Centre for Policy Futures

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

CREATE CHANGE

Addendum to Roadmap to QRET Report 2020: Pipeline Scenario B (without Queensland Pump Hydro)

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1. Introduction

Advance Queensland Roadmap to QRET Report 2020 concluded that a managed transition plan was required for Queensland to achieve its Renewable Energy Target (QRET) of 50% by 2030. The requirement for a managed transition plan was a consequence of:

- the challenges associated with a transmission network that was designed for large centralised coal-fired generation requiring adaptation to supply from many small decentralised variable renewable energy (VRE) plants remote from load centres and robust network infrastructure
- investment plans for VRE that will result in high levels of curtailment, should be assessed to avoid over-supply from VRE in locations that will never have the transmission infrastructure to deliver energy generated to demand centres
- the requirement for storage of some form or another to store VRE when generated at periods when surplus energy exists for dispatch at periods when a deficit of energy exists
- the requirement to close coal units to avoid excess supply which results in high levels of curtailment of VRE

Modelling undertaken to consider outcomes of various levels of investment in VRE indicated that high levels of coal generation closure, to avoid excess supply for the majority of the year, results in energy deficits.

This addendum provides some detail of modelling outcomes for the nodal supply demand balance across the rest of the National Electricity Market (NEM). The scenarios that showed evidence of the highest levels of renewable energy within the system in Queensland in 2030, were Pipeline Scenario B and ISP Central Scenario for the year 2040. This addendum will provide details for Pipeline Scenario B but without the additional Pump Hydro assumption for Queensland of 1020MW at Mt Byron and 1020MW at Urannah. For analysis and detail on the assumptions and modelling undertaken refer to Roadmap to Queensland Renewable Energy Target 2020 and ANEM NEM Nodal Modelling Report Final 2020.

2. NEW SOUTH WALES: Nodal Supply-Demand Balance for Summer Weekdays in 2030

a) Pipeline Scenario B (without Queensland Pump Hydro)

i. NSW Underlying assumptions

- N transmission network
- Direction of Flow loss method estimation
- Generation capacity at 2030 with ISP Central scenario demand assumptions
- Coal power in 2030 will decline to 4,040MW in NSW from 10,210MW currently (QLD 4,839MW from 8,059MW; VIC 3,144MW from 4,775MW)
- Coal unit closures:
  - QLD: Units 1-2 Callide B; Units 1-2 Stanwell; Units 1-2,5-6 Gladstone; Units 1-2 Tarong;
  - NSW: Units 1-4 Liddell; Units 1-4 Eraring; Units 5-6 Vales Point
  - VIC: Units 1-4 Yallourn
- Gas power in 2030 will decline to 1,174MW in NSW from 2,155MW currently (QLD 2,691MW from 3,076MW with closure of Swanbank E)
- Wind power in 2030 will reach 5,671MW in NSW (QLD 4,820MW; VIC 8,470MW; SA 3,652MW; TAS 2,302MW)
- Solar power in 2030 will reach 8,021MW in NSW (QLD 8,736MW; VIC 2,141MW; SA 4,213MW)
- Pump hydro (PHES) in 2030 includes Snowy 2.0 to reach 3,180MW in NSW (QLD 820MW; SA 610MW)
- Table 1 summarises generation capacity assumptions for NSW
- Transmission augmentation assumed for:
  - QNI to 5436MW
  - corridor from Armidale to Newcastle and Sydney to accommodate 5+GW of energy flows
  - Energy Connect from NSW to VIC and SA
  - Kerang-Link in Victoria
  - Battery of the Nation augmentation VIC to TAS

Table 1: New South Wales capacity assumptions under sB (without QLD Pump Hydro)

New South Wales Capacity	Current [1] (MW)	2030 (MW)	Notes
Coal	10,185	4,040	Closures: Liddell 2000MW, Eraring 2880MW, Vales Point 1320MW Capacity factor: 67% (full year); 71% (SummWD)
Gas	2,155	3,048	Closures: None Capacity factor: 17% (full year); 17% (SummWD)
Hydro	1,803	1,596	Closures: None Capacity factor: 4% (full year); 3% (SummWD)
Solar	1,126	8,021	Capacity factor: 23% (full year); 27% (SummWD) Curtailment SummWD: 29%, Max 6022MW
Wind	1,516	5,671	Capacity factor: 36% (full year); 35% (SummWD) Curtailment SummWD: 7%, Max 2420MW
PHES	856	3,180	Capacity factor: 6% (full year); 5% (SummWD)
Storage/Other	283	4,164	E-G Capacity factor; 9% (full year); 9% (SummWD)
TOTAL	17,925	29,721	

[1] Source: AEMO Generation Information July 2020

ii. NSW modelling outcomes for Summer Weekdays (SummWD)

1. NSW Fuel share of electricity generated

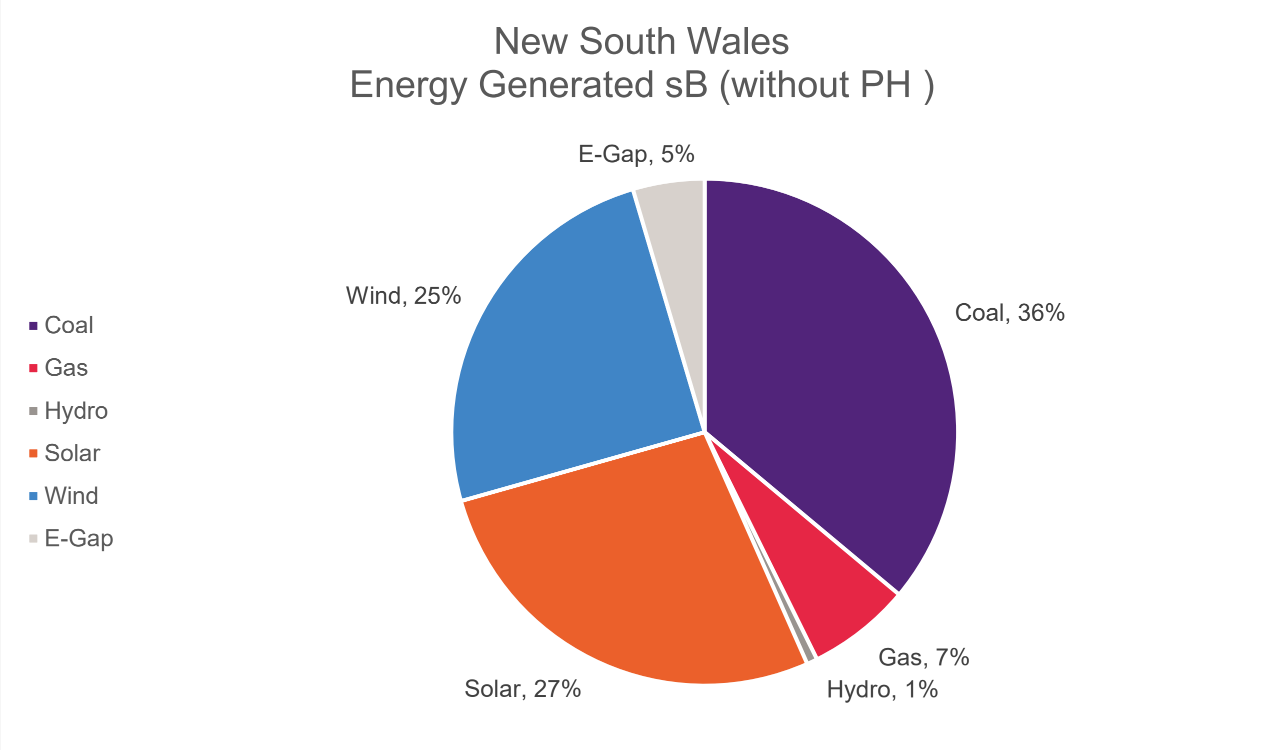

Figure 1: NSW Fuel share during summer weekdays under sB (without QLD Pump Hydro)

Modelling outcomes predict that 36% of electricity generated in NSW in 2030 is sourced from coal, 27% from solar, 25% from wind, 7% from gas and 1% from hydro as shown in Figure 1. The Energy-Gap (E-G) that emerges is sizeable, at 523GWh or 4% of energy generated, 65GWh (12%) of which occurs during the evening peak, 430GWh (82%) overnight and 28GWh (5%) during daylight. The maximum for coincident E-G is 3.0GW, although the median E-G is 0MW, indicating few very high coincident E-G periods. Table 2 provides detail.

Table 2: Count of NSW co-incident Energy-Gap under sB (without QLD Pump Hydro)

Energy-Gap	Periods	> 3000	> 2500	> 2000	> 1000	> 500	> 100	> 0	= 0
Total		1	6	13	528	304	342	154	1532
% of periods		-	0.2%	0.5%	18%	11%	12%	5%	53%
Overnight	43-48, 0-12	-	-	1	501	245	115	33	185
Evening Peak	34-42	1	3	4	21	26	161	111	213
Daytime	13-33	-	3	8	6	33	66	10	1134

2. **NSW Energy Flows (SummWD)**

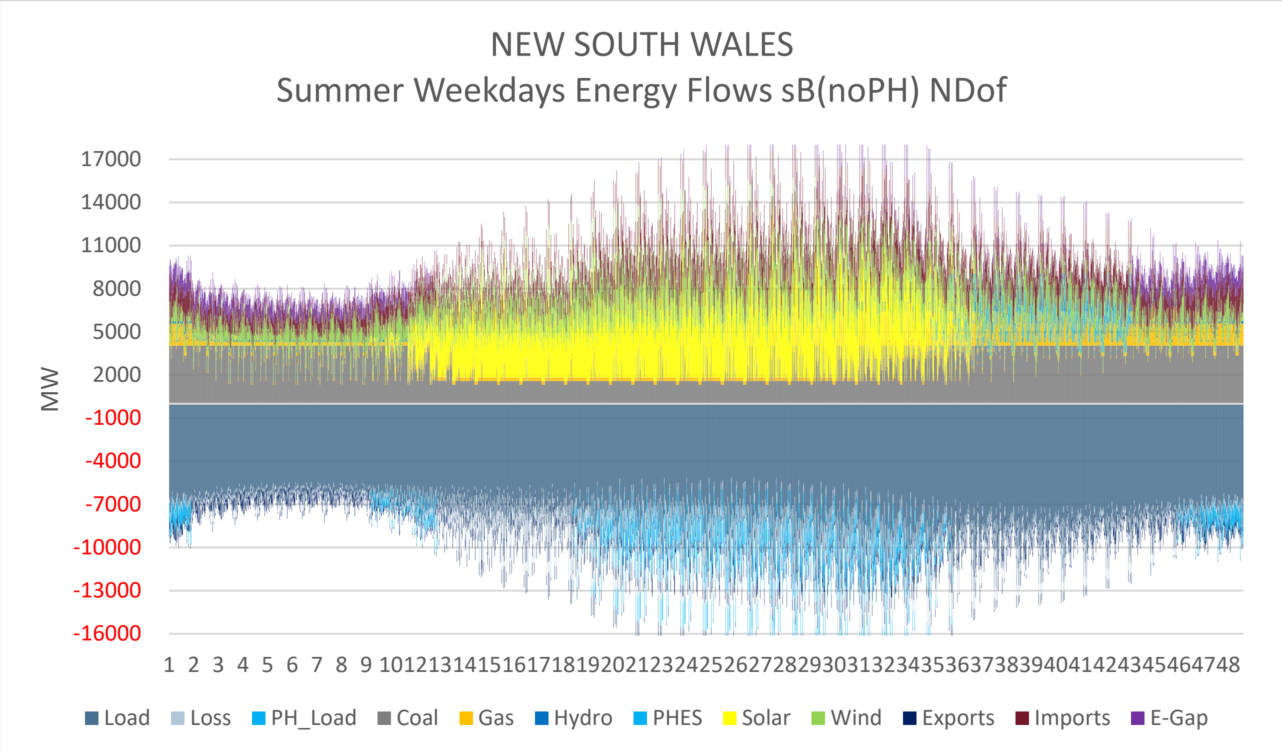

Figure 2: NSW energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 2 provides detail on the flow of energy through NSW nodes by time-of-day period by type of supply and demand for all of NSW. Of note:

- the steel grey coloured series indicates NSW demand, an average of 7,641MW
- the maroon coloured series indicates imports from Queensland which are ongoing all day but increase during daylight hours
- the navy coloured series indicates exports to Victoria which occur generally throughout the day but are smaller than the imports from QLD
- the light grey coloured series indicates coal generation within NSW which declines during sunlight hours
- the green and yellow coloured series indicate solar and wind generation
- the brown coloured series indicates NSW load
- the cyan coloured series indicate pump hydro (PHES) dispatch when positive and pumping load when negative
- the purple coloured series indicates Energy-Gap (E-G)

Table 3 provides totals and averages of SummWD energy flows. Coal generation across the state, with the removal of 6GW of capacity, achieves 71% capacity factor. Gas generation capacity factor is very low at 17%. Despite 36% curtailment of solar energy from potential dispatch, solar generation achieves a capacity factor of 27%. Curtailment of wind energy from potential dispatch is lower than solar at 10%, ensuring that wind generation state-wide achieves 35% capacity factor. E-G is persistent overnight at 1260MW and occasionally highly elevated from period 32-42, effectively evening peak, but otherwise very low. NSW imports (primarily from QLD) considerably more than it exports to VIC and NSW, which suggests the important role that imports from QLD play in supporting energy flows to Newcastle when Liddell and Eraring close.

Pumping for PHES (including Snowy 2.0) elevates the E-G. This is prevalent when PHES pumping occurs overnight when solar resource is non-existent and wind resource is low. In the analysis conducted here, PH dispatch outside of morning and evening peak, is classified as E-G and PH dispatch that fails to occur during morning and evening peak is detailed in Table 2 as PH spill. While the PHES pumping and dispatch present a modelling challenge, this highlights the reality that storage introduces significant additional load which can exacerbate the E-G. Other than PH pumping and dispatch, the periods of elevated E-G are associated with varying combinations of significantly elevated demand, significantly depressed wind energy and lower levels of imports from QLD.

Table 3: NSW Salient statistics under sB (without QLD Pump Hydro)

NSW Energy Statistics	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(11,003)	(8,865)	(7,641)	(13,399)	57%	(7,381)
PH_Load	(1,024)	(372)	(711)	(1,860)	38%	(200)
Coal	4,122	3,516	2,863	4,040	71%	3,145
Gas	756	853	525	3,028	17%	258
Hydro	78	107	54	686	8%	0
PH_Disp	240	695	167	1,940	9%	0
Solar	3,114	1,321	2,163	8,021	27%	1,961
Wind	2,834	2,175	1,968	5,042	39%	1,905
E-G	523	217	363	3,056	12%	0
Exports	(740)	(514)	(514)	(2,310)	22%	(416)
Imports	2,464	1,917	1,711	4,238	40%	1,614
Solar_spill	1,740	248	1,209	6,022	20%	4
Wind_spill	299	97	208	2,419	9%	2
PH_Spill	1,214	1,729	843	3,030	28%	0
Solar spill %	36%	16%	36%	43%		0
Wind spill %	10%	4%	10%	32%		0

3. NSW Variable Renewable Energy (VRE) Resource

Solar provides a predictable resource such that 27% capacity factor is achieved despite 36% curtailment from potential resource due to excess wind and coal generation available during the day as detailed in Figure 3 below. For this reason PH pumping conducted during the day does not lead to E-G's in the NSW system. Wind provides a less predictable resource as detailed in Figure 4 below. The NSW coincident wind resource figure below shows a concerning trend to lower wind in evidence overnight which impacts on PH pumping activities overnight and the ability to meet overnight demand, resulting in some E-G's overnight.

In summary, PHES nodes display a persistent E-G and Central Coast node shows evidence of highly escalated E-G for a few periods.

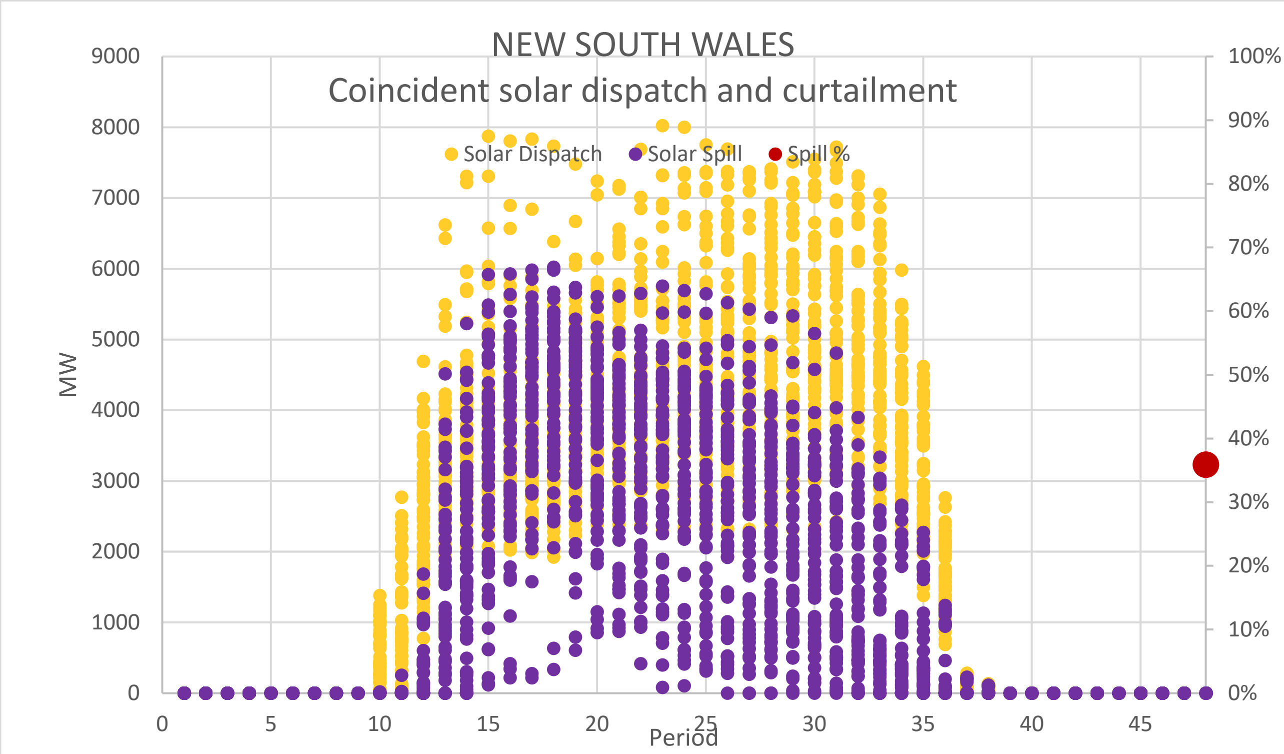

Figure 3: NSW Coincident solar dispatch and curtailment under sB (without QLD Pump Hydro)

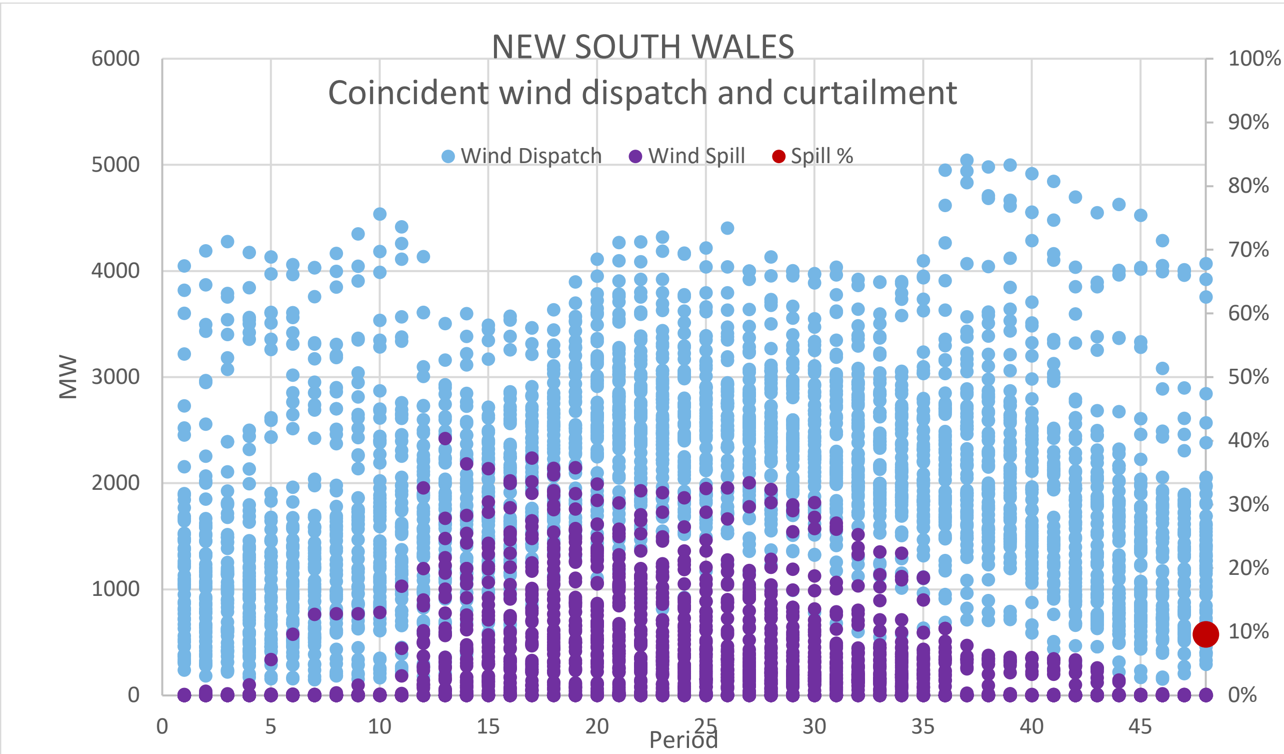

Figure 4: NSW Coincident wind dispatch and curtailment under sB (without QLD Pump Hydro)

4. ARMIDALE details for summer weekdays

Assumptions for Armidale (ARMD) generation capacity are detailed in Table 4.

