline

- ▶ Overview of Australia's "National" electricity market
- ▶ What are we learning? - economics and policy
- ▶ What are we learning? - some (more important) "way-of-thinking" things:
- ▶ Some suggestions for South Africa

The “national electricity market” in brief

- ▶ South and Eastern States only (Victoria, South Australia, Tasmania, New South Wales, Queensland). Mostly weakly interconnected.
- ▶ Started 1998
- ▶ ~34,000 MW simultaneous peak demand, ~ 12 million connections, 180 TWh p.a.
- ▶ Choice of retailer for about 75% of all customers (but also regulated “default” offers)
- ▶ Market is voluntary agreement amongst states (they have the constitutional responsibility to supply electricity).
- ▶ 5 minute, centrally-settled mandatory energy-only spot market all generators >30 MW; bi-lateral and exchange-based contract markets.
- ▶ Much policy action happens outside the market.

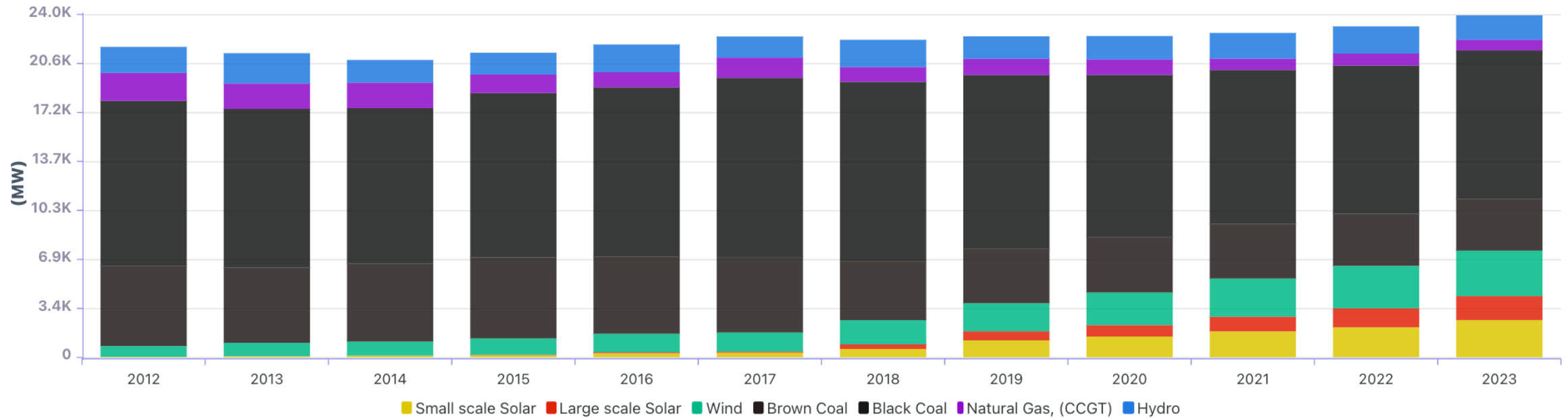
Variable renewables and storage inventory October 2024

- **Wind:** 83 farms (some co-located) 8.4 GW peak (simultaneous 5-minute), 10.9 GW (non-simultaneous 5 minute). From 2012 to 2024 added 56 wind farms (some co-located).
- **Farmed solar:** 86 farms (some co-located) with 6.8 GW peak (simultaneous 5-minute), 8.5 GW peak (non-simultaneous 5 minute). All added since 2015.
- **Rooftop solar:** 3.8m premises, 13.3 GW peak (simultaneous 5-minute). Estimated 24 GW peak (non-simultaneous 5 minute)
- **Pumped hydro:** 3, 2.5 GW peak (simultaneous 5-minute), 2.6 GW (non-simultaneous peak)
- **Battery:** 27 (some co-located), 0.9 GW peak (simultaneous 5-minute), 1.7 GW peak (non-simultaneous 5-minute)

Over last decade the main shift has been from “baseload” gas and brown coal to wind and rooftop solar



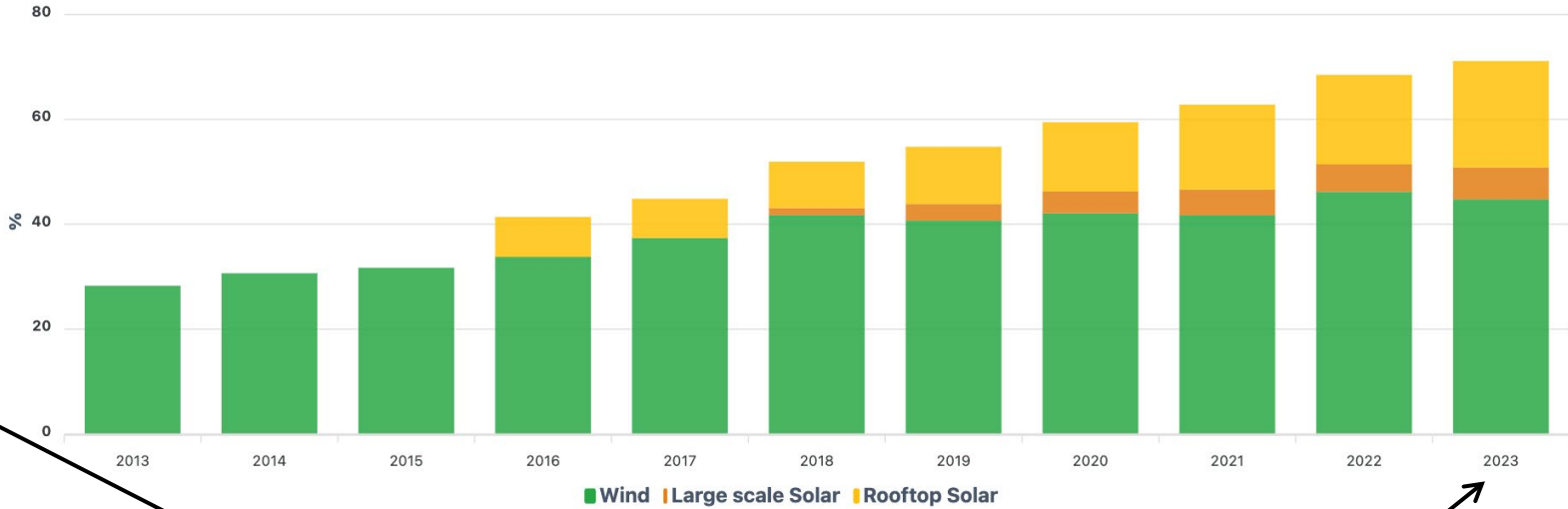
Generator Dispatch - Annual , NSW-QLD-SA-TAS-VIC



