ISP's 2050 NEM

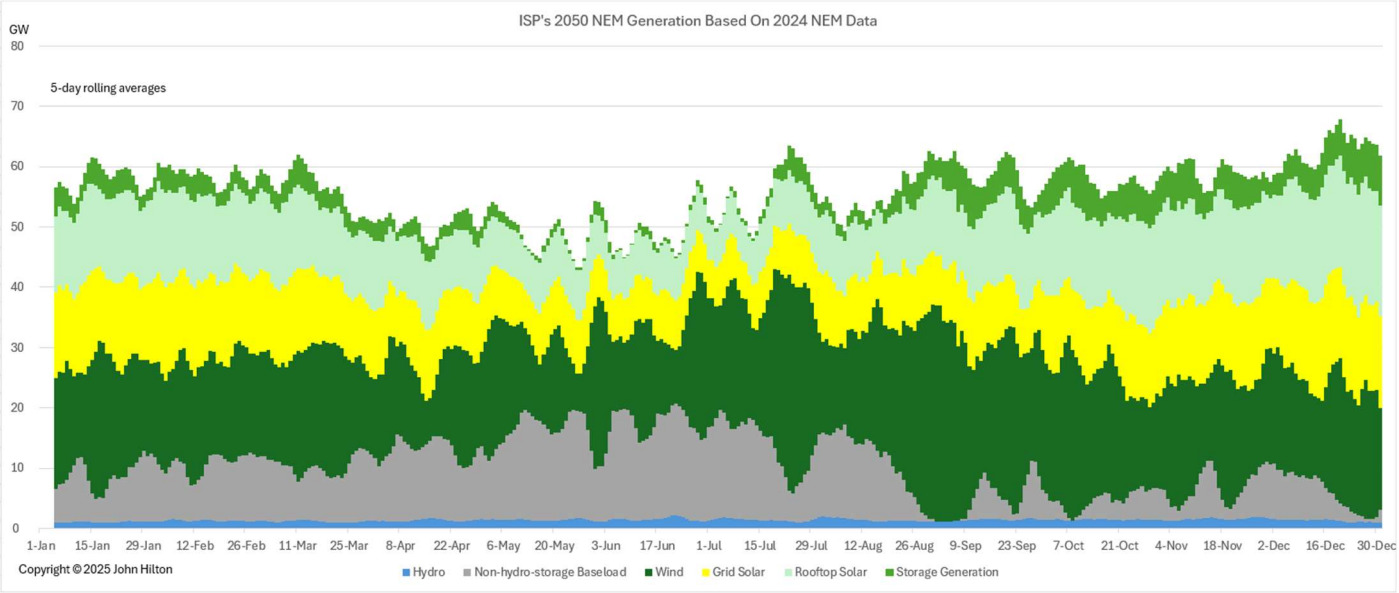
Based On 2024 NEM Data

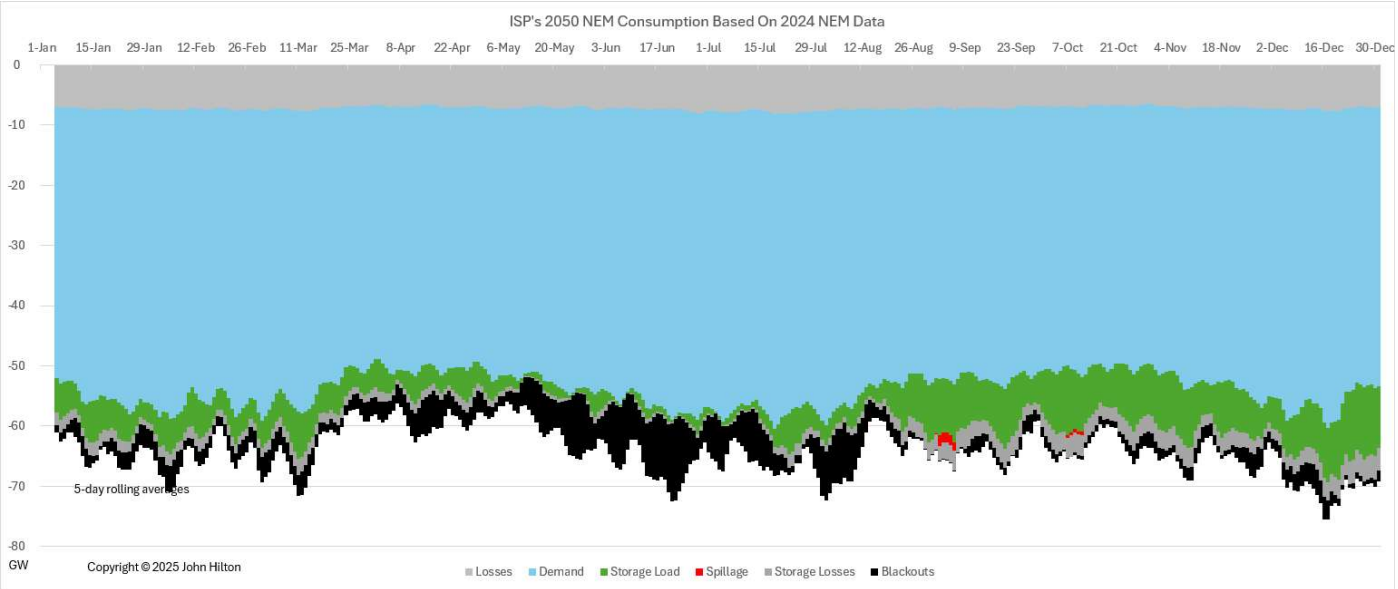
February 2025

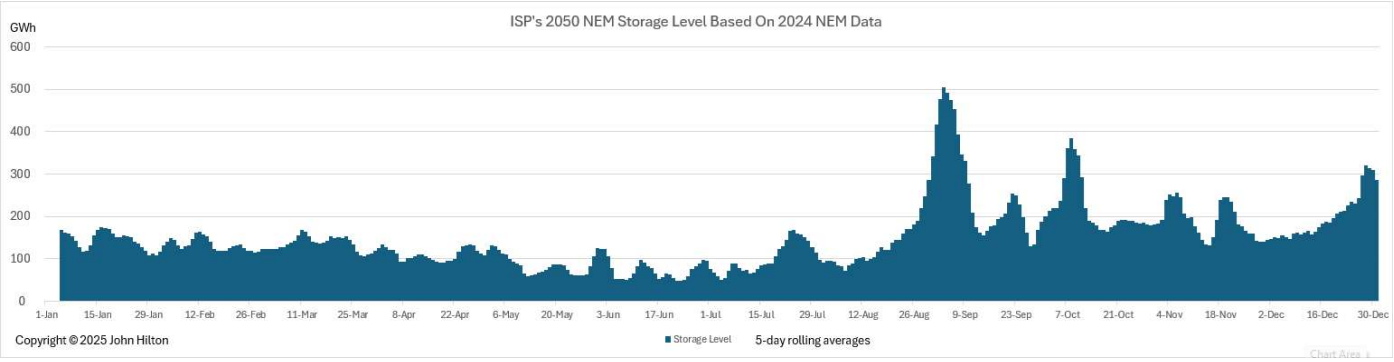
Apply the latest Integrated System Plan's (ISP) 'recipe' for 2050 to 2024 generation data...

- Scale Wind and Grid Solar by six
- Scale Rooftop Solar by four
- Scale Hydropower by 83%
- Scale Electricity Demand by 208%
- Provide 49 GW / 646 GWh of dispatchable storage
- Provide 15 GW of gas power and 4GW of other baseload power
- Include additional power system security services

The following generation and consumption graphs tell the story and it doesn't look good! Note the large number of partial blackout periods (in black of course) as the grid doesn't cope.







2024 was an unremarkable year weather-wise. Australia's wind and solar resources are widely dispersed so scaling these resources provides a reliable model as the wind and solar responses to the weather are already baked in to the 2024 data.

According to this model…

Blackouts

Generation is overall 4% shy over the year of what is needed to avoid blackouts which occur mainly in the colder months. The worst time in the model is 6:40 PM on 13th June when the NEM, at 21.5 GW, is over 40 GW short of the 59 GW demand as storage is empty and the 2.5 GW wind just covers NEM grid losses. Clearly far more than 19 GW of dispatchable non-storage generation will in fact be required!

CO_2

Fossil fuel generators provided **132 TWh** of electricity in **2024**. Non-hydro-storage baseload, having 15GW of fossil fuel gas and 4GW of unspecified generation, will produce **93 TWh** of electricity in **2050**. The large number of blackouts will not be tolerated so more wind, solar and storage and/or non-hydro-storage baseload will be added. Adding non-hydro-storage baseload will only increase the 93 TWh generation number. Not much of a transition given the massive investment.

Storage and Spillage

Storage is heavily relied on to absorb daytime solar power to then return it at night. The storage graph shows longer term storage is consumed, when really needed, typically over a week or so.