Table 4: Armidale capacity assumptions under sB (without QLD Pump Hydro)

ARMD Capacity	Current [2] (MW)	2030 (MW)	Notes
Solar	76	1,546	Capacity factor: 27% 33% curtailed, Max curtailment 1,306MW
Wind	442	706	Capacity factor: 42% 3% curtailed, Max curtailment 394MW
Storage/Other/ E-G	0	377	Capacity factor: 2% Incidences: EvPeak 308 (51%); ONight 134 (12%); Sunlight: 525 (44%)
TOTAL	518	2,629	

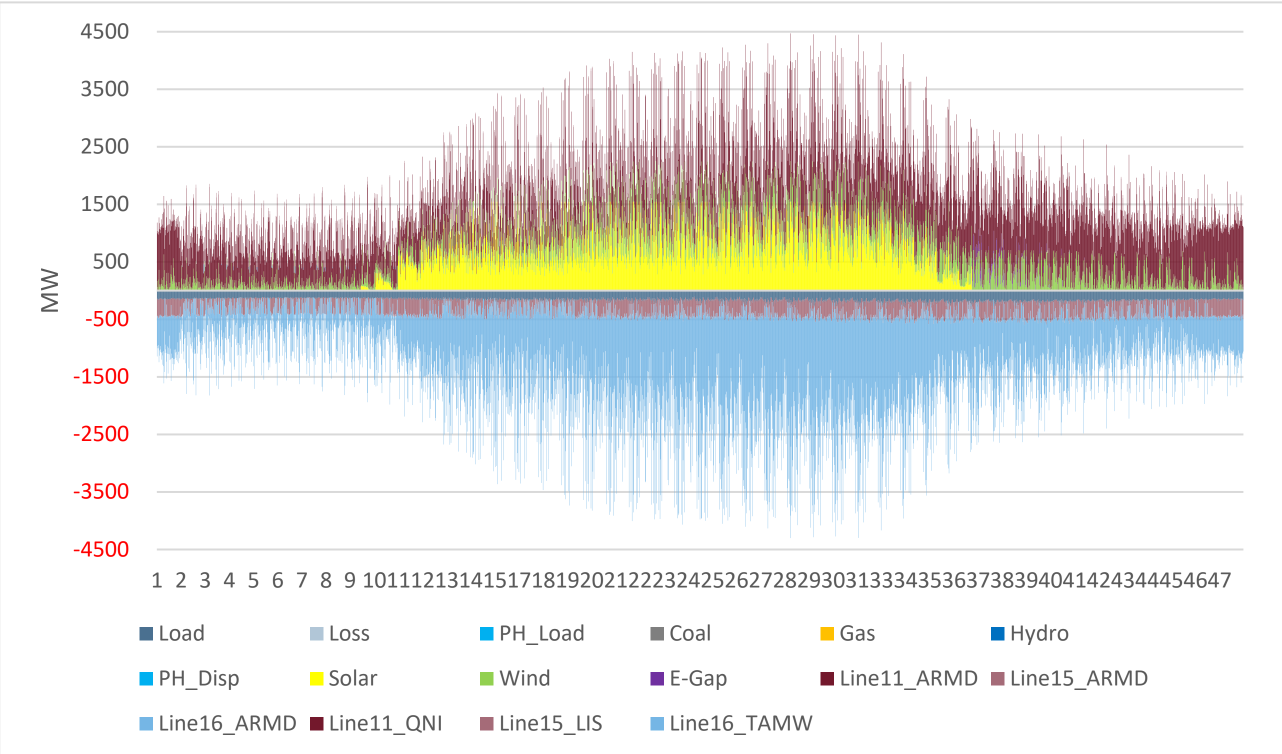

Figure 5: Armidale energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 5 provides detail on the flow of energy through ARMD node by time-of-day period by type of supply and demand for ARMD. Of note:

- the steel grey coloured series indicates ARMD demand, an average of 161MW

[2] Source: AEMO Generation Information July 2020

- the maroon coloured series indicates imports from QNI which are ongoing all day but increase during daylight hours
- the light blue coloured series indicates exports southwards towards Tamworth and ultimately Newcastle and Sydney, which elevate significantly during sunlight hours reflecting the solar resource in both QLD and ARMD
- the green and yellow coloured series indicate solar and wind generation which is small relative to the capacity available for dispatch and the flows in and out of the node
- the purple coloured series indicates Energy-Gap (E-G). E-G occurs only during periods 37-40, as is shown in Figure 6.

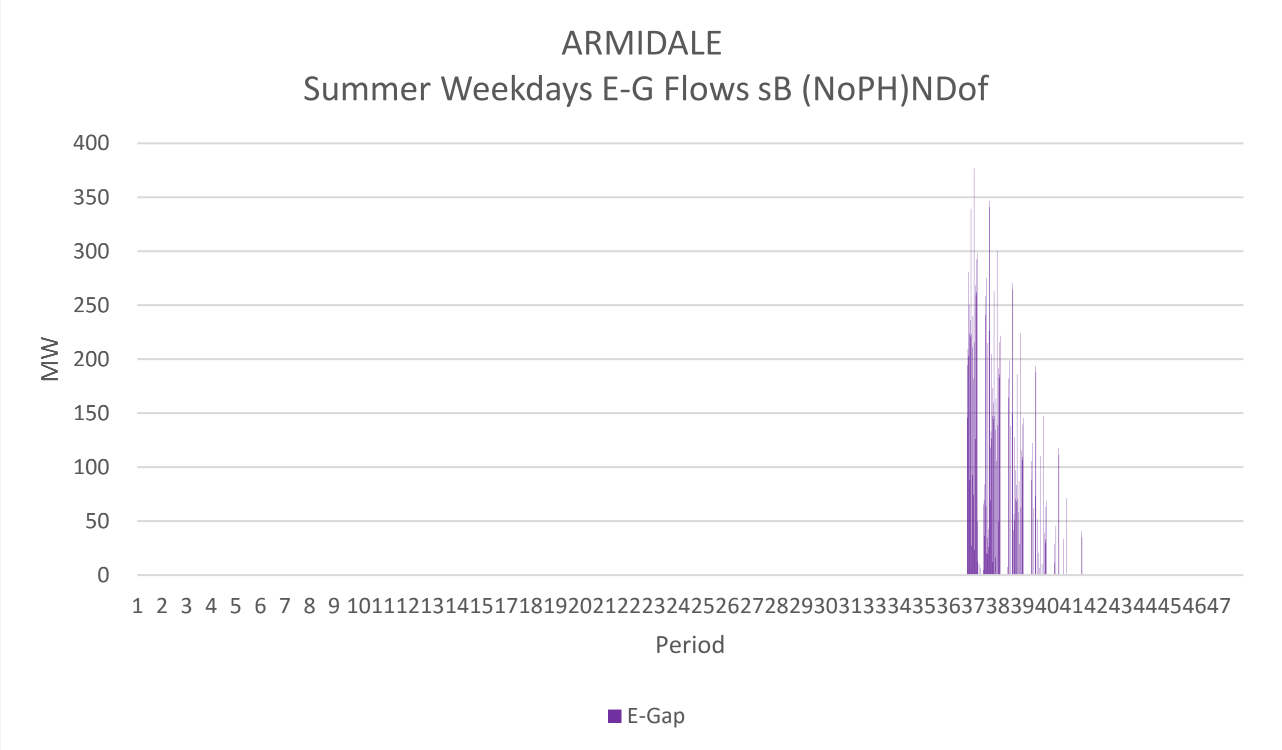

Figure 6: Armidale Energy Gap during SummWD in SB (without QLD Pump Hydro)

This clustering of E-G from 6:30pm to 8pm results from NSW evening peak coinciding with a significant decline in solar energy coupled with low wind energy across all of NSW. This is evident in Figures 3 and 4 where solar and wind energy across NSW decline in tandem just as demand is increasing in the load centres. Although there is capacity to transfer from QLD via QNI, QLD experiences similar supply-demand constraints at this time of the day, resulting in restricted imports from QLD.

Solar curtailment in ARMD is high at 33%, primarily as a result of insufficient load during the day in NSW to sustain wind (5,671MW), solar (8,021MW) and coal generation at minimum stable operating levels (1316MW), a total supply of 15GW for an average load of 7.7GW plus PH pumping of 1.9GW at mid-day. Although wind curtailment in ARMD is less severe at 3%, it faces the same problems as solar when it occurs during sunlight hours. Curtailment of wind is less severe than solar because solar output during the day is so high.

Table 5 provides the energy flow statistics for ARMD and Figures 7 and 8 show solar and wind dispatch and curtailment for Armidale.

Table 5: Armidale salient statistics under sB (without QLD Pump Hydro)

ARMD Statistics	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(232)	(189)	(161)	(282)	57%	(156)
Solar	590	213	410	1,546	27%	292
Wind	428	364	297	706	42%	253
E-G	8	28	6	377	2%	0
Exports (node)	(2,146)	(1,546)	(1,490)	(4,035)	37%	(1,317)
Imports (node)	1,408	1,183	978	2,527	39%	967
Solar_spill	286	4	199	1,306	15%	0
Wind_spill	13	1	9	394	2%	0
Solar spill %	33%	2%	33%	46%		
Wind spill %	3%	0%	3%	36%		

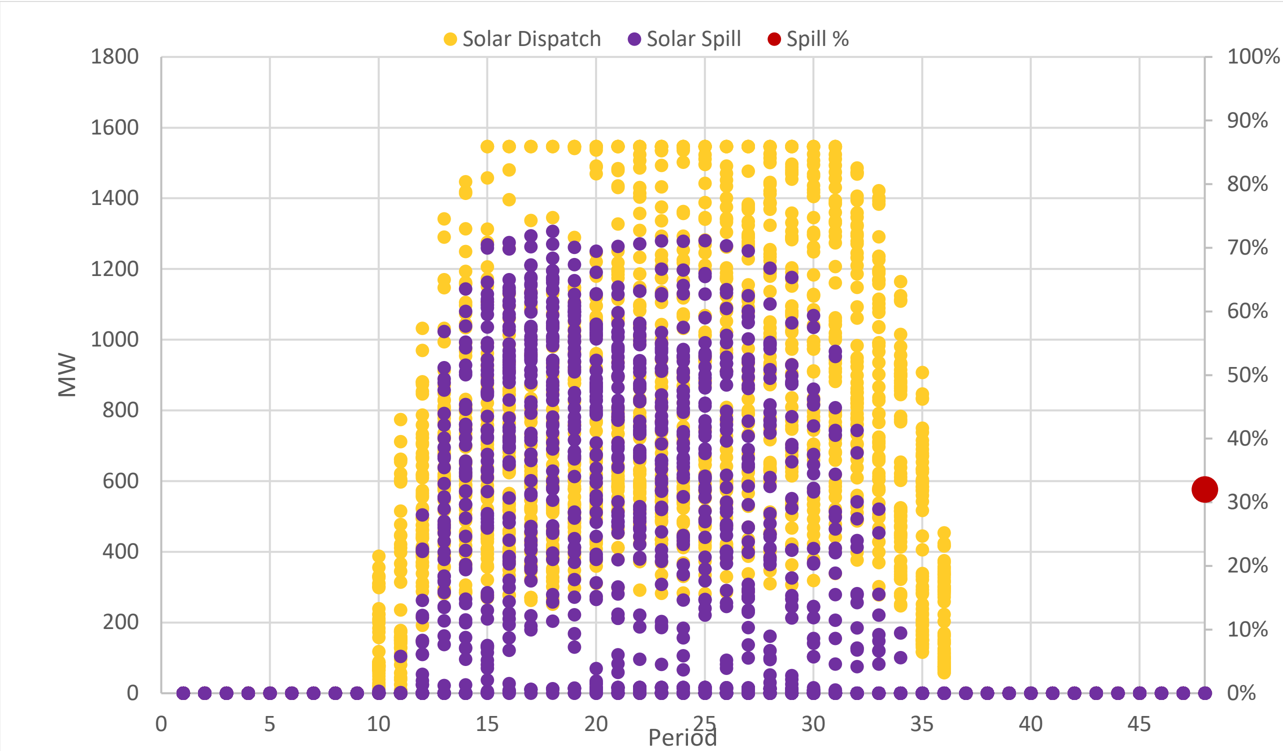

Figure 7: Armidale solar dispatch and curtailment under sB (without QLD Pump Hydro)

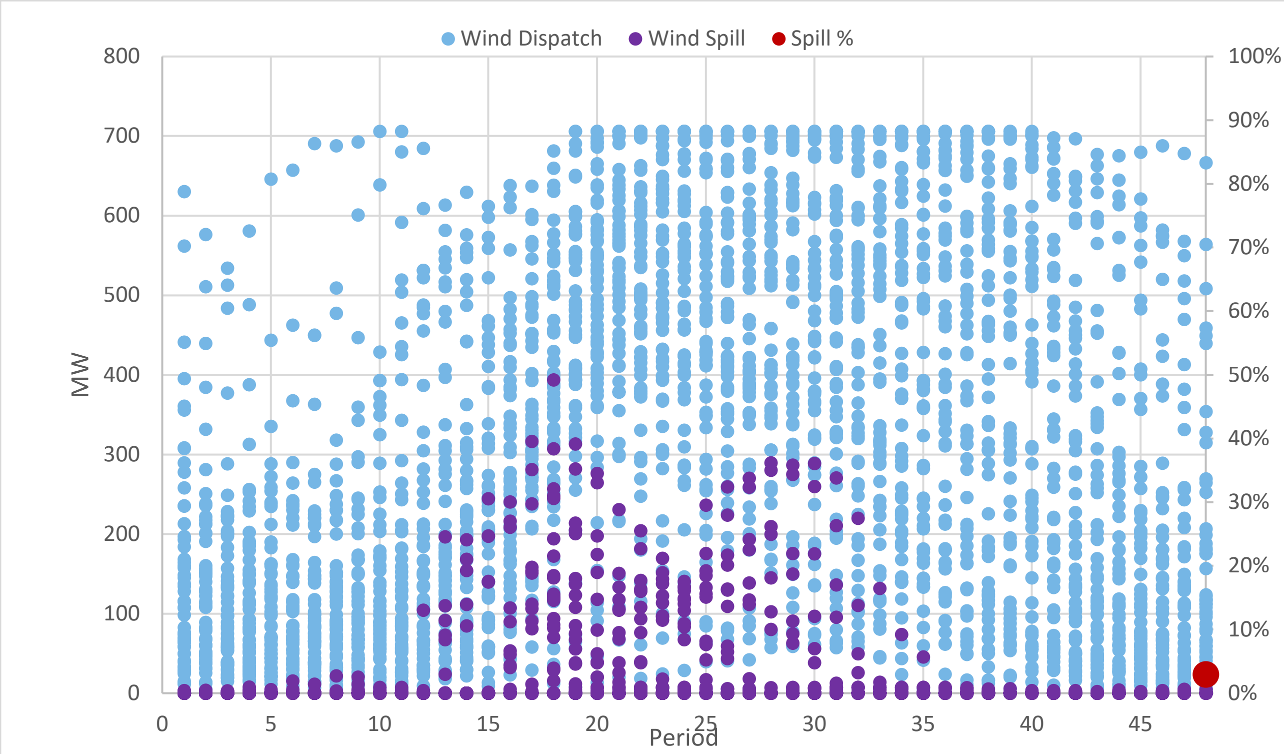

Figure 8: Armidale wind dispatch and curtailment under sB (without QLD Pump Hydro)

5. TAMWORTH details for summer weekdays

Table 6 provides a summary of Tamworth (TAMW) generation capacity assumptions

Table 6: Tamworth capacity assumptions under sB (without QLD Pump Hydro)

TAMW Capacity	Current [3] (MW)	2030 (MW)	Notes
Solar	-	1,207	Capacity factor: 31% 25% curtailed, Max curtailment 968MW
Wind	-	700	Capacity factor: 34% 13% curtailed, Max curtailment 548MW
Storage/Other/ E-G	-	323	Capacity factor: 4% Incidences: EvPeak 461 (77%); ONight 184 (17%); Sunlight: 429 (36%)
TOTAL	-	2,230	

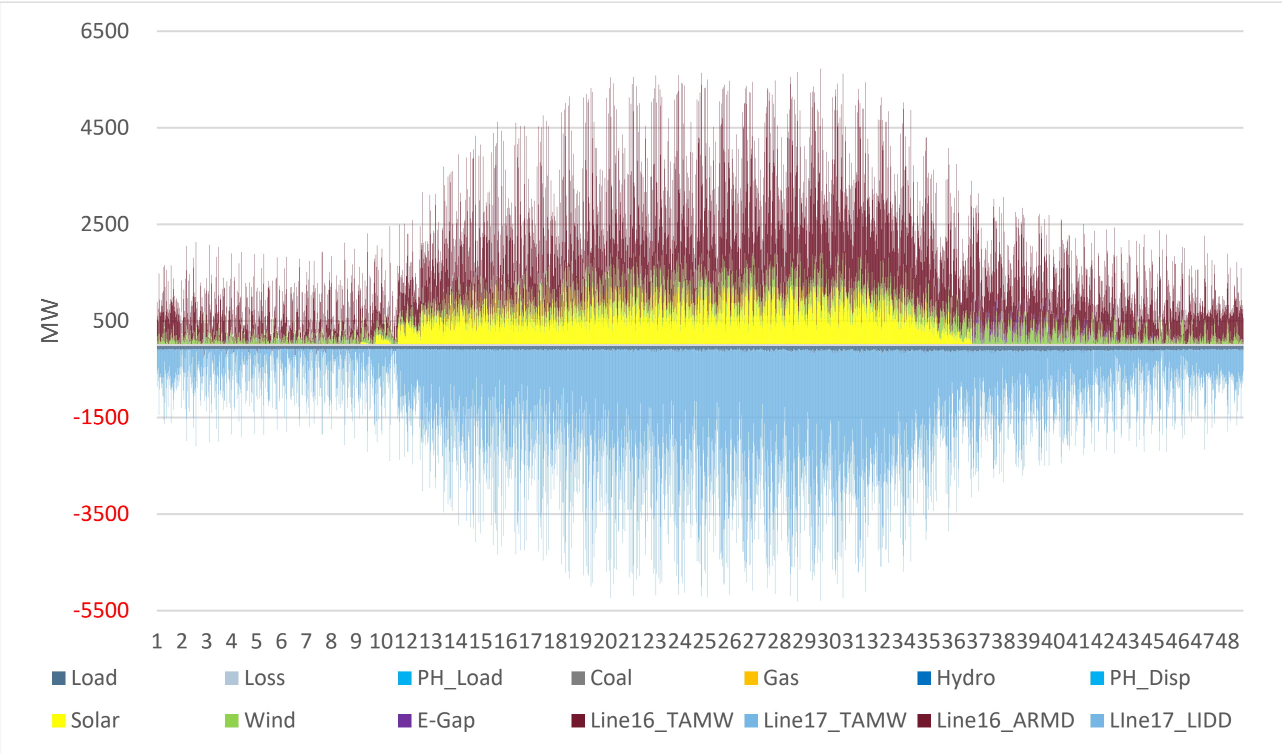

Figure 9: Tamworth energy flows for SummWD under sB (without QLD Pump Hydro)