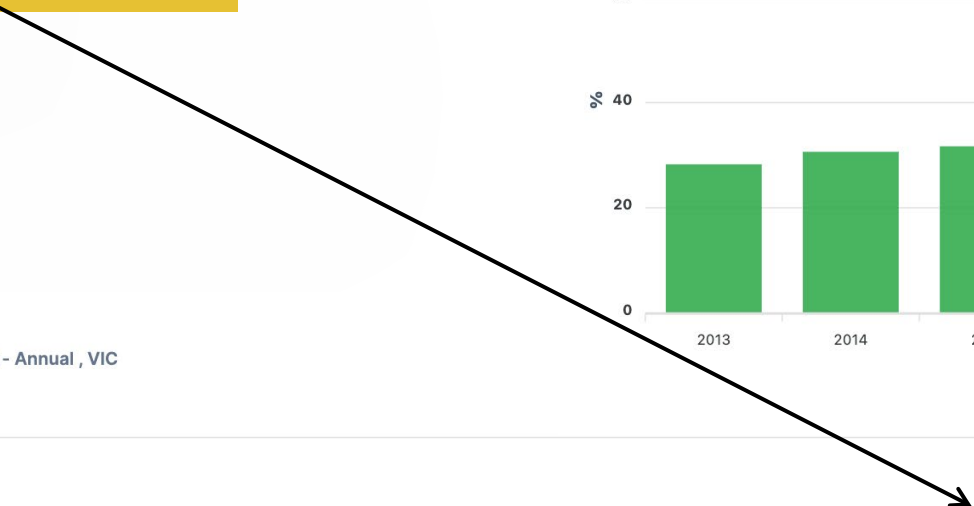
VRE 71% of South Australia's end-use consumption in 2023 (twice as high as Victoria and Portugal – the highest country globally)



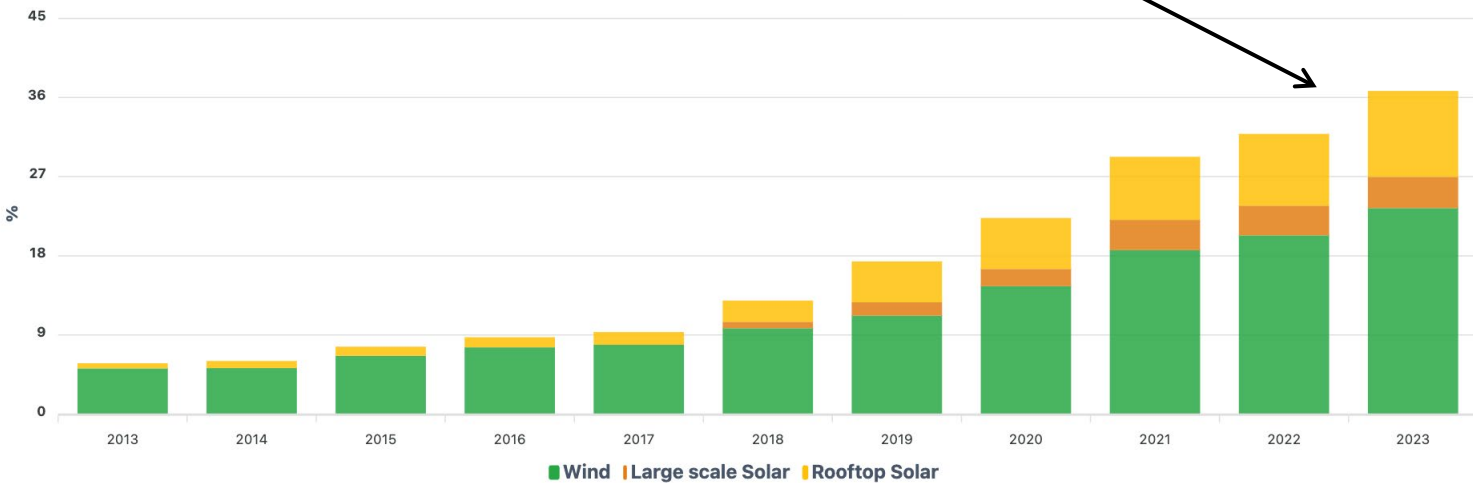
Percentage of Regional User Demand - Annual, SA