There is little spillage (wasted oversupply) as the storage fills in late August. Also note, the excess grid power never exceeds storage's ability to absorb it[1].

Background - 2024 Generation Data

AEMO's nemweb.com.au website provides the power output for all NEM-connected generators every five minutes and rooftop solar generation is reported every thirty minutes. All up, over 24 million data points provide an accurate history for the previous 12 months. The NEMWeb project at github.com/jhilton00/NEMWeb is an open-source analysis of this data.

From the 2024 analysis 5-minute interval data for five categories is copied over.

- Hydropower
- Wind
- Grid solar
- Rooftop solar (interpolated from 30-minute data)
- Electricity demand used by factories, businesses and residences

[1] The ISP only includes storage generation output's capacity, not the storage input capacity. The model simply uses the same value.

Methodology

The five categories are scaled to form the corresponding 2050 categories then the power-flow analysis, as presented in the Average NEM Power Flows 2024.pdf[2] where system losses are calculated, baseload generation is determined and storage responses are included. The 5-minute interval model is then summarized in a daily table that is used to derive the results and graphs.

APPENDIX

The following table is copied from the *Parameters and Results* tab in NEM ISP 2050.xlsx. Anyone can download and adjust these parameters (in orange cells) as they see fit to revise the model.

Name	Value	Notes
Hydro Factor	83%	ISP Page 11 graph, 7.5/9 - as read from graph
Grid Solar Factor	600%	ISP Page 11, bottom dot point, "Triple grid-scale variable renewable energy (VRE) by 2030, and increase it six-fold by 2050"
Wind Factor	600%	ISP Page 11, bottom dot point, "Triple grid-scale variable renewable energy (VRE) by 2030, and increase it six-fold by 2050"
Rooftop Solar Factor	400%	ISP Page 12 third dot point, "Support a forecast four-fold increase in rooftop solar capacity"
ISP 2050 Firming Capacity	75 GW	ISP Page 73 2nd paragraph: "75 GW of firming technology" ISP Page 65 4th paragraph: "Firming technologies include storage, hydro, gas and other fuelled generation."
Hydropower 2024	9 GW	ISP Page 6 "8.5 GW of hydropower assets in operation across Australia today"
Non-hydro-storage Baseload	19 GW	
Demand Factor	208%	ISP Bottom of page 23, "Future energy consumption from the NEM will rise by approximately 108% by 2050"
Storage Capacity	646 GWh	ISP Page 12 second dot point, "This includes 49 GW/ 646 gigawatt hours (GWh) of dispatchable storage"
Storage Generation Capacity	49 GW	ISP Page 12 second dot point, "This includes 49 GW/ 646 gigawatt hours (GWh) of dispatchable storage"
UK Average Generation 2024	37 GW	
UK Grid Inertia 2024	220 GWs	
Aus Average Generation 2024	24.7 GW	github.com/jhilton00/NEMWeb
Aus Average Generation 2050	50 GW	
Aus Grid Inertia 2050	297 GWs	Use the UK's ratio to estimate Australia's requirement
SynCon Power Consumption Factor	3 MW/GWs	
SynCon Power Consumption	892 MW	
Average Transmission Loss Factor	8%	
Average Dist Network Loss Factor	5%	

[2] https://github.com/jhilton00/NEMWeb/blob/master/Average%20NEM%20Power%20Flows%202024.pdf

Aluminium Smelters Consumption	2,118	github.com/jhilton00/NEMWeb, Tomago's 960MW has been removed from 2024's consumption
Rooftop to Dist Network Factor	95%	The percentage of rooftop solar power put into the distribution network
Rooftop Local Consumption Factor	5%	
Baseload Threshhold May to Aug	20%	Turn on baseload to try and maintain this amount of storage
Baseload Threshhold Sep to Apr	20%	Turn on baseload to try and maintain this amount of storage
Storage Threshhold May to Aug	129 GWh	
Storage Threshhold Sep to Apr	129 GWh	
Average Storage Charging 2024	182	github.com/jhilton00/NEMWeb
Average Storage Discharging 2024	121	github.com/jhilton00/NEMWeb
Storage Turnaround Loss Factor	34%	
Storage Charging Loss Factor	18%	
Storage Discharging Loss Factor	23%	
Starting Storage	300 GWh	

Average Demand	47 GW	100%
Average Non-hydro Baseload	9 GW	19%
Non-hydro Baseload Capacity Factor	47%	
Business and Residential Factor	95%	The percentage of non-aluminium-smelter demand
Baseload Factor	115%	