[3] Source: AEMO Generation Information July 2020

Figure 9 provides detail on the flow of energy through TAMW node by time-of-day period by type of supply and demand for TAMW. Of note:

- the maroon coloured series indicates imports from ARMD and ultimately from QNI which are ongoing all day but increase during daylight hours
- the light blue coloured series indicates exports southwards towards Liddell and ultimately Newcastle and Sydney, which elevate significantly during sunlight hours reflecting the solar resource in both QLD, ARMD and TAMW
- there is little evidence of nodal load because demand is small (average of (101MW) in TAMW
- the green and yellow coloured series indicate solar and wind generation which is small relative to both the resource available for dispatch and the flows in and out of the node. Figures 11 and 12 provide further detail
- the purple coloured series indicates Energy-Gap (E-G). E-G in Tamworth is slightly smaller than that in Armidale at a maximum of 323MW but also occurs persistently during peak periods 37-43 for the same reasons as detailed in the Armidale section. Figure 10 provides detail

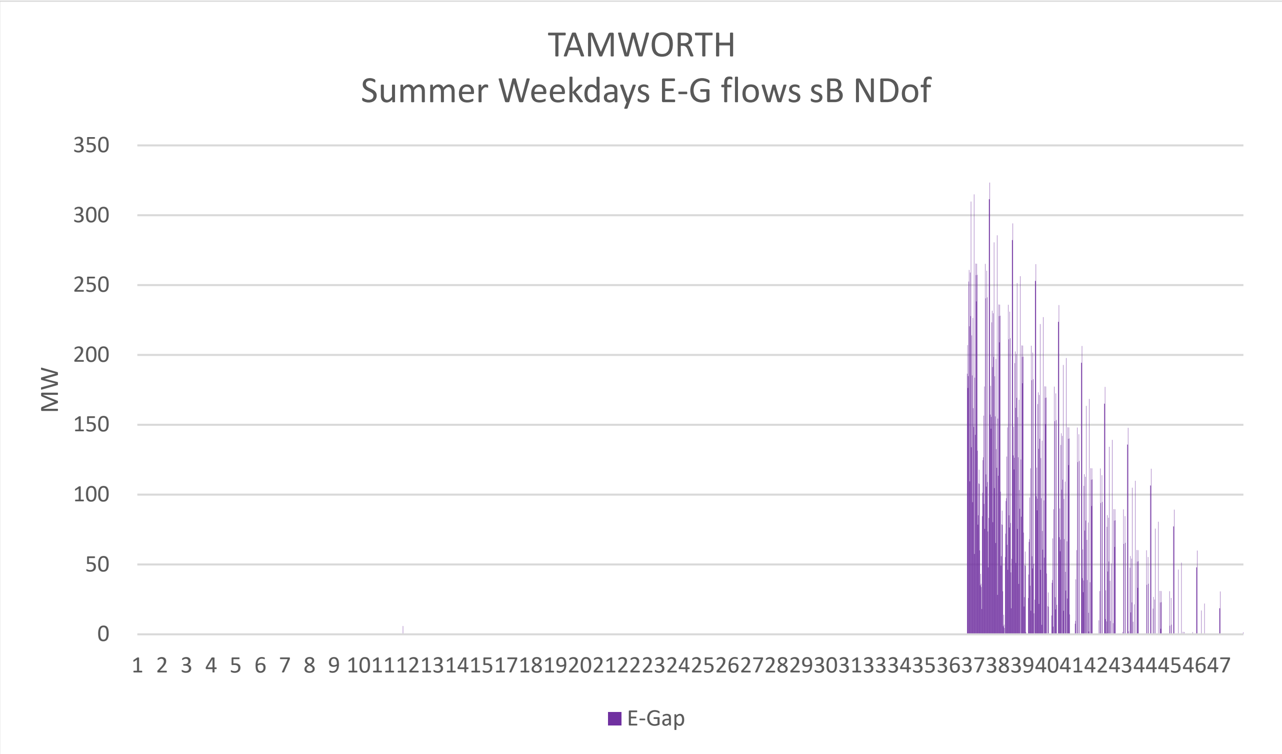

Figure 10: Tamworth energy gap for SummWD under sB (without QLD Pump Hydro)

Table 7 details statistics for Tamworth energy flows

Table 7: Tamworth salient statistics under sB (without QLD Pump Hydro)

TAMWORTH Statistics	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(146)	(118)	(101)	(181)	56%	(97)
Solar	535	192	371	1,207	31%	271
Wind	341	296	237	700	34%	206
E-G	20	60	14	323	4%	0
Exports (node)	(2,435)	(1,590)	(1,691)	(5,160)	33%	(1,435)
Imports (node)	1,827	1,246	1,268	3,989	32%	1,044
Solar_spill	174	2	121	968	13%	0
Wind_spill	50	7	34	548	6%	0
Solar spill %	25%	1%	25%	45%		
Wind spill %	13%	2%	13%	44%		

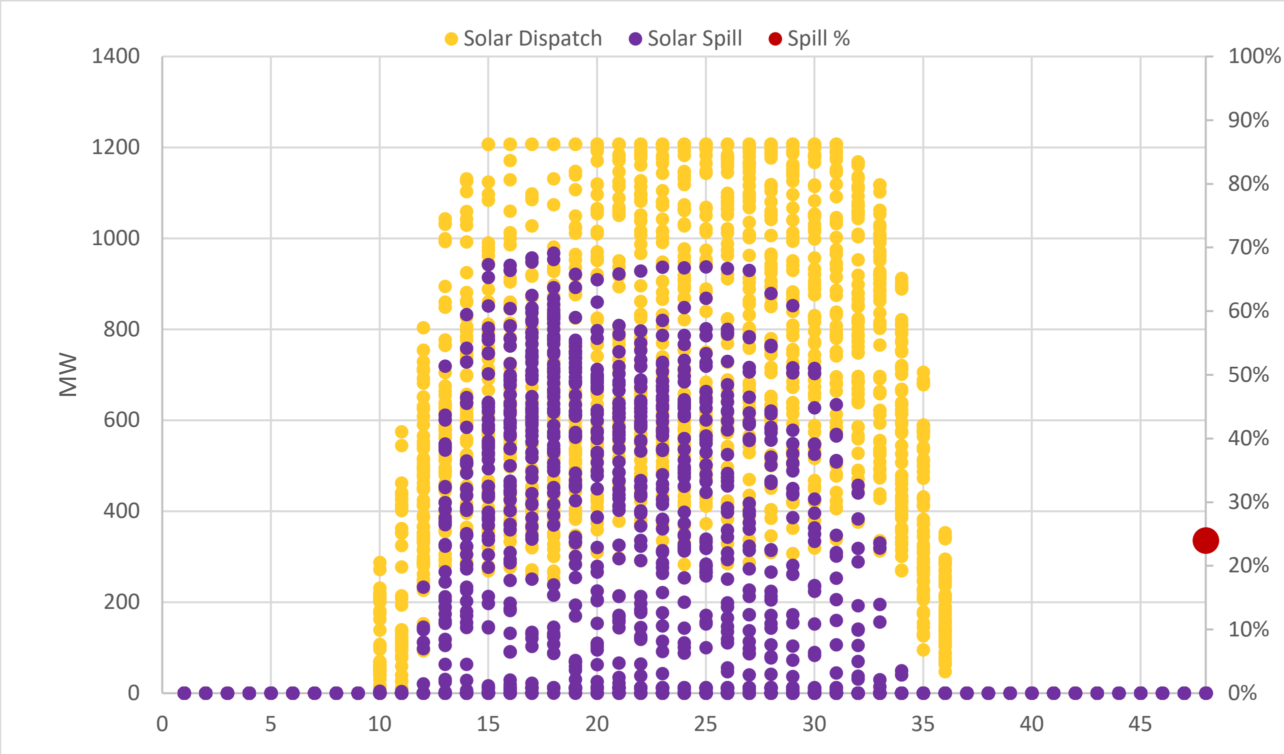

Figure 11: Tamworth solar dispatch and curtailment under sB (without QLD Pump Hydro)

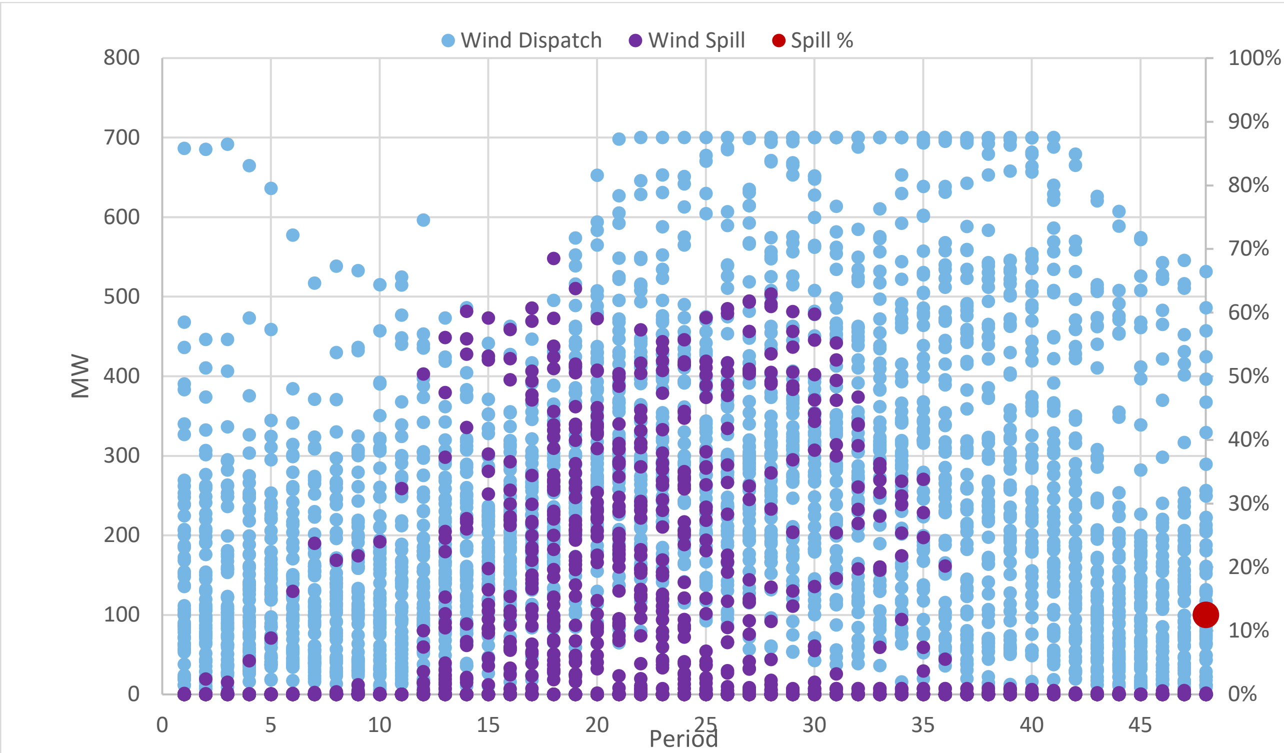

Figure 12: Tamworth wind dispatch and curtailment under sB (without QLD Pump Hydro)

6. LIDDELL details for summer weekdays

Table 8 summarises the generating capacity assumptions for Liddell (LIDD)

Table 8: Liddell capacity assumptions under sB (without QLD Pump Hydro)

LIDD Capacity assumptions	Current [4] (MW)	2030 (MW)	Notes
Coal	2000	-	Liddell scheduled to close
Gas	-	-	
Storage/Other/ E-G	-	-	
TOTAL	2000	-	

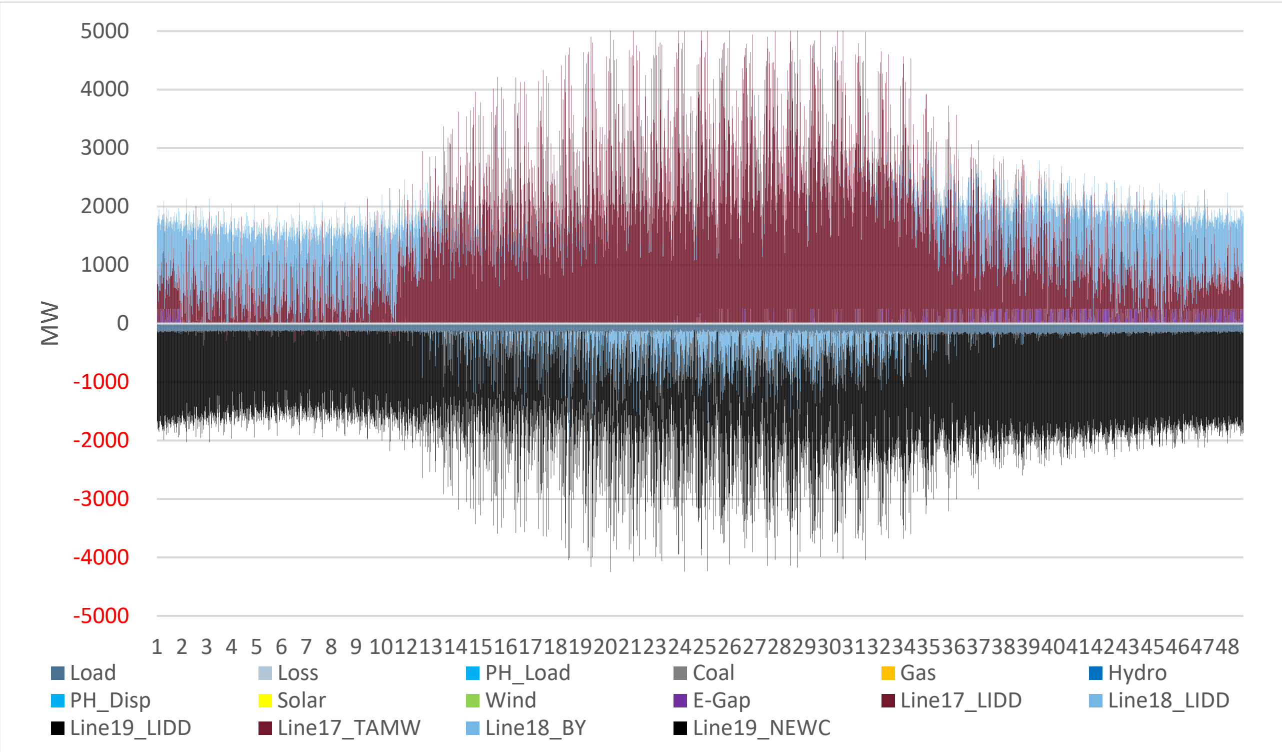

Figure 13: Liddell energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 13 provides detail on the flow of energy through LIDD node by time-of-day period by type of supply and demand for LIDD. Of note:

[4] Source: AEMO Generation Information July 2020

- the maroon coloured series indicates imports from TAMW, ARMD and ultimately from QNI primarily during daylight hours
- the light blue coloured series indicates imports, primarily overnight from evening peak through to morning peak from Bayswater, required for Newcastle load.
- the black coloured series indicates exports from LIDD southwards to Newcastle, which elevates during sunlight hours reflecting the solar resource in QLD, ARMD and TAMW
- there is little evidence of nodal load because demand is small (average of (149MW) in LIDD
- there is no E-G in the LIDD node, despite the closure of Liddell power station
- Table 9 details statistics for LIDD energy flows

Table 9: Liddell salient statistics under sB (without QLD Pump Hydro)

LIDDL Statistics	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(215)	(173)	(149)	(264)	57%	(144)
Solar						
Wind						
E-G	-	-	-	-	-	0
Exports (node)	(2,715)	(1,907)	(1,885)	(4,007)	47%	(1,715)
Imports (node)	3,171	2,160	2,202	5,160	43%	1,893

7. NEWCASTLE details for summer weekdays

Table 10 summarises generating capacity assumptions for Newcastle (NEWC)

Table 10: Newcastle capacity assumptions under sB (without QLD Pump Hydro)

NEWC Capacity assumptions		Current [5] (MW)	2030 (MW)	Notes
Coal	-	-	-	
Gas	-	-	-	
Storage/Other/ E-G	-	-	-	
TOTAL	-	-	-	Load only node

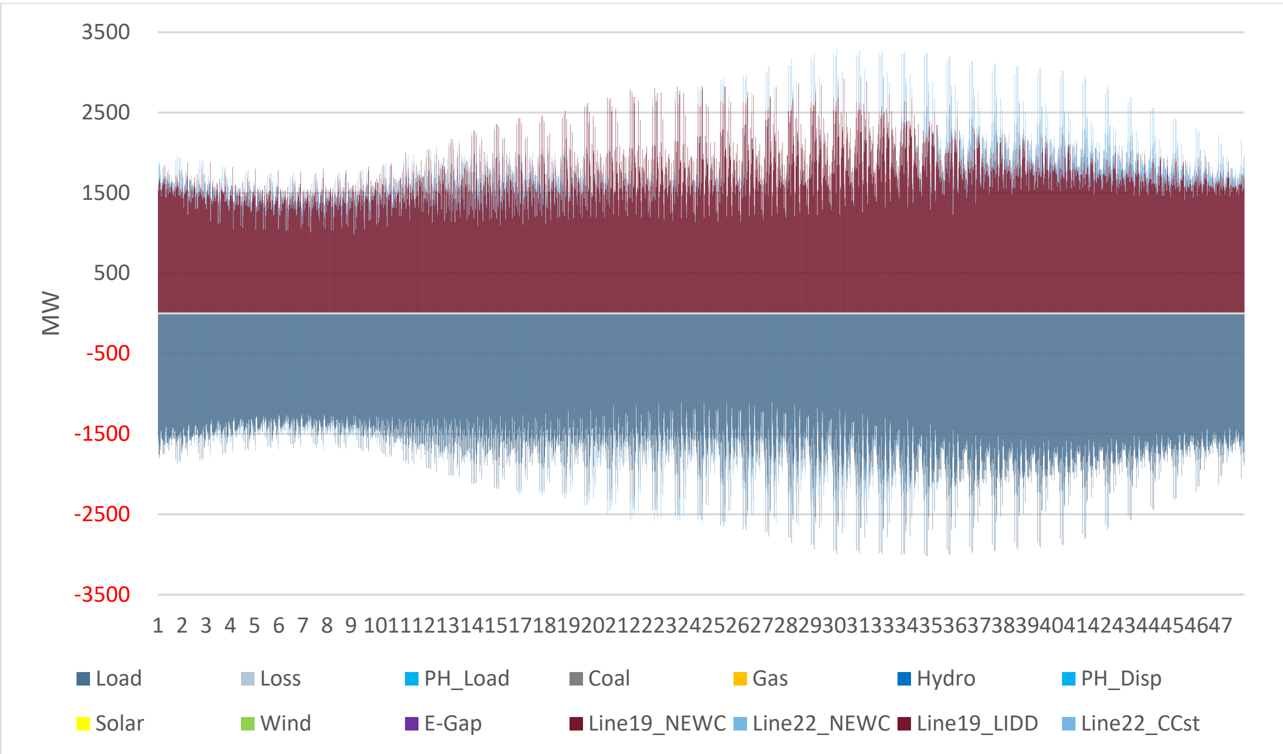

Figure 14: Newcastle energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 14 provides detail on the flow of energy through NEWC node by time-of-day period by type of supply and demand. Of note:

[5] Source: AEMO Generation Information July 2020

- NEWC has no local generation and is reliant on energy flows from LIDD
- the maroon coloured series indicates imports from LIDD, TAMW, ARMD and ultimately from QNI
- the light blue coloured series indicates imports from or to the Central Coast required to meet Newcastle load.
- the steel blue coloured series indicates NEWC load which averages 1,715MW
- there is no E-G in the NEWC node
- Table 11 details statistics for NEWC energy flows

Table 11: Newcastle salient statistics under sB (without QLD Pump Hydro)

NEWC Statistics	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(2,470)	(1,967)	(1,715)	(3,020)	57%	(1,654)
Solar						
Wind						
E-G	0	0	0	0	0%	0
Exports (node)	(31)	(11)	(21)	(400)	5%	0
Imports (node)	2,632	2,089	1,828	3,288	56%	1,752

8. CENTRAL COAST details for summer weekdays

Table 12 summarises generating capacity assumptions for Central Coast (CCST) node

Table 12: Central Coast capacity assumptions under sB (without QLD Pump Hydro)

CCST Capacity assumptions	Current [6] (MW)	2030 (MW)	Notes
Coal	4,200	-	Closures: Eraring (2,880MW) & Vales Point B (1,320MW)
Gas	766	1,448	Additions: Balancing OCGT (724MW) Capacity factor: 5%
Storage/Other/ E-G	-	1,923	E-G Capacity factor: 1% Incidences: EvPeak 38 (6%), ONight 4 (-%), Sunlight 10 (0.8%)
TOTAL	4,966	3,371	

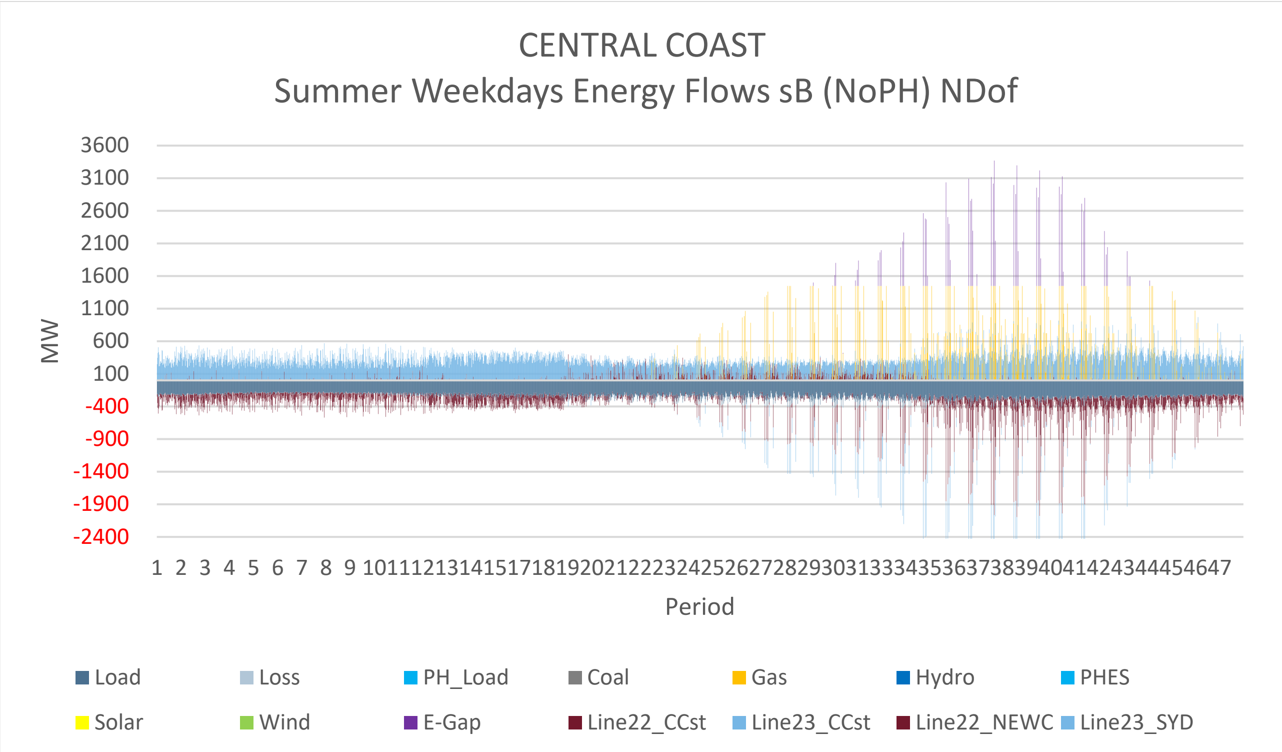

Figure 15: Central Coast energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 15 provides detail on the flow of energy through CCST node by time-of-day period by type of supply and demand. Of note:

[6] Source: AEMO Generation Information July 2020

- CCST hosts 2.88GW Eraring and Vales Point Power Stations which sB assumes will be closed by 2030. This has implications for meeting demand in Sydney during evening peak.
- the maroon coloured series indicates exports to NEWC to meet demand.
- the light blue coloured series indicates imports from Sydney throughout the day.or to the CCST required to meet NEWC load.
- the steel blue coloured series indicates CCST load which averages 244MW
- the gold coloured series indicates energy sourced from Colongra and another gas generator of the same capacity, assumed under sB (without QLD Pump Hydro), to balance NSW supply-demand.
- there is a significantly elevated E-G in the CCST node for 38 periods, primarily periods 32-42 on days 350, 357 and 364 which reflect extremely elevated demand over Christmas-New Year. The model predicts that CCST node will be incapable of importing adequate energy from NEWC-LIDD to meet exports required to service load in Sydney. This will result in very large E-Gs for approximately 17 hours. Figure 16 provides detail

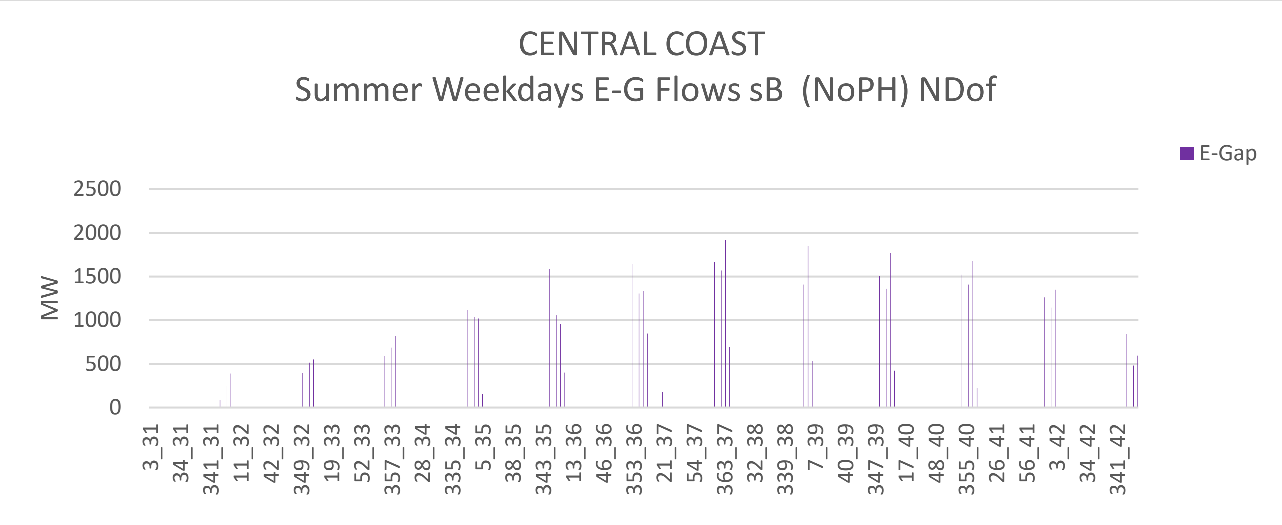

Figure 16: CCst energy-gap for SummWD under sB (without QLD Pump Hydro)

- Table 13 details statistics for CCST energy flows

Table 13: Central Coast salient statistics under sB (without QLD Pump Hydro)

CCST Statistics	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(351)	(285)	(244)	(440)	55%	(235)
Gas	114	237	79	1,448	5%	0
E-G	23	69	16	1,923	1%	0
Exports (node)	(205)	(285)	(142)	(2,846)	5%	(80)
Imports (node)	424	272	295	578	51%	297

9. BAYSWATER details for summer weekdays

Table 14 provides detail on generating capacity assumptions for Bayswater (BY) node

Table 14: Bayswater capacity assumptions under sB (without QLD Pump Hydro)

BY capacity assumptions	Current [7] (MW)	2030 (MW)	Notes
Coal	2665	2640	Capacity factor: 76%
Gas	50	50	Capacity factor: 2%
Storage/Other/ E-G	-	-	
TOTAL	2715	2690	

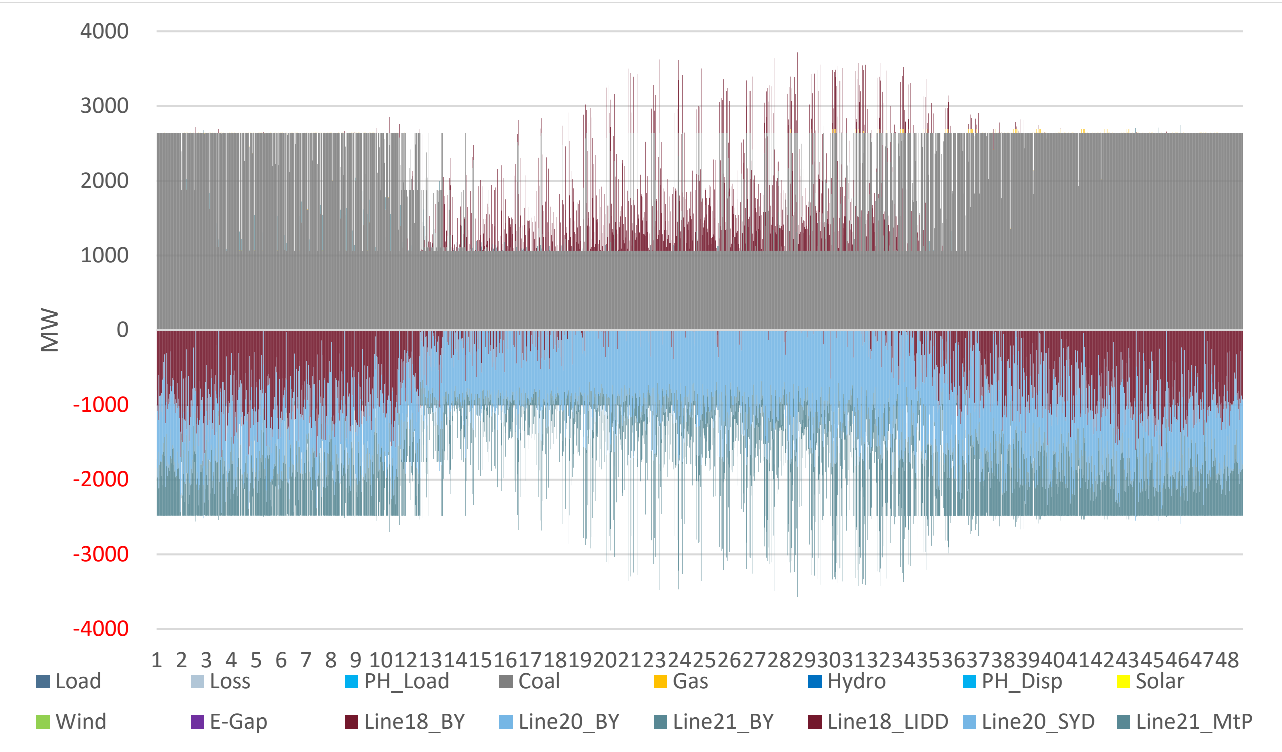

Figure 17: Bayswater energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 17 provides detail on the flow of energy through BY node by time-of-day period by type of supply and demand. Of note:

- BY node hosts 2.64GW Bayswater Power Station. The grey coloured series indicates Bayswater power station generation, which reduces significantly during sunlight hours.

[7] Source: AEMO Generation Information July 2020

- the maroon coloured series indicates imports from LIDD, TAMW, ARMD and ultimately QLD, primarily during sunlight hours, but with exports to LIDD after sundown and before sun-up, presumably to supply NEWC
- the light blue coloured series indicates exports to Sydney throughout the day
- the aqua-blue coloured series indicates exports to Mt Piper node, also to meet demand in Sydney
- there is no E-G in BY
- Table 15 details statistics for BY energy flows

Table 15: Bayswater salient statistics under sB (without QLD Pump Hydro)

BY Statistics	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	0	0	0	0	0%	0
Coal	2,873	2,449	1,995	2,640	76%	2,639
Gas	2	4	1	50	2%	0
E-G	0	0	0	0	0%	0
Exports (node)	(2,966)	(2,347)	(2,060)	(3,408)	60%	(2,481)
Imports (node)	265	41	184	1,849	10%	0

10. SYDNEY details for summer weekdays

Table 16 provides a summary of generating capacity assumptions for Sydney (SYD) node

Table 16: Sydney capacity assumptions under sB (without QLD Pump Hydro)

Sydney capacity assumptions	Current [8] (MW)	2030 (MW)	Notes
Gas	185	176	Capacity factor: 49%
Storage/Other/ E-G	-	-	
TOTAL	185	176	

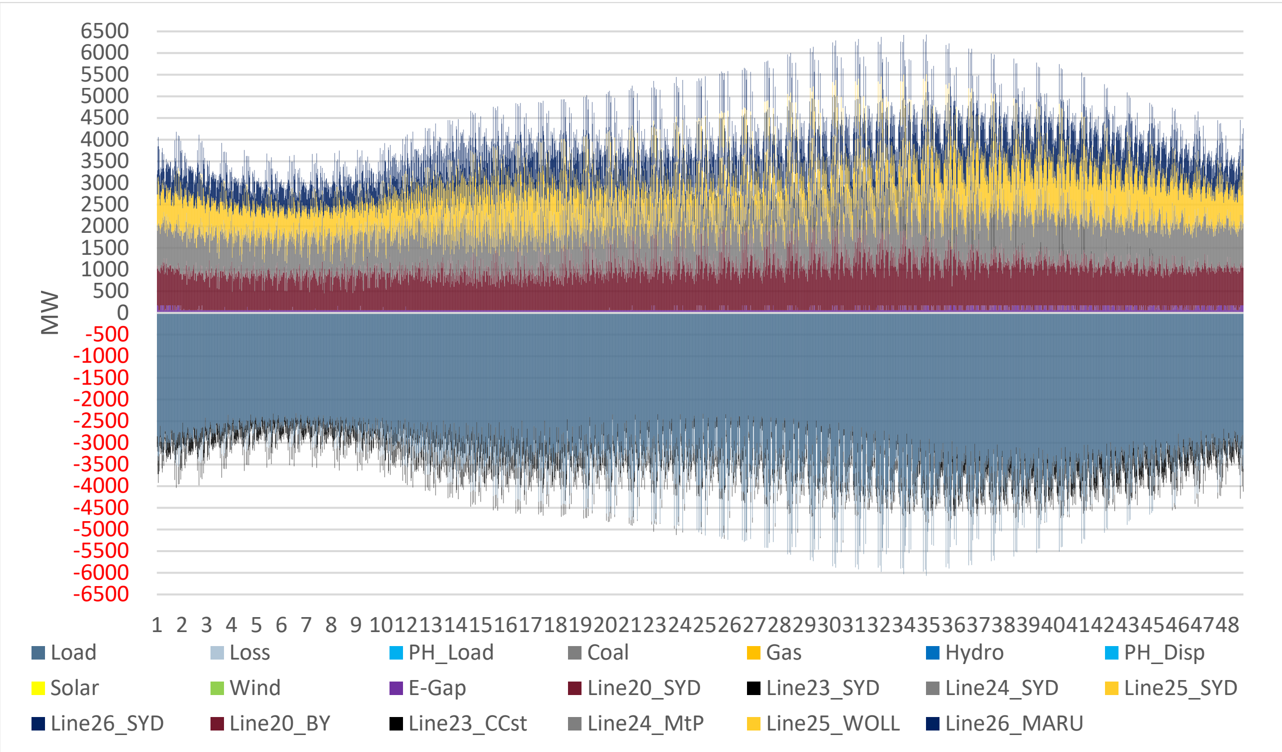

Figure 18: Sydney energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 18 provides detail on the flow of energy through SYD node by time-of-day period by type of supply and demand. Of note:

- the maroon coloured series indicates imports from BY

[8] Source: AEMO Generation Information July 2020

- the grey coloured series indicates imports from Mt Piper
- the dark-blue coloured series indicates imports from Marulan node, where there is significant wind and solar capacity
- the steel-blue coloured series indicates SYD load
- the gold coloured series indicates Smithfield generation
- the black coloured series indicates exports to CCST and presumably NEWC
- there is no E-G in SYD
- Table 17 details statistics for SYD energy flows

Table 17: Salient statistics under sB (without QLD Pump Hydro)

SYDStatistics	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(4,883)	(3,952)	(3,391)	(6,071)	56%	(3,287)
Gas	124	117	86	176	49%	62
E-G	0	0	0	0	0%	0
Exports (node)	(394)	(261)	(273)	(578)	47%	(284)
Imports (node)	5,350	4,268	3,716	6,250	59%	3,641

11. MT PIPER details for summer weekdays

Table 18 provides a summary of generating capacity assumptions for Mt Piper (MtP) node

Table 18: Mt Piper capacity assumptions under sB (without QLD Pump Hydro)

MtP Capacity assumptions	Current [9] (MW)	2030 (MW)	Notes
Coal	1,320	1,400	Capacity factor: 62%
Solar		120	Capacity factor: 42%
Wind		143	Capacity factor: 36%
Storage/Other/ E-G		-	
TOTAL	1,320	1,663	

Table 19: Mt Piper salient statistics under sB (without QLD Pump Hydro)

MtP Statistics	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(170)	(137)	(118)	(204)	58%	(114)
Coal	1,249	1,067	867	1,400	62%	557
Solar	73	21	50	120	42%	31
Wind	73	51	51	143	36%	45
E-G	0	0	0	0	11%	0
Exports (node)	(2,929)	(2,198)	(2,034)	(4,475)	45%	(1,935)
Imports (node)	1,828	1,293	1,269	3,467	37%	1,087
Solar spill	1,249	1,067	867	1,400	62%	557

Tables 18 and 19 provide detail on the capacity assumptions and flow of energy through MtP node. Of note:

- MtP node hosts Mt Piper 1.4GW coal generator

[9] Source: AEMO Generation Information July 2020

- Solar and wind generation in the node is assumed to be relatively modest at 120MW and 143MW respectively
- Energy is imported into MtP node from:
    - Wellington node which is assumed to host a large 1.6GW wind capacity by 2030, and
    - BY node which hosts Bayswater coal-fired power station
- Energy is exported from MtP node to SYD and Marulan node in roughly equal measures. Marulan in turn exports to Wollongong, as is discussed in the Wollongong sub-section below
- there is negligible E-G in MtP

12. WOLLONGONG details for summer weekdays

Table 20 provides a summary of generating capacity assumptions for Wollongong (WOLL) node

Table 20: Wollongong capacity assumptions under sB (without QLD Pump Hydro)