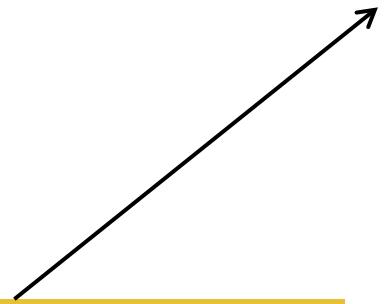
Victoria 36% in 2023



Percentage of Regional User Demand - Annual, VIC

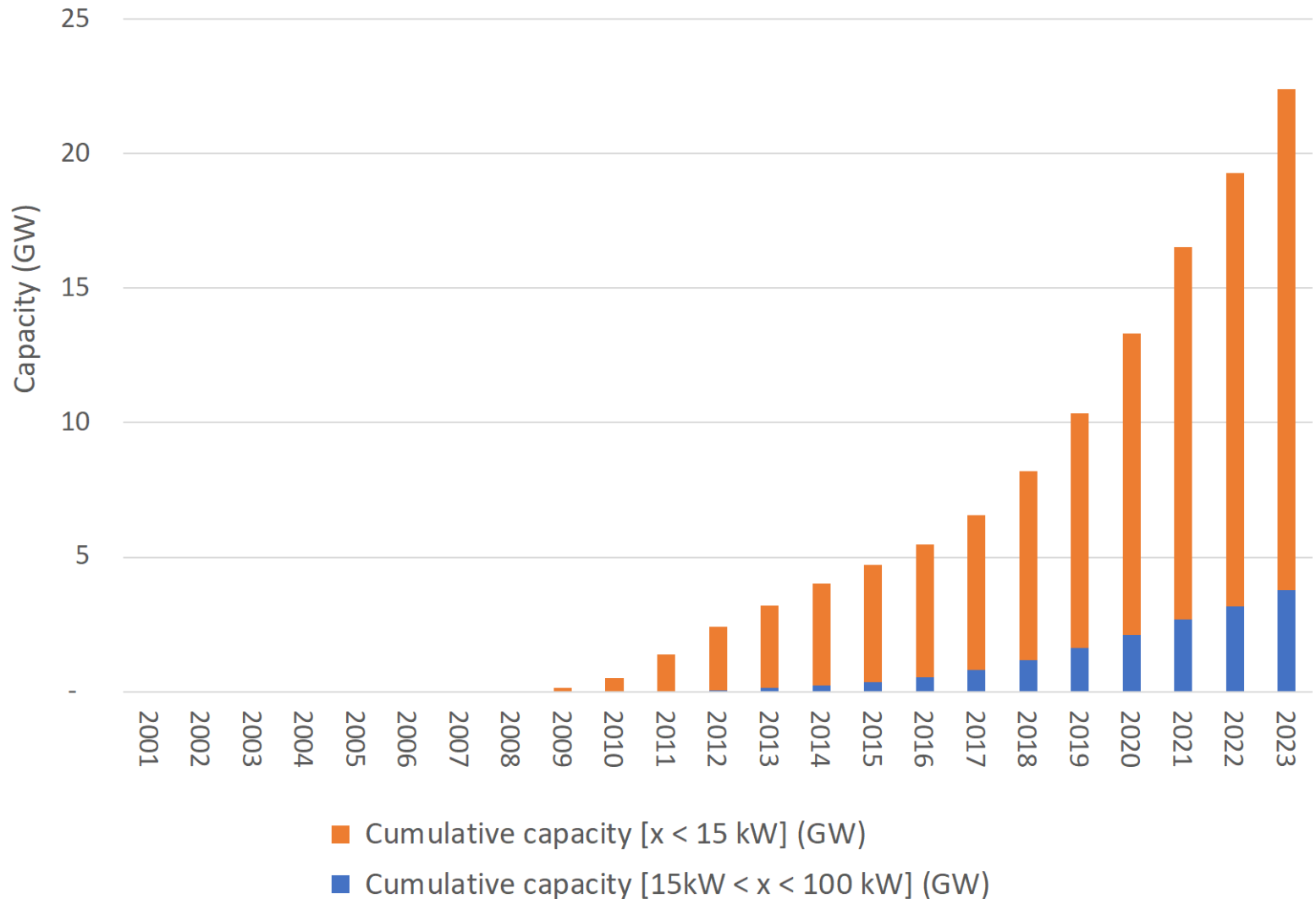


South Australia, 71% in 2023



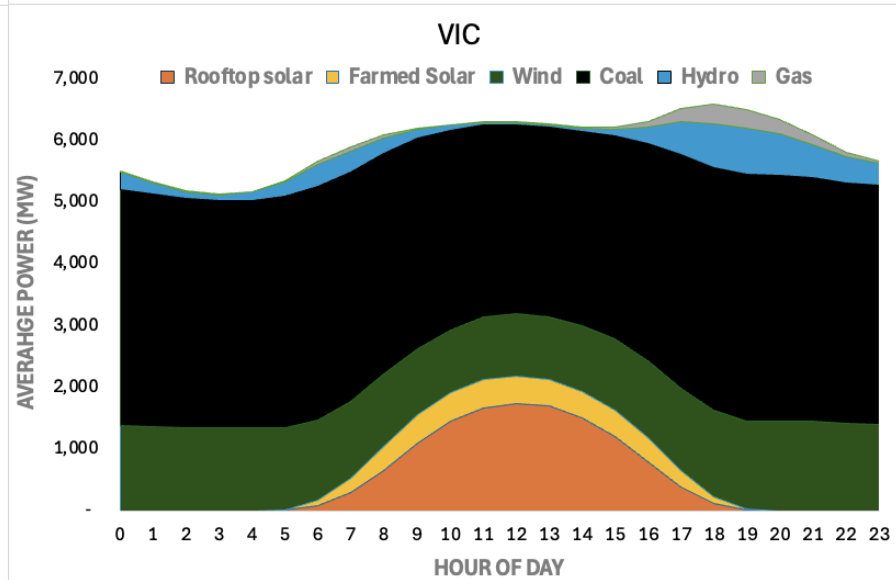
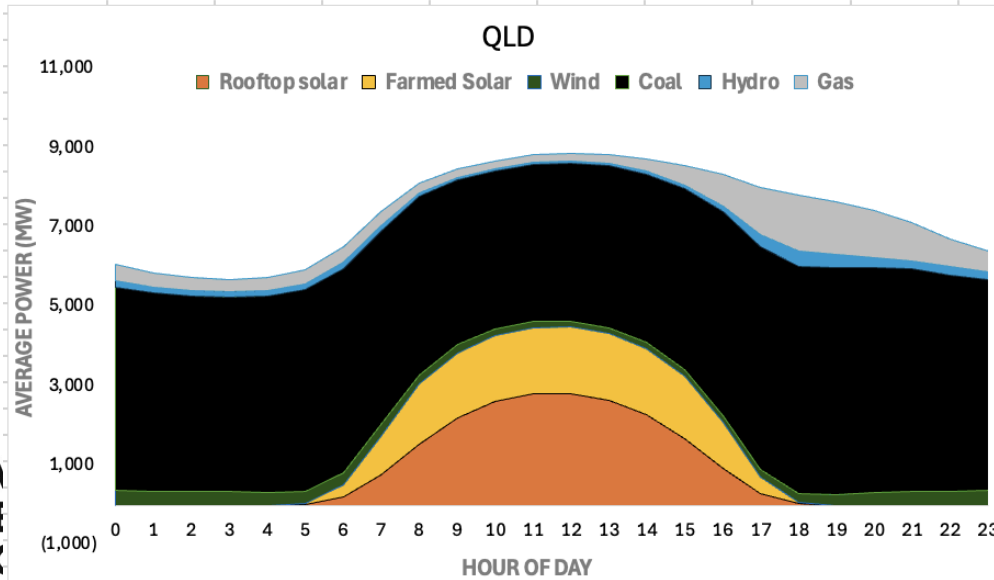