WOLL capacity assumptions	Current [10] (MW)	2030 (MW)	Notes
Gas	440	460	Capacity factor: 53%
PHES	240	240	Capacity factor: 14%
Storage/Other/ E-G		240	Capacity factor: 26% Incidences: EvPeak 50 (8%); ONight 936 (87%); Sunlight: 95 (8%)
TOTAL	680	940	

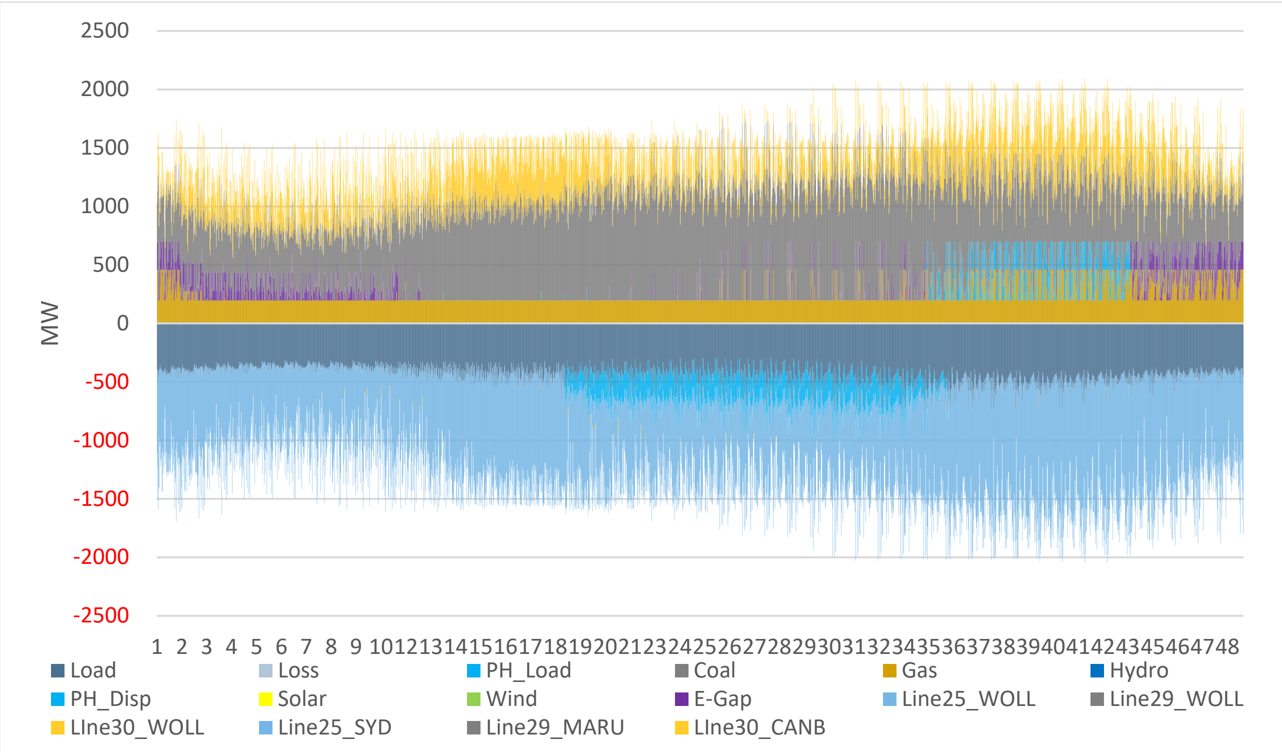

Figure 19: Wollongong energy flows fro SummWD under sB (without QLD Pump Hydro)

Figure 19 provides detail on the flow of energy through WOLL node by time-of-day period by type of supply and demand. Of note:

[10] Source: AEMO Generation Information July 2020

- the grey coloured series indicates imports from Marulan node (which is assumed to host 1.6GW of wind generation)
- the gold coloured series indicates imports from Canberra (which is assumed to host 821MW of wind and 133MW of solar generation)
- the light blue coloured series indicates exports to SYD
- the steel-blue coloured series indicates WOLL load
- the dark gold coloured series indicates Tallawarra GT generation
- the cyan coloured series indicates Shoalhaven pump hydro load (if negative) and dispatch (if positive)
- an E-G appears in WOLL node after evening peak until morning peak and sporadically during the day, and reflects dispatch from Shoalhaven (240MW) which is outside of the dispatch strategy and assumed to be E-G because dispatch is only possible at high spot price. The associated reason for classifying this dispatch as E-G, is because all-night dispatch would deplete potential for dispatch during morning and evening peak. However, it is apparent that there is a significantly large requirement for supply overnight (due to the lack of solar energy, and unreliable generation from wind) in addition to evening peak. This implies a greater requirement for storage to meet demand overnight. (New version of ANEM, which pumps based on VRE resource and dispatches based on storage, will provide greater clarity with respect to real E-G). Figure 20 shows detail

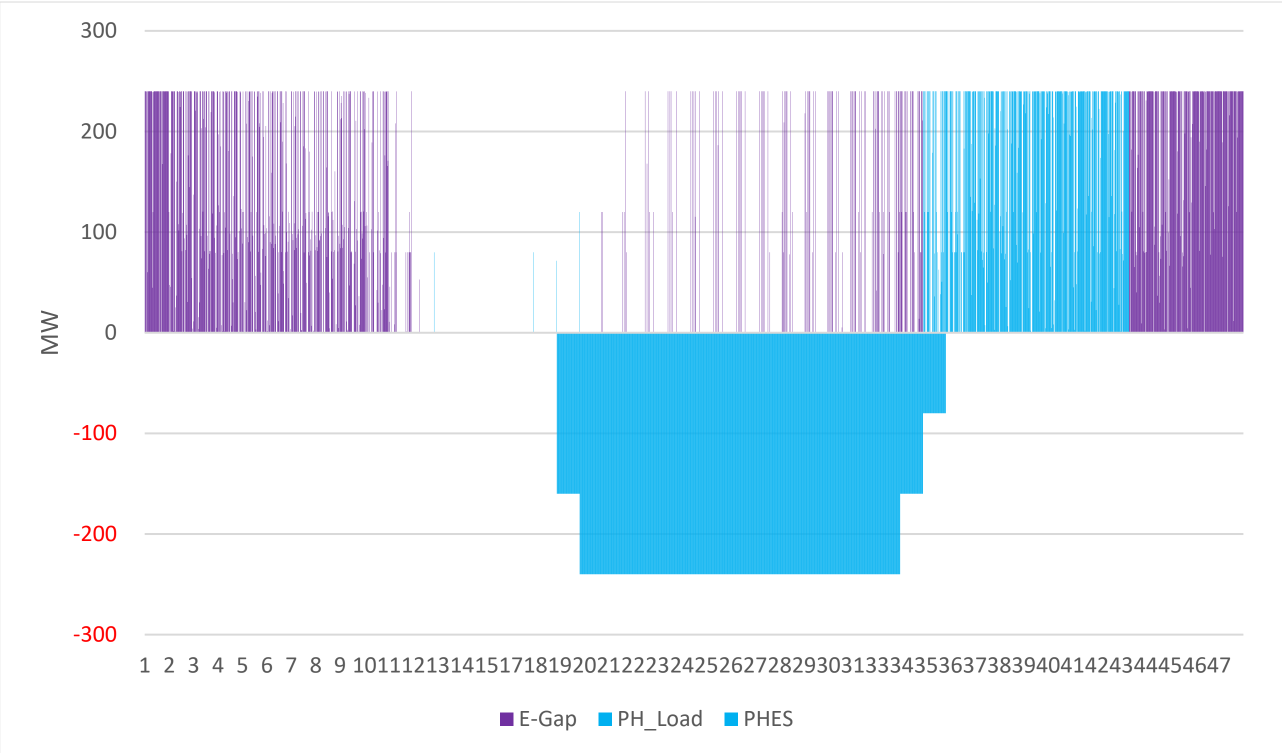

Figure 20: Wollongong energy-gap for SummWD under sB (without QLD Pump Hydro)

- Table 21 details statistics for WOLL energy flows

Table 21: Wollongong salient statistics under sB (without QLD Pump Hydro)

WOLL Statistics	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(641)	(513)	(445)	(760)	59%	(430)
PH Load	(113)	(48)	(78)	(240)	33%	0
Gas	348	289	242	460	53%	196
PHES	48	141	34	240	14%	0
E-G	88	17	61	240	26%	0
Exports (node)	(1,231)	(1,037)	(855)	(1,462)	58%	(835)
Imports (node)	1,544	1,189	1,072	1,488	72%	1,130
PH_spill	67	51	46	240	19%	0

13. TUMUT details for summer weekdays

Table 22 summarises generating capacity assumptions for Tumut (TUM) node

Table 22: Tumut capacity assumptions under sB (without QLD Pump Hydro)

TUM Capacity assumptions	Current [11] (MW)	2030 (MW)	Notes
Hydro	1,669	1,596	Capacity factor: 8%
PHES	616	2,940	Capacity factor: 8%
Storage/Other/ E-G		1,700	Capacity factor: 16% Incidences: EvPeak 28 (5%), ONight 950 (88%), Sunlight 46 (4%)
TOTAL	2,949	6,900	

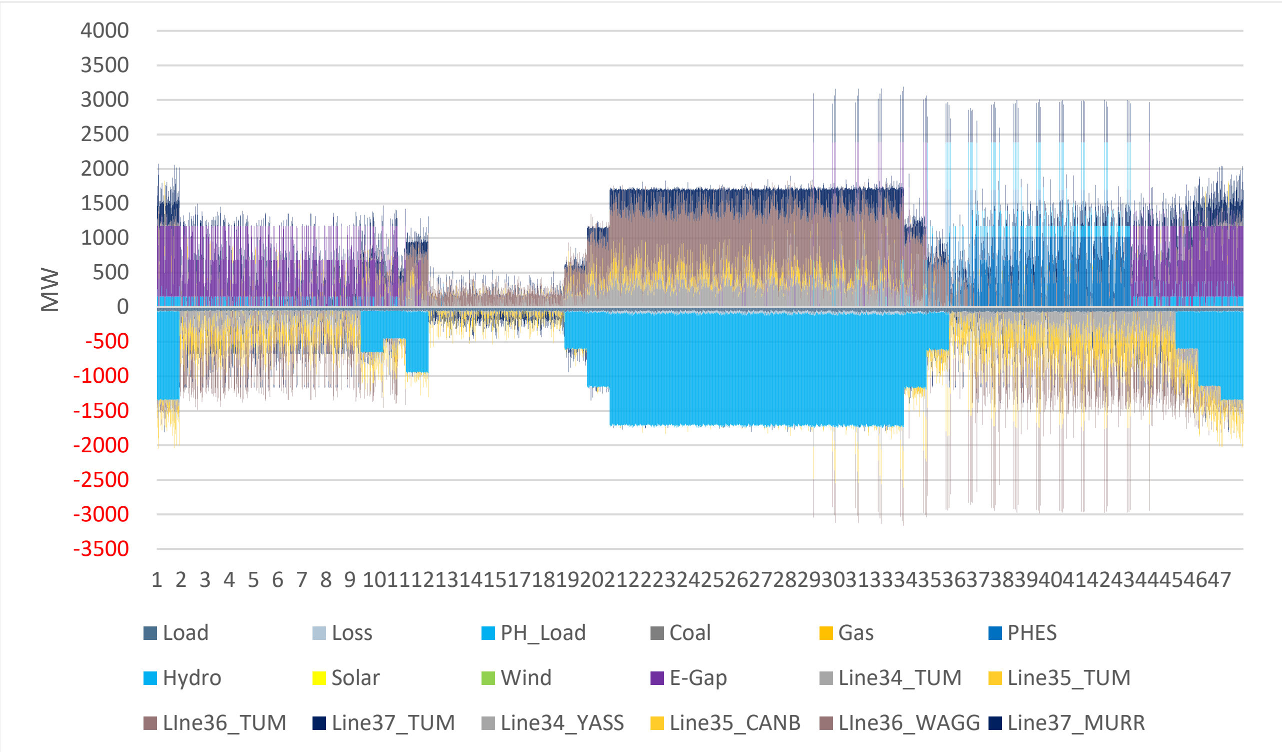

Figure 21: Tumut energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 21 provides detail on the flow of energy through TUM node by time-of-day period by type of supply and demand. Of note:

- the grey coloured series indicates imports and exports between TUM and Yass nodes, representing modest flows of energy between the nodes

[11] Source: AEMO Generation Information July 2020

- the light brown coloured series indicates imports and exports between TUM and Wagga nodes. Imports from Wagga result from assumed significant solar generation of 2GW in Wagga node. Significantly elevated exports to Wagga, correspond with periods 42-42 on days 350, 357 and 364, assumed to be Christmas-New Year elevated demand. The energy exported from TUM to Wagga is thereafter exported to VIC.
- the navy-blue coloured series indicates imports/exports from/to Murray node in VIC
- gold coloured series indicates exports to Canberra primarily for evening peak
- the cyan coloured series indicates Tumut 3 and Snowy 2.0 pump hydro load (if negative) and dispatch (if positive)
- a persistent E-G is apparent in TUM node after evening peak and before morning peak, and reflects dispatch from Tumut 3 (900MW) and Snowy 2.0 (2040MW) which is outside of the dispatch strategy and assumed to be E-G because dispatch is only possible at high spot price. The associated reason for classifying this dispatch as E-G, is because all-night dispatch would deplete potential for dispatch during morning and evening peak. However, it is apparent that there is a significantly large requirement for supply overnight (due to the lack of solar energy, and unreliable generation from wind) and sporadically during the day in addition to evening peak. This implies a greater requirement for storage to meet demand overnight. (New version of ANEM, which pumps based on VRE resource and dispatches based on storage, will provide greater clarity with respect to real E-G). Figure 22 shows detail

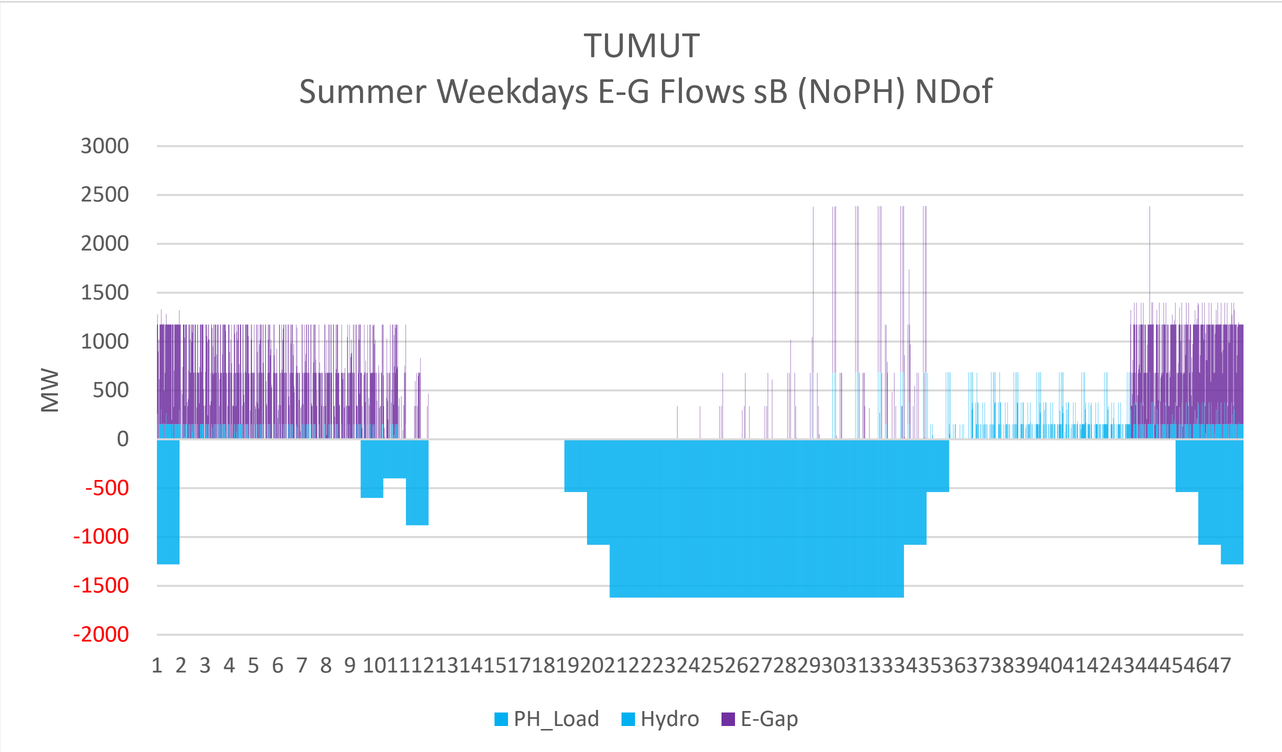

Figure 22: Tumut energy-gap for SummWD under sB (without QLD Pump Hydro)

- Table 23 details statistics for Tumut energy flows

Table 23: Tumut salient statistics under sB (without QLD Pump Hydro)

TUM Statistics	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(86)	(70)	(60)	(106)	56%	(58)
PH Load	(911)	(324)	(633)	(1,620)	39%	(200)
Hydro	78	107	54	686	8%	0
PHES	192	554	133	1,700	8%	0
E-G	383	41	266	1,700	16%	0
Exports (node)	(637)	(778)	(442)	(2,881)	15%	(210)
Imports (node)	1,004	484	697	1,904	37%	370

14. WELLINGTON details for summer weekdays

Table 24 summarises generating capacity assumptions for Wellington (WELL) node

Table 24: Wellington capacity assumptions under sB (without QLD Pump Hydro)

WELL capacity assumptions	Current [12] (MW)	2030 (MW)	Notes
Solar	301	1,659	Capacity factor: 26% Curtailment: 39%, Max curtailment 1398MW
Wind	113	1,621	Capacity factor: 33% Curtailment: 14%, Max curtailment 1164MW
Storage/Other/ E-G	-	7	Capacity factor: 0%
TOTAL	414	3,287	

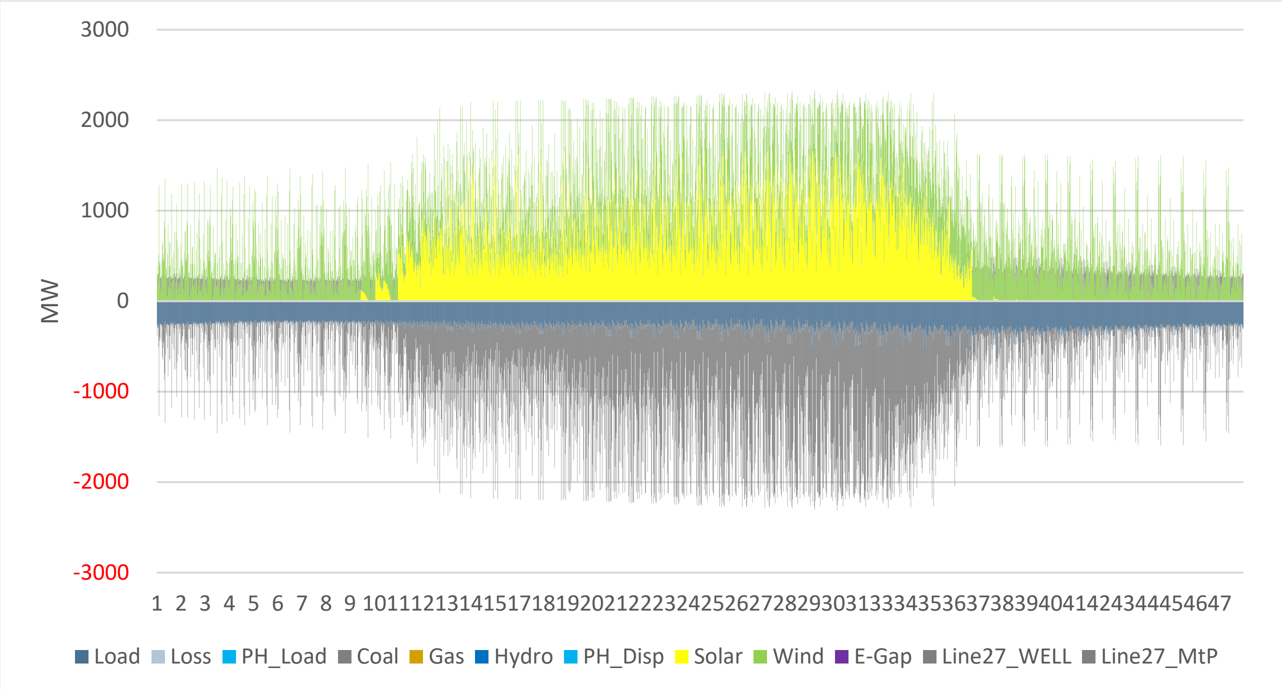

Figure 23: Wellington energy flows for Summer WD under sB (without QLD Pump Hydro)

Figure 23 provides detail on the flow of energy through WELL node by time-of-day period by type of supply and demand. Of note:

[12] Source: AEMO Generation Information July 2020

- the grey coloured series indicates exports to MtP node and ultimately to SYD
- the steel-blue coloured series indicates load in WELL
- light green and yellow coloured series indicate dispatch from wind (1,621MW) and solar (1,659MW). Solar dispatch is considerably lower than available resource indicating the over-supply of wind within WELL node but also wind, solar and coal across the NEM during the day. See dispatch and curtailment details in Figures 24 and 25
- E-G in WELL node is negligible
- Table 25 details statistics for WELL energy flows

Table 25: Wellington salient statistics under sB (without QLD Pump Hydro)

WELL Statistics	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(413)	(335)	(287)	(504)	57%	(276)
Solar	624	314	433	1,659	26%	328
Wind	779	623	541	1,621	33%	503
E-G	0	0	0	7	0%	0
Exports (node)	(1,004)	(615)	(698)	(1,830)	38%	(608)
Imports (node)	29	23	20	384	5%	0
Solar_spill	404	14	280	1,398	20%	0
Wind_spill	125	15	87	1,164	7%	0
Solar spill %	39%	4%	39%	46%		
Wind spill %	14%	2%	14%	42%		

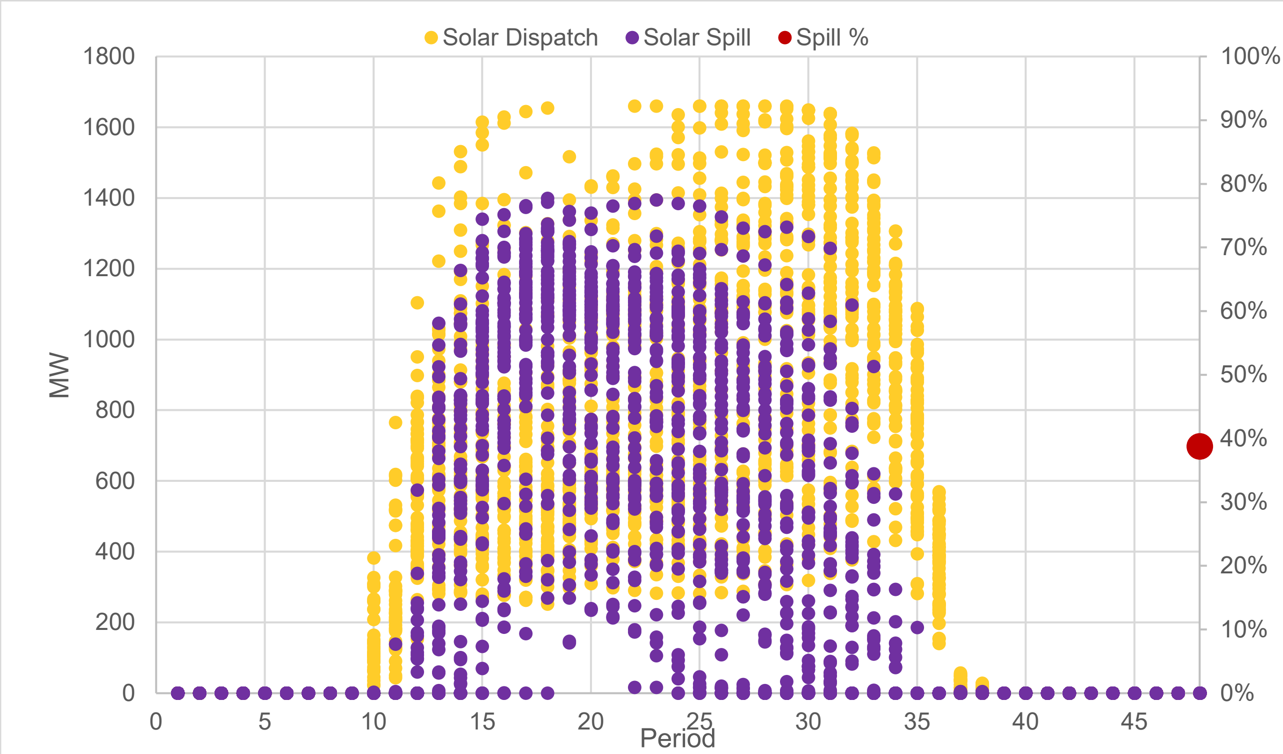

Figure 24: Wellington solar dispatch and curtailment under sB (without QLD Pump Hydro)

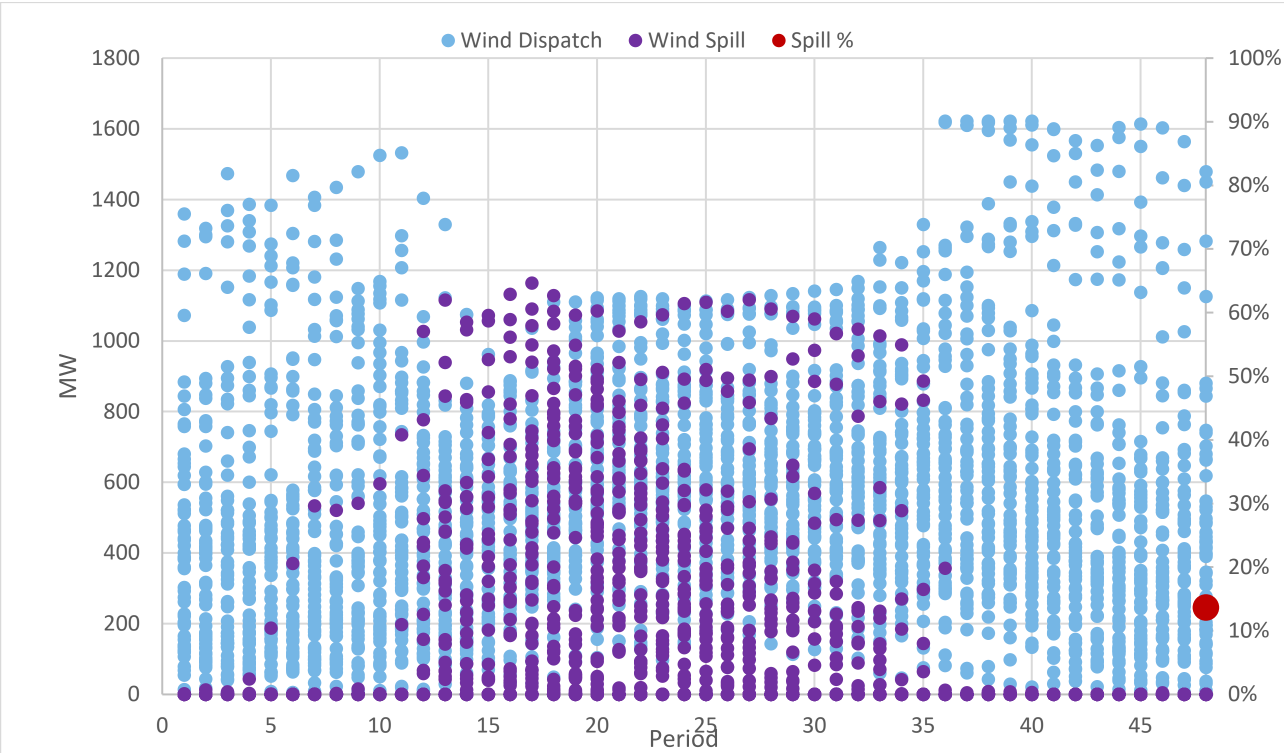

Figure 25: Wellington wind dispatch and curtailment under sB (without QLD Pump Hydro)

15. WAGGA details for summer weekdays

Table 26 provides a summary of generating capacity assumptions for Wagga (WAGG) node

Table 26: Wagga capacity assumptions under sB (without QLD Pump Hydro)

WAGG Capacity assumptions	Current [13] (MW)	2030 (MW)	Notes
Gas	664	664	Capacity factor: 12%
Solar	343	2,049	Capacity factor: 21% Curtailment: 55%, Max curtailment 2070MW
Storage/Other/ E-G	-	174	Capacity factor: 0% Incidences: EvPeak 90 (15%), ONight 44 (4%), Sunlight 48 (4%)
TOTAL	343	2,223	

[13] Source: AEMO Generation Information July 2020

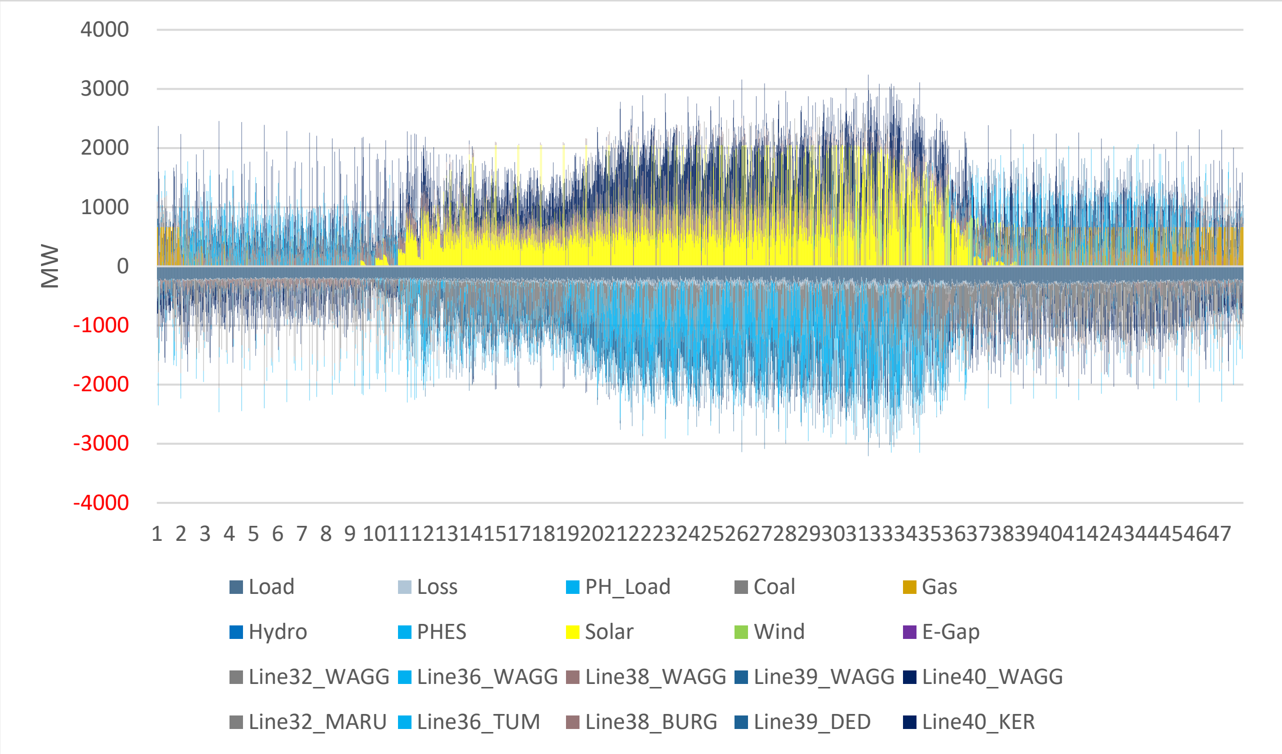

Figure 26: Wagga energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 26 provides detail on the flow of energy through WAGG node by time-of-day period by type of supply and demand. Of note:

- the navy blue coloured series indicates imports/exports between WAGG and Kerang node in VIC
- the royal blue coloured series indicates imports/exports (primarily exports) between WAGG and Dederang in VIC
- the cyan coloured series indicates imports/exports between WAGG and TUM node
- the light brown coloured series indicates imports/exports between WAGG and Buronga, where 450MW of solar generation is assumed to be located by 2030
- the yellow coloured series indicates dispatch from solar (2,049MW). Solar dispatch is considerably lower than available resource indicating the over-supply of wind, solar and coal across the NEM during the day. See dispatch and curtailment details in Figure 28
- E-G in Wagga node is small. There are 8 periods when an E-G greater than 20MW occurs. During these periods (during the same period on consecutive days), energy flows reverse from imports from Kerang in VIC to exports to Kerang in VIC. Figure 27 shows detail

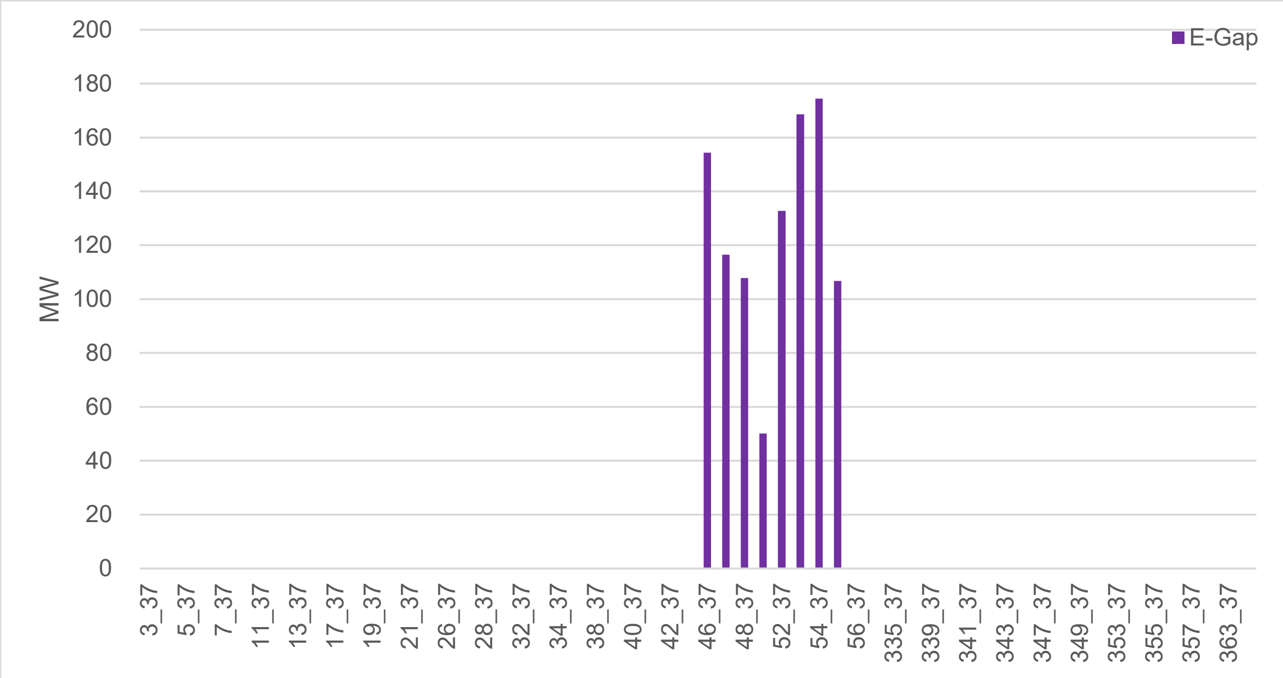

Figure 27: Wagga energy-gap for SummWD under sB (without QLD Pump Hydro)

- Table 27 details statistics for Wagga energy flows

Table 27: Wagga salient statistics under sB (without QLD Pump Hydro)

WAGGA	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(364)	(294)	(253)	(448)	56%	(243)
Gas	111	118	77	664	12%	0
Solar	608	372	423	2,049	21%	157
E-G	1	2	0	174	0%	0
Exports (node)	(1,575)	(1,087)	(1,094)	(2,852)	38%	(1,026)
Imports (node)	1,263	921	877	2,707	32%	806
Solar spill	730	151	507	2,070	24%	0
Solar spill %	55%	29%	55%	50%		

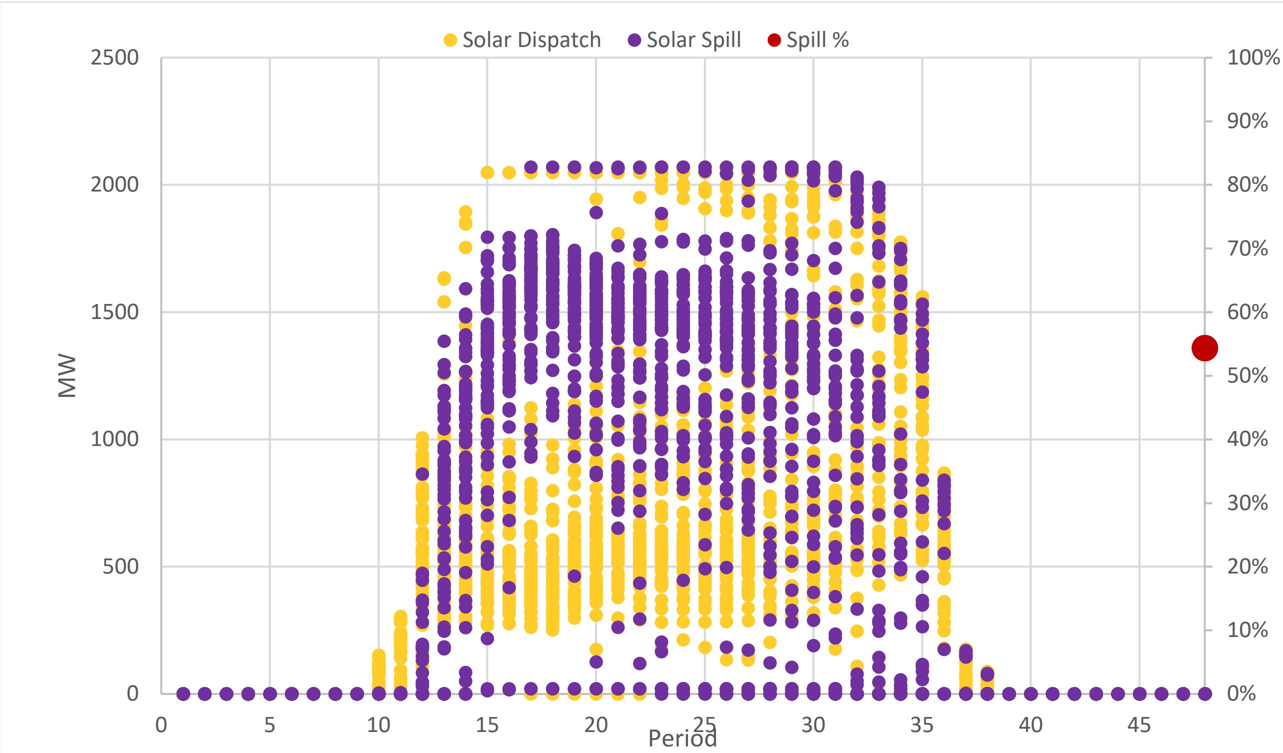

Figure 28: Wagga solar dispatch and curtailment under sB (without QLD Pump Hydro)

16. BURONGA details for summer weekdays

Table 28 provides a summary of generating capacity assumptions for Buronga (BURG) node

Table 28: Buronga capacity assumptions under sB (without QLD Pump Hydro)

BURG Capacity assumptions	Current [14] (MW)	2030 (MW)	Notes
Solar	29	450	CF (full year) 28%, (SummWD) 35% Curtail (full year) 14%, (SummWD) 23%
Storage/E-G		-	Capacity factor: 0%
TOTAL	29	450	