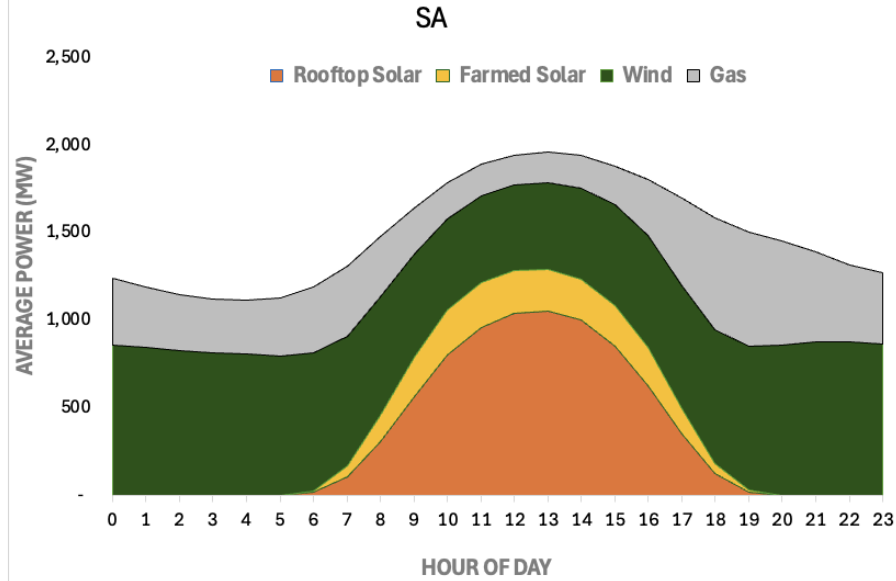
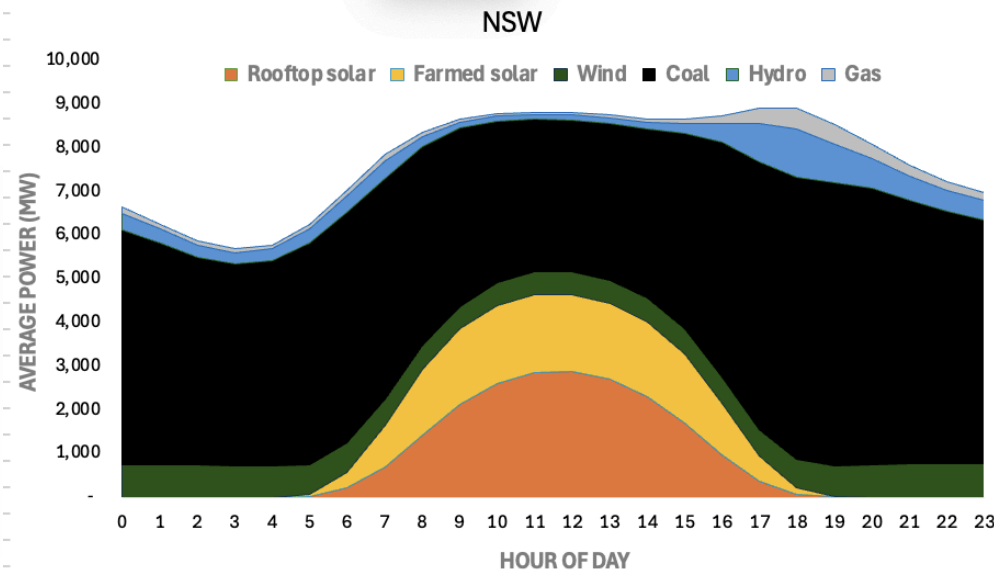
Good solar irradiance, high retail electricity prices, rapidly declining PV costs and supportive policy has taken Australia to first place globally in per-capita rooftop solar, Australia-wide