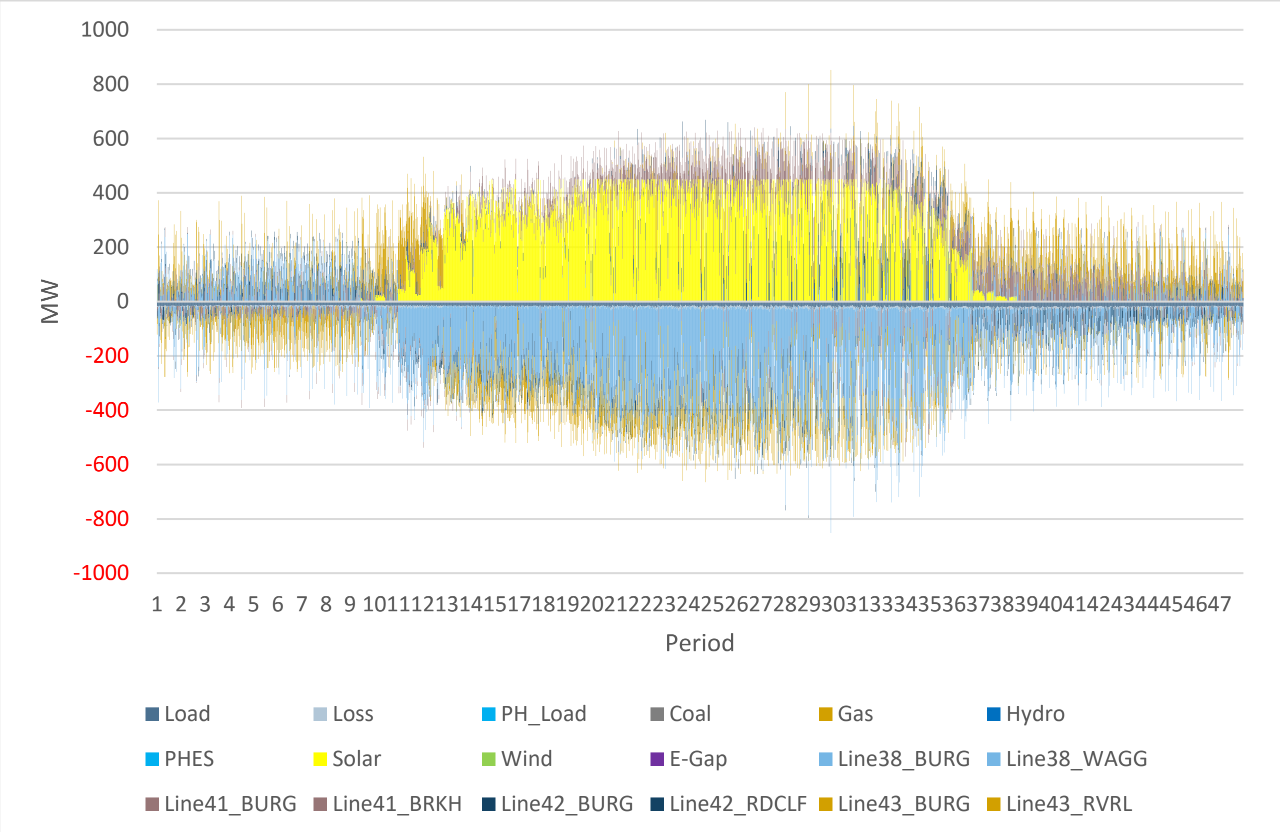

Figure 29: Buronga energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 29 provides detail on the flow of energy through BURG node by time-of-day period by type of supply and demand. Of note:

- the navy blue coloured series indicates imports/exports between BURG and Red Cliffs (VIC) nodes, where 1000MW is assumed to be located by 2030

[14] Source: AEMO Generation Information July 2020

- the light blue coloured series indicates imports/exports (primarily exports) between BURG and WAGG nodes, where 2049MW of solar generation is assumed to be located by 2030
- the light brown coloured series indicates imports/exports between BURG and Broken Hill, where 53MW of solar generation and 199MW of wind generation is assumed to be located by 2030
- the dark gold coloured series indicates imports/exports between BURG and Riverlands (SA), where 1230MW of solar generation is assumed to be located by 2030
- the yellow coloured series indicates dispatch from solar (450MW). Potential solar resource in BURG is very high during summer (46% CF) compared to 19% CF during winter, and 33% over the full year. 24% of solar dispatch is curtailed from potential resource indicating the over-supply of energy across the NEM during the day.
- There is negligible E-G in BURG node.

17. CONCLUDING OBSERVATIONS on NSW nodal supply-demand balance

Curtailment of both wind and solar at WELL and solar at WAGG and BURG, are surprising given the ISP-based transmission augmentations of Energy Connect, Humelink and KerangLink are factored in to the modelling and both nodes are within favoured renewable zones (REZ) supported by the NSW government. The modelling outcomes imply that additional coal closures and/or storage will be needed to uplift the maximum capacity of the VRE resources in the REZ nodes.

3. VICTORIA: Nodal Supply-Demand Balance for Summer Weekdays in 2030

a) Pipeline Scenario B (without Queensland Pump Hydro)

i. VIC Underlying assumptions

- N transmission network
- Direction of Flow loss method estimation
- Coal power in 2030 will decline to 3,144MW in VIC from 4,775MW currently (NSW 4,040MW from 10,210MW; QLD 4,839MW from 8,059MW)
- Coal unit closures by 2030 include:
  - QLD: Units 1-2 Callide B; Units 1-2 Stanwell; Units 1-2,5-6 Gladstone; Units 1-2 Tarong;
  - NSW: Units 1-4 Liddell; Units 1-4 Eraring; Units 5-6 Vales Point
  - VIC: Units 1-4 Yallourn
- Gas power in 2030 will decline slightly to 2,364MW in VIC from 2,477MW currently (QLD 2,691MW from 3,076MW with closure of Swanbank E; NSW 1,174MW from 2,155MW)
- There is no pump hydro (PHES) in 2030 in VIC (NSW 3,180MW; QLD 820MW; SA 610MW)
- Wind power in 2030 will reach 8,470MW in VIC (NSW 5,671MW; QLD 4,820MW; SA 3,652MW; TAS 2,302MW)
- Solar power in 2030 will reach 2,141MW in VIC (NSW 8,021MW; QLD 8,736MW; SA 4,213MW)
- A summary of generation capacity assumptions is provided in Table 29
- Transmission augmentation assumed for:
  - QNI to 5436MW
  - corridor from Armidale to Newcastle and Sydney to accommodate 5+GW of energy flows
  - Energy Connect from NSW to VIC and SA
  - Kerang-Link in Victoria
  - Battery of the Nation augmentation VIC to TAS

Table 29: VIC capacity assumptions under sB (without QLD Pump Hydro)

VIC Capacity assumptions	Current [15] (MW)	2030 (MW)	Notes
Coal	4,775	3,144	Closures: Yallourn 1450MW Capacity factor: 75% (full year); 79% (Summ WD)
Gas	2,477	2,364	Closures: No Capacity factor: 7% (full year); 6% (Summ WD)
Hydro	2,292	2,316	Closures: No Capacity factor: 10% (full year); 9% (Summ WD)
Solar	478	2,141	Capacity factor: 26% (full year); 34% (Summ WD) Curtailment: 24%, Max curtailment 1725MW
Wind	2,693	8,470	Capacity factor: 25% (full year); 21% (Summ WD) Curtailment: 15%, Max curtailment 5,431MW
Storage/Other	115	406	Capacity factor: 0% (full year); 0% (SummWD)
TOTAL	12,830	18,840	

[15] Source: AEMO Generation Information July 2020

ii. VIC modelling outcomes for Summer Weekdays in 2030

1. VIC Fuel share (Summer Weekdays)

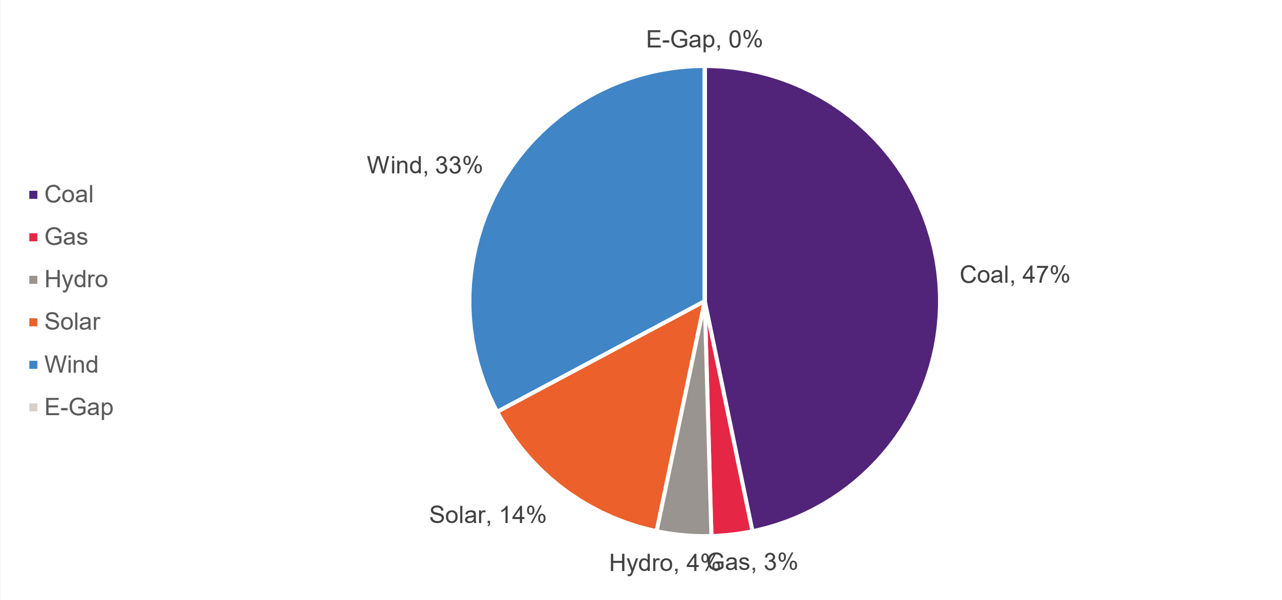

Figure 30: VIC fuel share during SummerWD under sB (without QLD Pump Hydro)

Modelling outcomes predict that 47% of electricity generated in VIC in 2030 should be sourced from coal, 33% from wind, 14% from solar, 4% from hydro, and 3% from gas as shown in Figure 30. E-G is shown to be negligible.

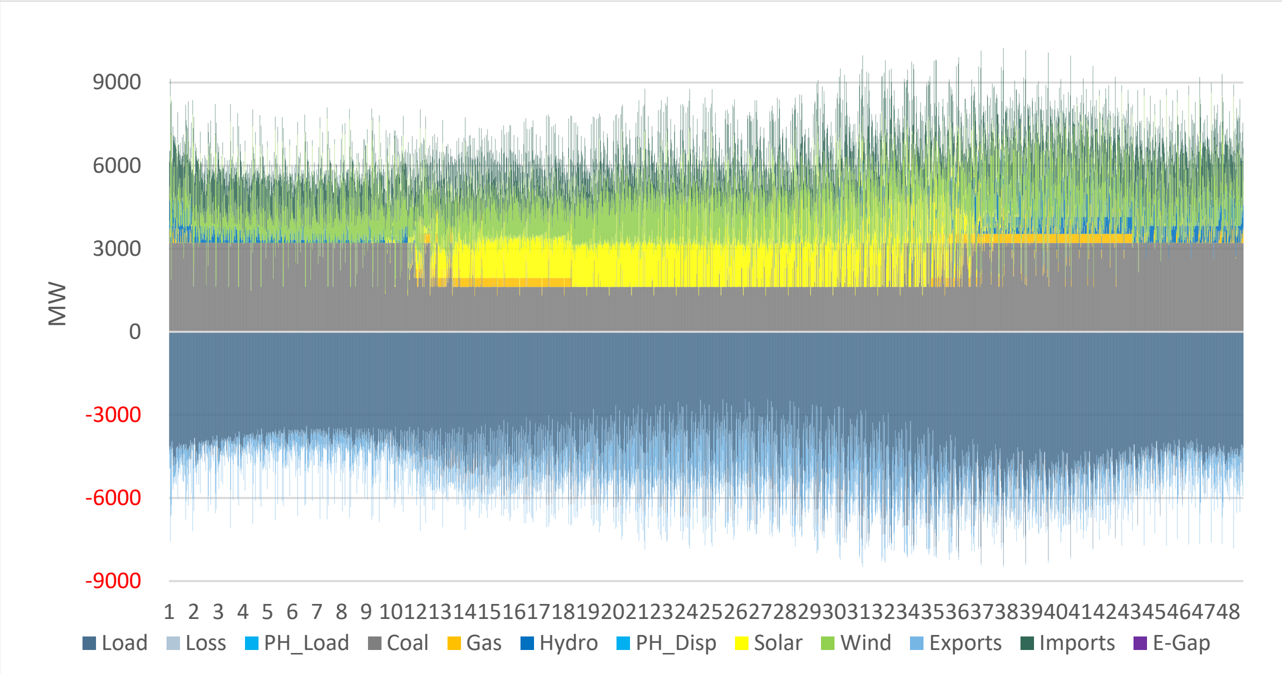

Figure 31: VIC energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 31 provides detail on the flow of energy through VIC by time-period according to source. Of note:

- the light blue coloured series indicates exports to NSW (predominantly) which are ongoing all day but increase during daylight hours
- the dark green coloured series indicates imports from Tasmania, South Australia and NSW (in roughly equal measures) which occur generally throughout the day but are smaller than the exports to NSW
- the grey coloured series indicates coal generation within VIC which declines during sunlight hours
- the gold coloured series indicates gas generation within VIC which tends to dispatch during morning and evening peaks
- the light green and yellow coloured series indicate solar and wind generation, which are lower than expected due to significant levels of curtailment, especially for solar. Further details in Figures 32 and 33
- the grey-blue coloured series indicates VIC load
- the purple coloured series indicates E-G

Table 30 provides totals and averages of the summer weekday energy flows. Coal generation across the state, with the removal of 1.6GW of capacity, achieves 79% capacity factor. Gas and hydro generation show low capacity factors at 6 and 9% respectively. Even with 24% curtailment of solar energy from potential dispatch, solar generation achieves a capacity factor of 34%. This is as a result of high dispatch during Summer Weekdays – capacity factors drop significantly during winter months. Curtailment of wind energy from potential dispatch is lower than solar at 15%, ensuring that wind generation state-wide achieves 32% capacity factor. As mentioned previously, E-G is negligible. VIC imports 1,752GWh in relatively equal measures from TAS, SA and NSW during Summer Weekdays. It exports 1,394 GWh primarily to NSW (937GWh), which highlights the important role that interconnection with NSW, SA and TAS plays in supporting energy flows as large quantities of VRE enter the system.

Table 30: VICTORIA salient statistics under sB (without QLD Pump Hydro)

VIC Statistics	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(6,543)	(5,342)	(4,544)	(8,431)	54%	(4,366)
PH_Load	-					
Coal	3,573	2,802	2,481	3,210	77%	3,050
Gas	216	355	150	2,240	7%	0
Hydro	303	381	211	2,147	10%	0
PH_Disp		0	0	0	0%	0
Solar	1,062	511	738	2,141	34%	498
Wind	2,502	2,058	1,737	5,431	32%	1,569
E-G	0			51	0%	0
Exports	(1,396)	(854)	(970)	(3,407)	28%	(911)
Imports	1,745	1,263	1,212	3,182	38%	1,171
Solar_spill	338	94	234	1,725	14%	0
Wind_spill	442	111	307	3,823	8%	3
Solar spill %	24%	16%	24%			
Wind spill %	15%	5%	15%			

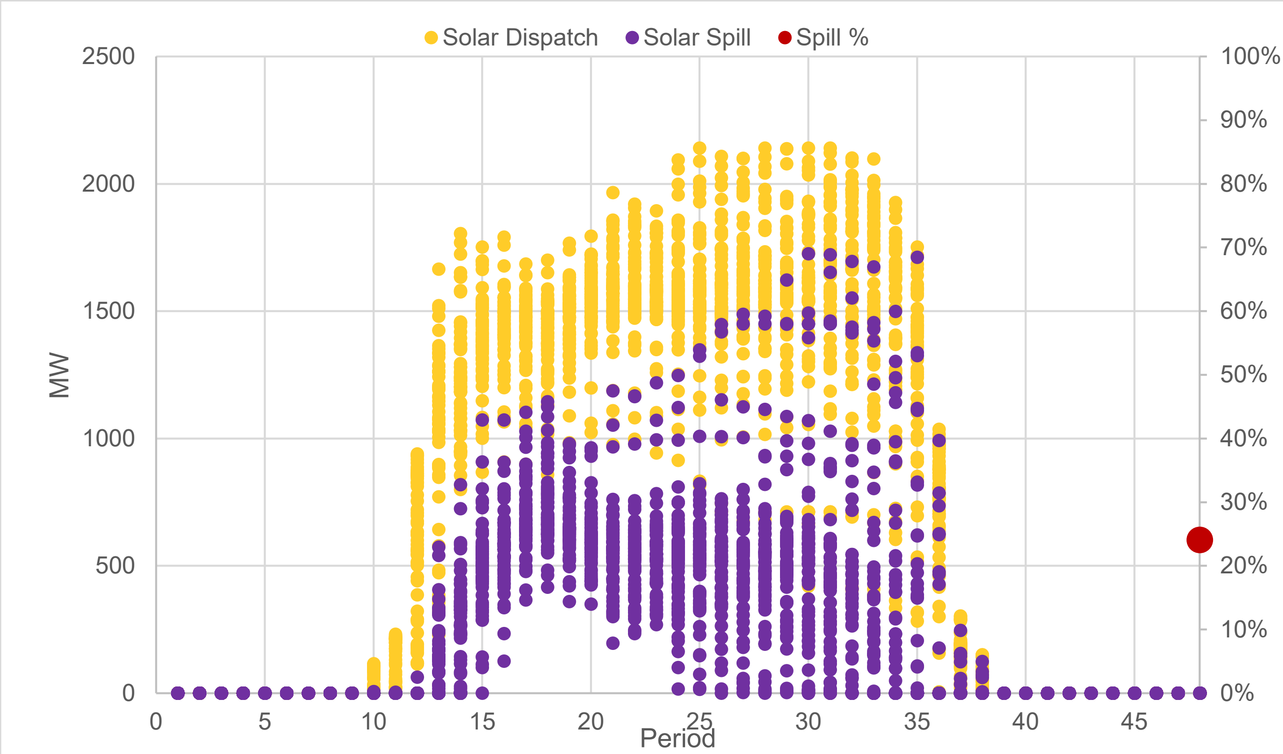

Figure 32: VIC coincident solar dispatch and curtailment under sB (without QLD Pump Hydro)