Cumulative rooftop PV capacity

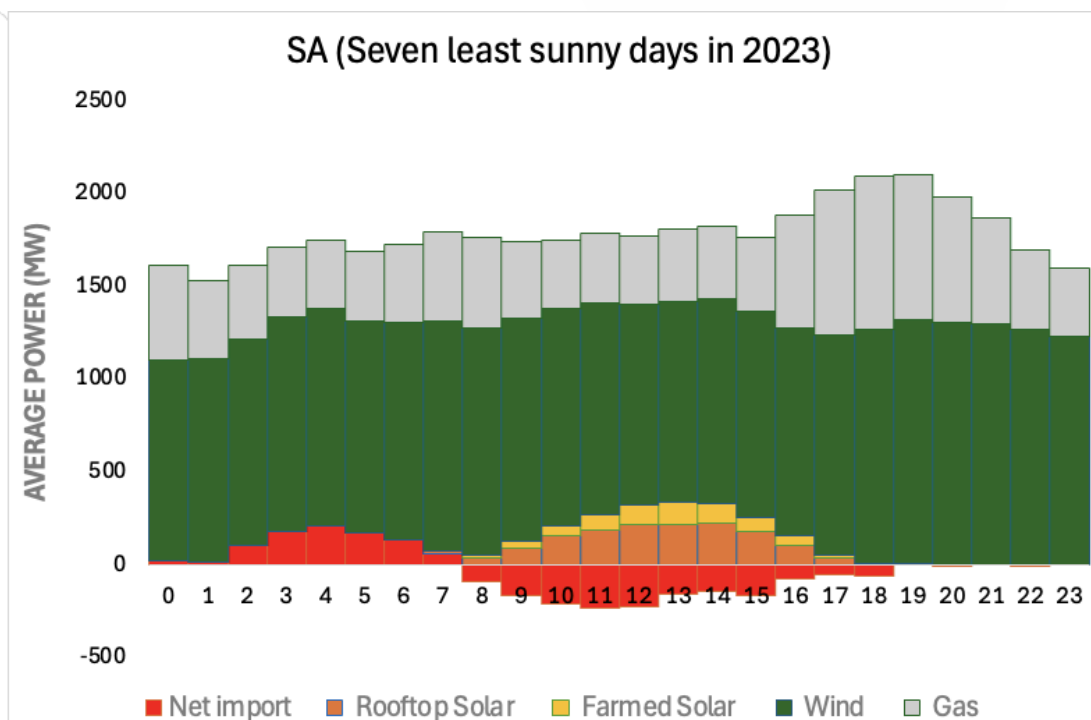
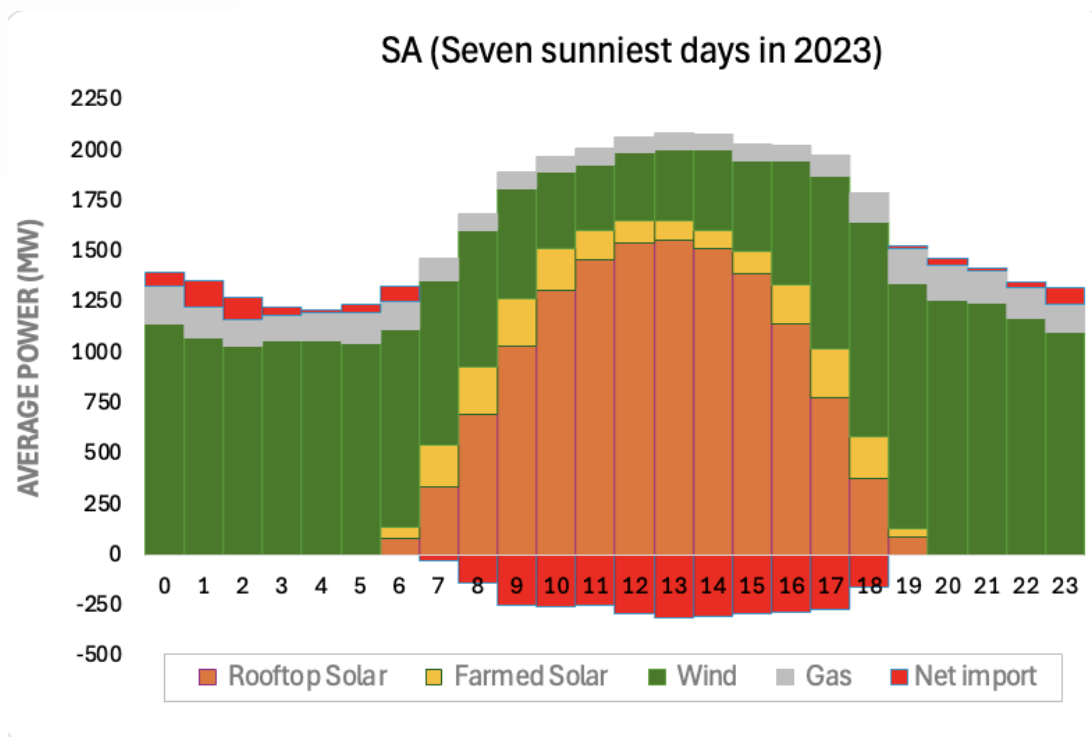


- About than 1 in 3 eligible homes have rooftop solar. End 2023 ~ 820 watts per capita (Hawaii next highest (541 w/capita) then California (364/capita))
- RTS = 23.2 GWh in the NEM in 2023; ~ 11% of grid-supplied electricity, slightly less than wind
- Commercial and industrial rooftop solar now growing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

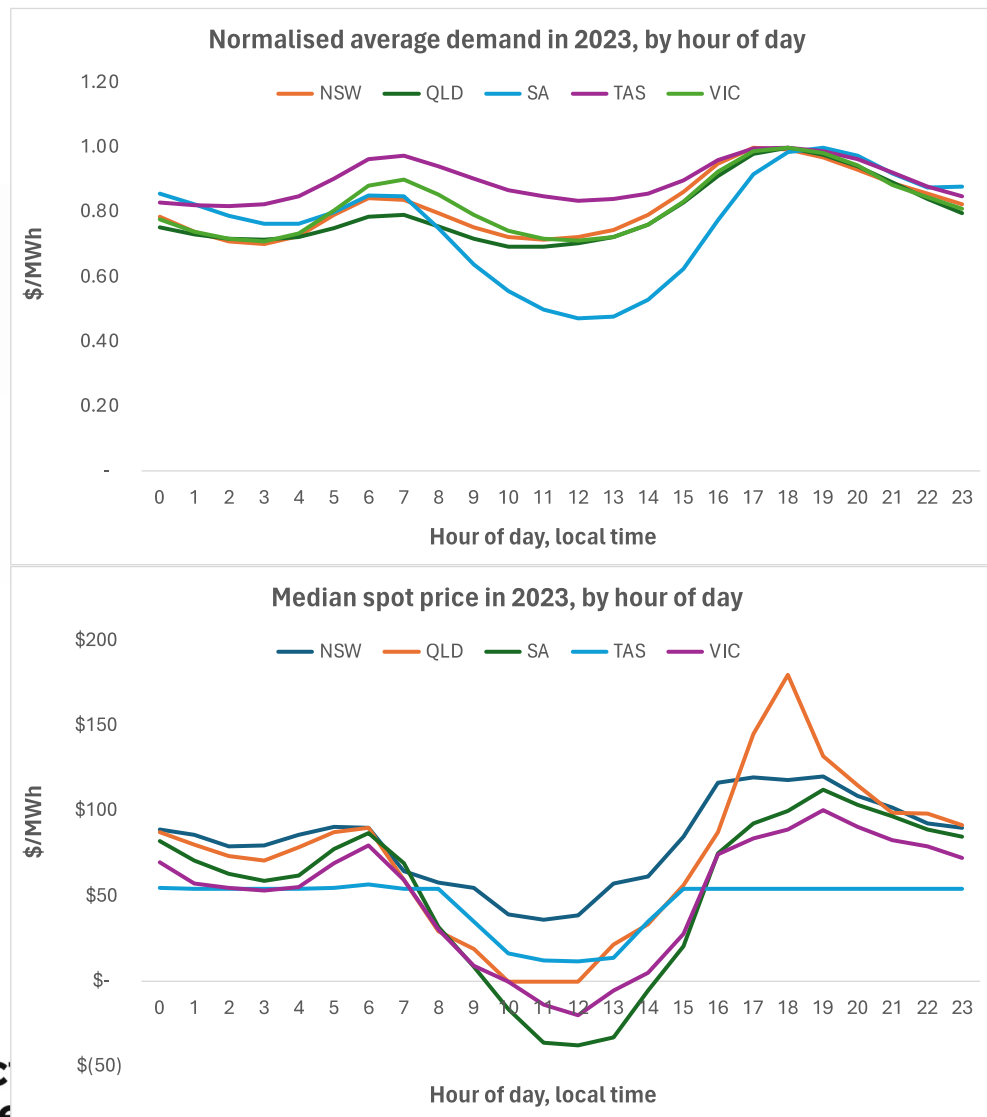
Rooftop PV now a big part of daytime supply



But big disparity between most sunny and least sunny days



Rooftop solar is the main explanation for lower day-time spot prices



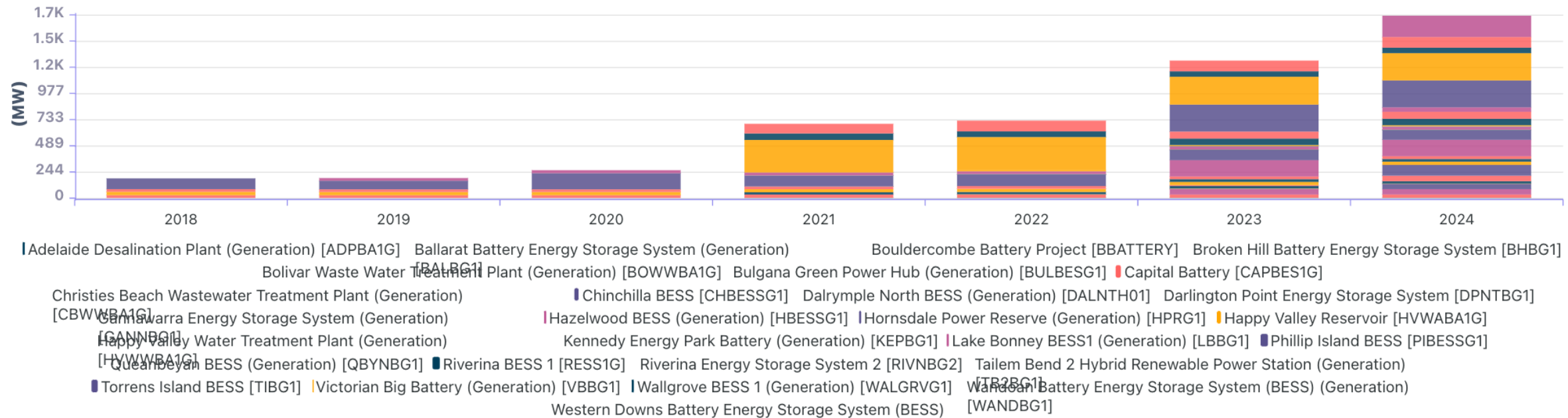
Rooftop solar reduces day-time prices in two ways:

- It substitutes grid supplied electricity and so reduces demand for grid supplied electricity and so depresses prices. This effect is not large however (only around 25% of rooftop solar is self-consumed at the premises).
- The remaining 75% is exported to the grid, greatly reducing the demand for much more expensive generation during the day. This is the main source of the (downward) price impact on the grid.

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



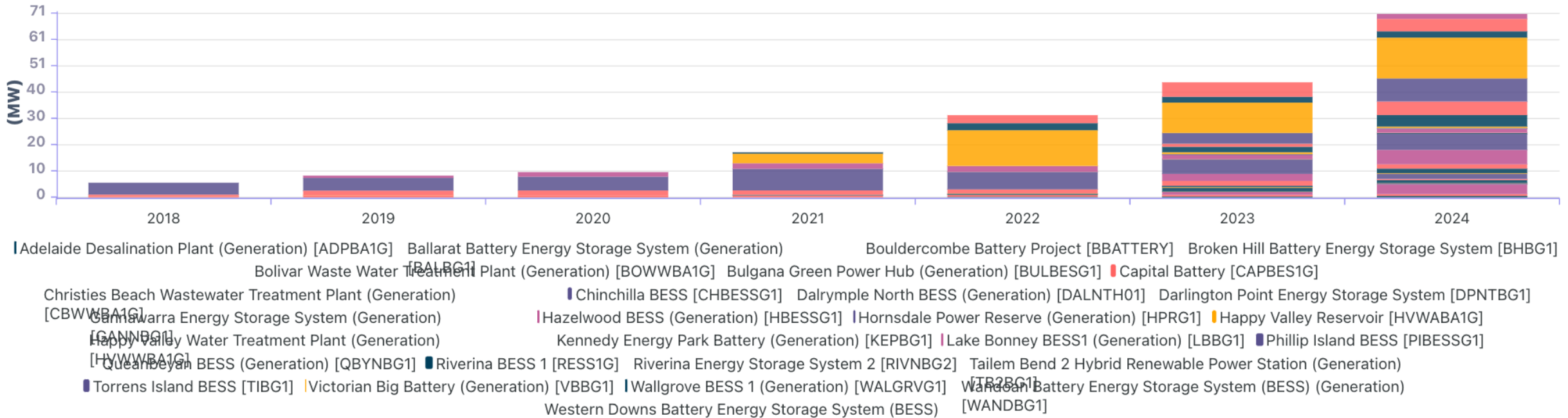
Maximum Generation - Annual , NSW-QLD-SA-TAS-VIC



Batteries are still minor part of average supply (71 MW (2024 ytd) v 24,050 MW NEM average demand. But more than doubling every year.

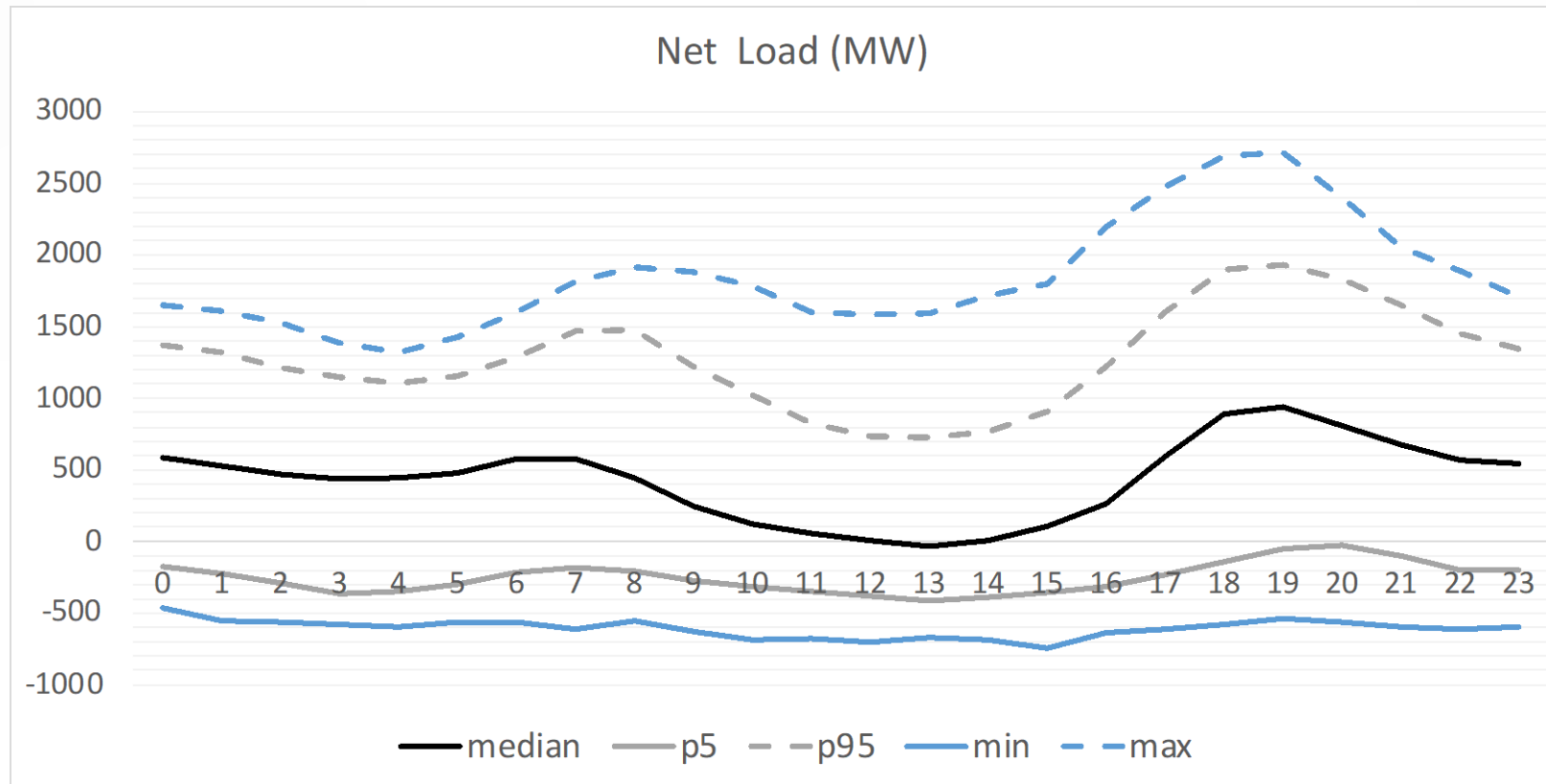


Generator Dispatch - Annual , NSW-QLD-SA-TAS-VIC



Power system reliability and security

- ▶ South Australia has been the main scene of action so far. Highly variable net load (demand measured at transmission) less VRE (i.e. requirement for dispatchable generation) is the challenge



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.

What are we discovering? Some economic and policy things

1. Transmission expansion is hard
2. Network access rights (and pricing) is a big issue
3. Short term (5-minute) wholesale prices are very valuable
4. Ever-declining costs of rooftop solar and ease of connection has delivered robust customer demand for 15 years
5. The declining stock of (supply-side) rotating mass has stimulated debate about inertia and system strength. It is not clear that there is an unresolvable problem here.
6. Large scale load defection (and increasing grid defection) seems to be increasingly likely
7. The decarbonization of electricity supply is a mammoth and difficult thing. It will take time.

What are we discovering? Some (more important) “way-of-thinking” things:

1. The “climate emergency” has made top-down command-and-control more popular: “in times of war you empower the Generals”. Its (mostly) not working.
2. We consistently over-rate the things we know and under-rate the things others know. Bad mistake is energy policy when so much is unknown.
3. The rate of technology change and innovation is extraordinary. Don’t create a situation in which you rely on regulators and policy-makers being at the front of the curve.
4. You need to climb the foothills before you can climb the mountain (and by the time you get to Base Camp, the mountain looks quite different from what you had imagined).
5. The sole purpose of production is consumption. And, individual customers have very different needs and wants. Policy, strategy and regulation that reflects this dictum, is more likely to be successful in meeting the range of customers’ different needs.

Some suggestions for South Africa as it gradually orients to open markets

1. The freedom to choose is valuable but it also creates obligations (buying well takes effort and skill). Some customers rejoice in new freedoms while others resent new obligations and pine for the “old days” when “life was simpler”.
2. Allowing customers to choose, provides benefits to all customers but some win more than others. Policy and regulation must provide some protection for the least well-off and those unable to engage in the market.
3. Freely-determined prices co-ordinate effectively when those prices are visible and trusted. Regulators, policy-makers and the market operator must actively pursue price transparency and credibility.

Resources

▶ www.vepc.org.au

▶ www.v-nem.org