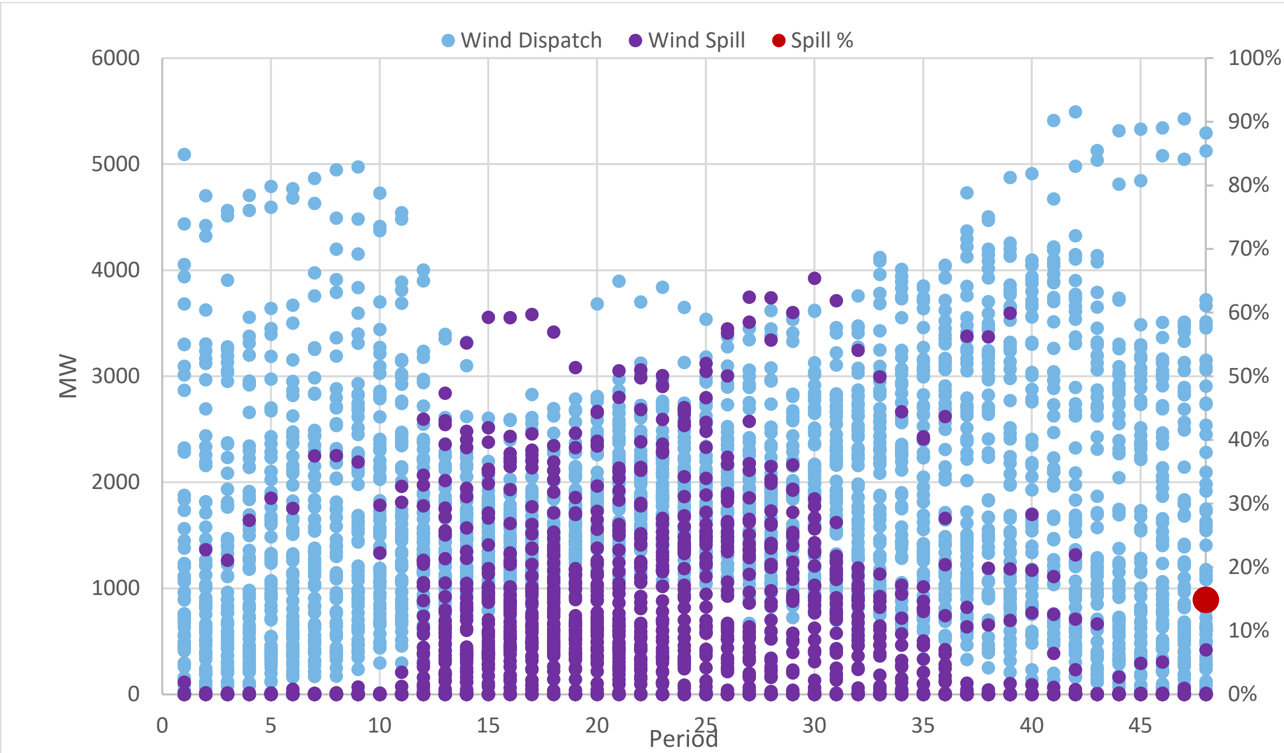

Figure 33: VIC coincident wind dispatch and curtailment under sB (without QLD Pump Hydro)

2. MELBOURNE details for summer weekdays

Table 31 provides a summary of generating capacity assumption for Melbourne (MELB) node

Table 31: MELBOURNE capacity assumptions under sB (without QLD Pump Hydro)

MELBOURNE Capacity assumptions	Current [16] (MW)	2030 (MW)	Notes
Gas	982	972	Capacity Factor: 13%
Wind		55	Capacity Factor: 33%, Max dispatch: 55MW
Storage/Other		-	
TOTAL	982	1,027	

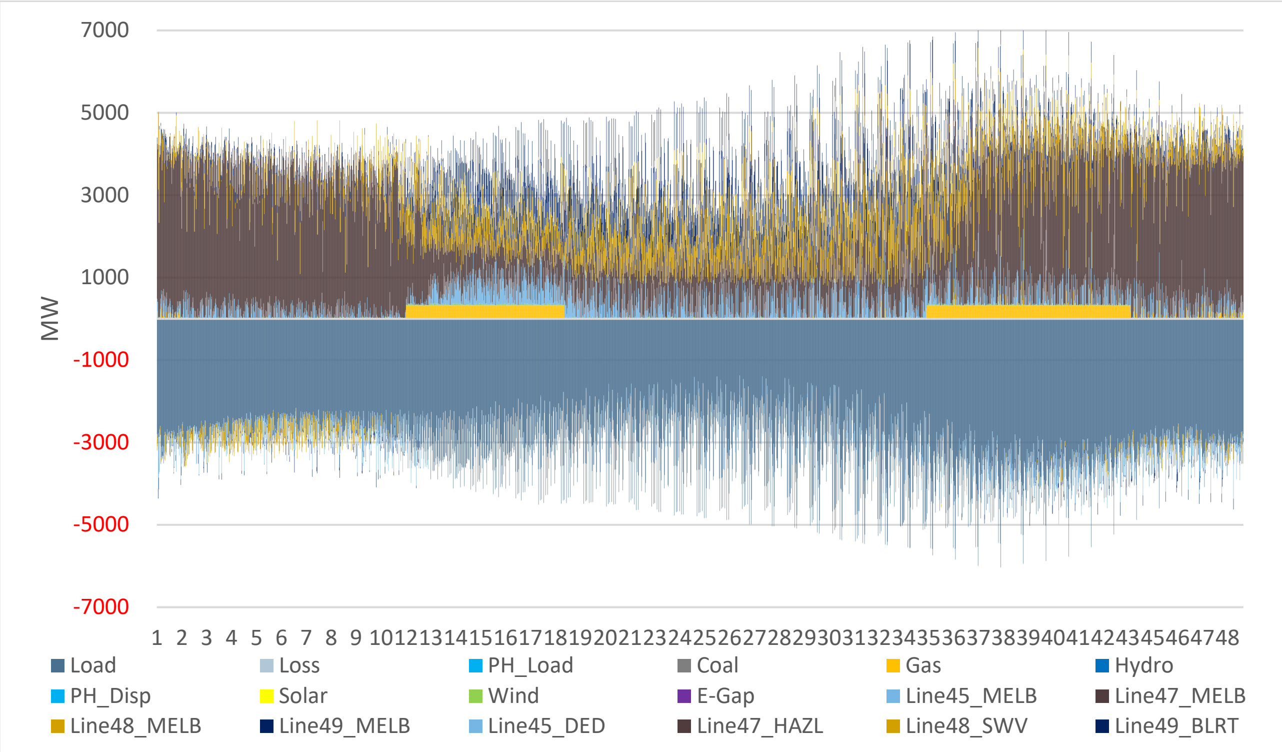

Figure 34: MELBOURNE energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 34 provides detail on the flow of energy through MELB node by time-of-day period by type of supply and demand. Of note:

- the brown coloured series indicates imports from Hazelwood node, which transfers energy from Loy Yang (coal), imports from Tasmania and gas from Morwell

[16] Source: AEMO Generation Information July 2020

- the dark gold coloured series indicates imports from SW Victoria node, where there is significant wind capacity (4,090MW)
- the navy-blue coloured series indicates imports from Ballarat node, where there is significant wind capacity (1,270MW)
- the steel-blue coloured series indicates MELB load
- the gold coloured series indicates generation from gas including Somerton, Newport and Laverton North
- the light blue coloured series indicates exports (primarily) to Dederang node
- E-G in the MELB node is negligible
- Table 32 details statistics for MELB energy flows

Table 32: MELBOURNE salient statistics under sB (without QLD Pump Hydro)

MELB SALIENT STATISTICS	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(4,471)	(3,738)	(3,105)	(6,031)	51%	(2,973)
Gas	175	284	121	966	13%	0
Wind	26	16	18	55	33%	15
E-G	0	0	0	0	8%	0
Exports	(252)	(155)	(175)	(1,562)	11%	0
Imports	5,320	4,258	3,695	6,688	55%	3,785
Wind_spill	1	0	0	10	4%	0
Wind spill %	2%	3%	2%			

3. SOUTH WEST VICTORIA details for summer weekdays

Table 33 provides a summary of South West Victoria (SWV) generating capacity assumptions

Table 33: SOUTH WEST VICTORIA capacity assumptions under sB (without QLD Pump Hydro)

SWV Capacity assumptions	Current [17] (MW)	2030 (MW)	Notes
Gas	584	566	Capacity Factor: 4%
Wind	862	4,090	Capacity Factor: 24%, Max dispatch 3866MW Curtailment: 21%, Max curtailment 2802MW
Storage/Other		-	
TOTAL	1,446	4,656	

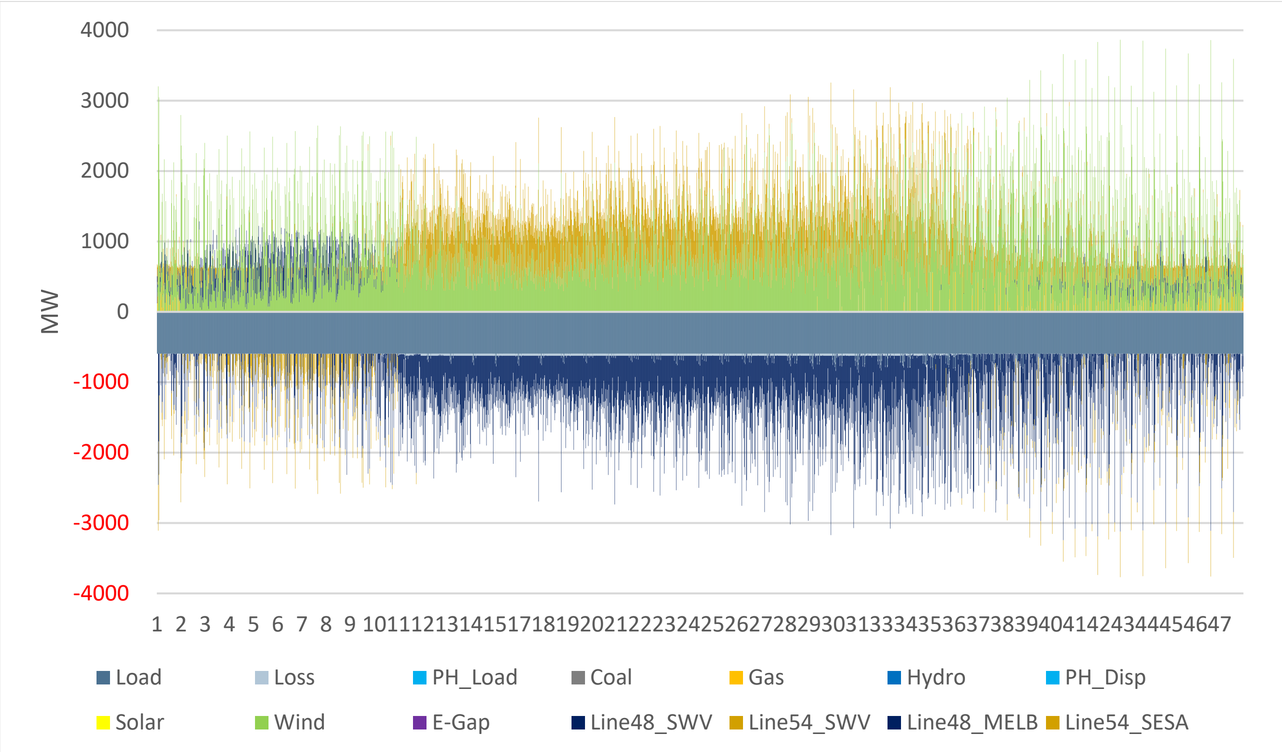

Figure 35: SW VICTORIA energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 35 provides detail on the flow of energy through SWV node by time-of-day period by type of supply and demand. Of note:

[17] Source: AEMO Generation Information July 2020

- the dark gold coloured series indicates imports (primarily) from SE South Australia node, where there is solar (363MW) and wind (315MW) capacity
- the navy-blue coloured series indicates exports (primarily) to MELB node
- the steel-blue coloured series indicates SWV load - primarily Portland aluminium smelter
- the gold coloured series indicates generation from gas, Mortlake (566MW), which dispatches only at evening peak and overnight and makes up a small proportion of generation in SWV node
- the light green coloured series indicates generation from 4,090MW of wind capacity. Wind resource for SWV is poor over summer, showing potential dispatch of only 29% (increasing to 50% during winter). Coupled with 21% curtailment, wind dispatched in SWV node during summer only achieves only 23% capacity factor. Figure 36 shows detail
- E-G in the SWV node is negligible
- Table 34 details statistics for SWV energy flows

Table 34: SOUTH WEST VICTORIA salient statistics under sB (without QLD Pump Hydro)

SWV STATISTICS	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(870)	(620)	(604)	(866)	70%	(594)
Gas	30	51	21	566	4%	0
Wind	1,361	1,221	945	3,866	24%	756
E-G	0	0	0	0	5%	0
Exports	(1,028)	(884)	(714)	(3,175)	22%	(634)
Imports	597	297	414	802	52%	525
Wind_spill	355	41	247	2,802	9%	0
Wind spill %	21%	3%	21%			

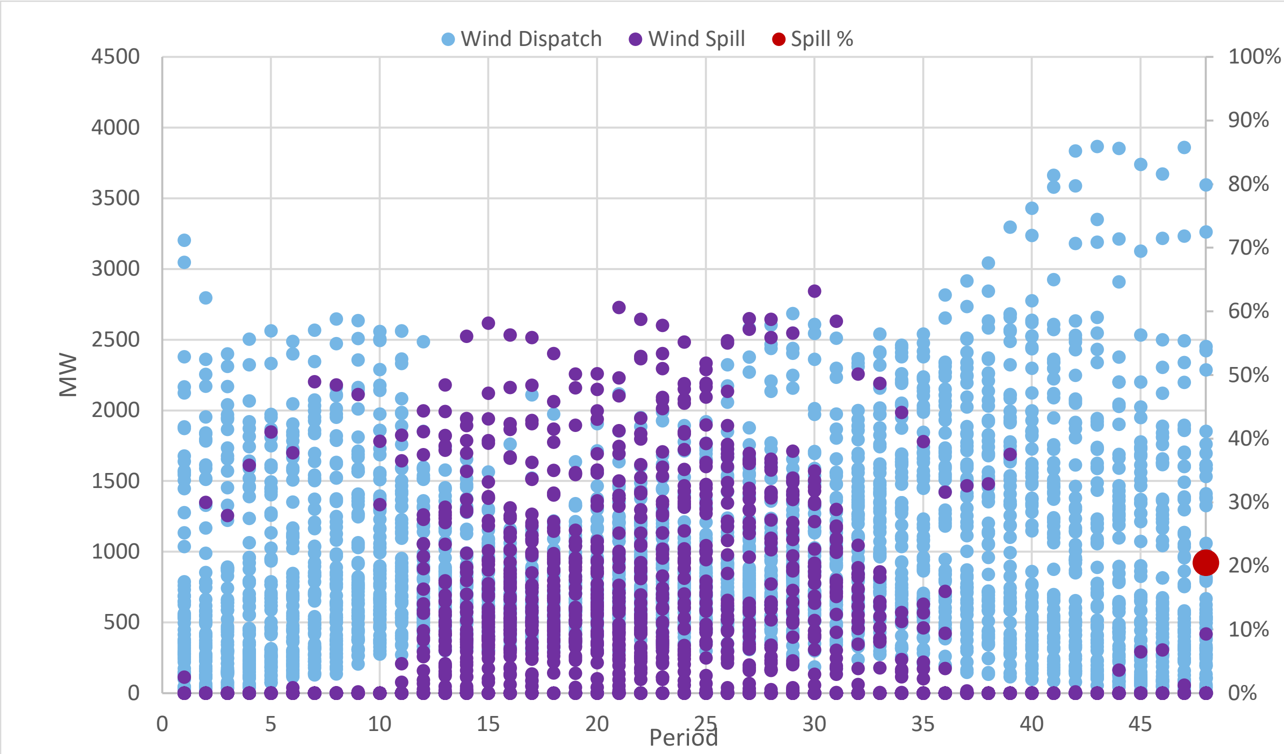

Figure 36: SW VICTORIA wind dispatch and curtailment under sB (without QLD Pump Hydro)

4. BALLARAT details for summer weekdays

Table 35 details generating capacity assumptions for Ballarat (BLRT) node

Table 35: BALLARAT capacity assumptions under sB (without QLD Pump Hydro)

BLRT Capacity assumptions	Current [18] (MW)	2030 (MW)	Notes
Wind	644	1,270	Capacity Factor: 31%, Max dispatch 1259MW Curtailment: 8%, Max curtailment 1099MW
Storage/Other	30	-	
TOTAL	674	1,270	

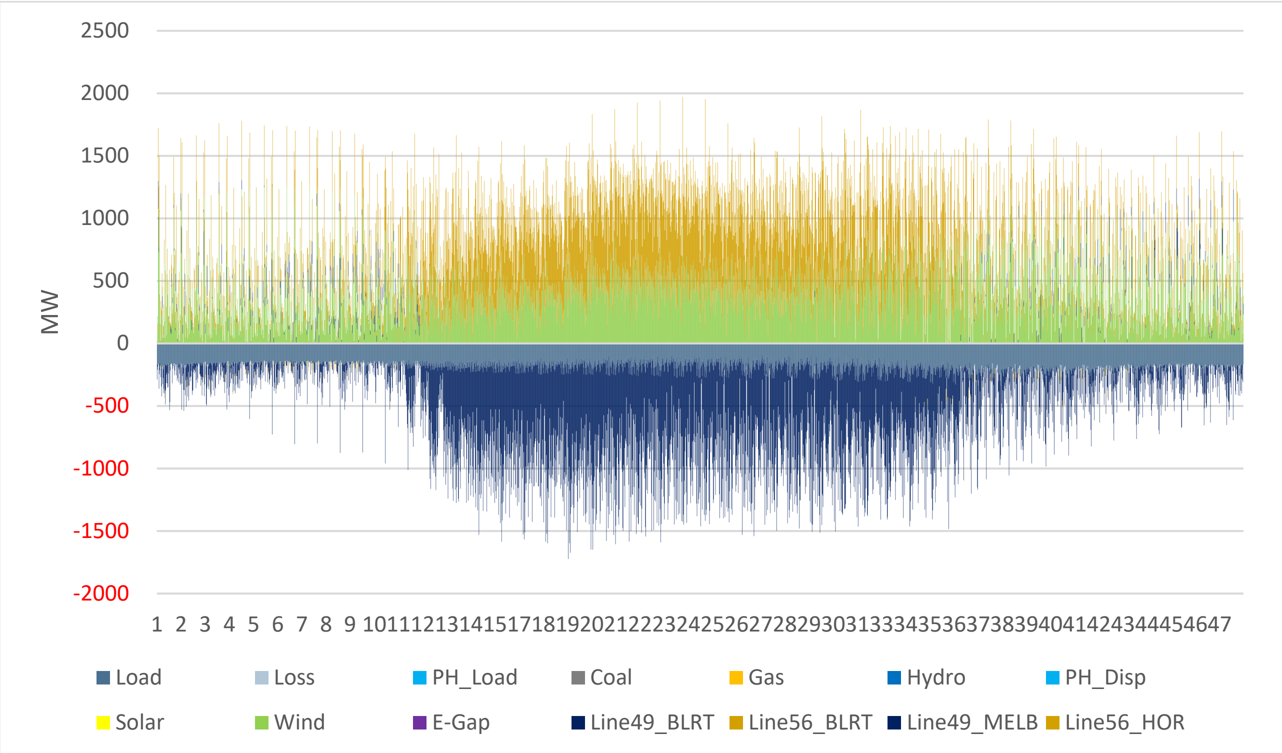

Figure 37: BALLARAT energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 37 provides detail on the flow of energy through BLRT node by time-of-day period by type of supply and demand. Of note:

- the dark gold coloured series indicates imports (primarily) from Horsham node, where there is solar (292MW) and wind (765MW) capacity
- the navy-blue coloured series indicates exports (primarily) to MELB node

[18] Source: AEMO Generation Information July 2020

- the steel-blue coloured series indicates BLRT load
- the light green coloured series indicates generation from 1,270MW of wind capacity. Figure 38 shows detail highlighting that the wind resource seldom results in maximum output out of sunlight hours and is in conflict with solar dispatch during sunlight hours, resulting in a capacity factor of 31%
- E-G in the BLRT node is negligible
- Table 36 details statistics for BLRT energy flows

Table 36: BALLARAT salient statistics under sB (without QLD Pump Hydro)

BLRT STATISTICS	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(260)	(213)	(180)	(339)	53%	(173)
Wind	563	458	391	1,259	31%	369
E-G	0	0	0	0	7%	0
Exports	(907)	(599)	(630)	(1,653)	38%	(665)
Imports	763	474	530	1,292	41%	523
Wind_spill	49	38	34	1,099	3%	0
Wind spill %	8%	7%	8%			

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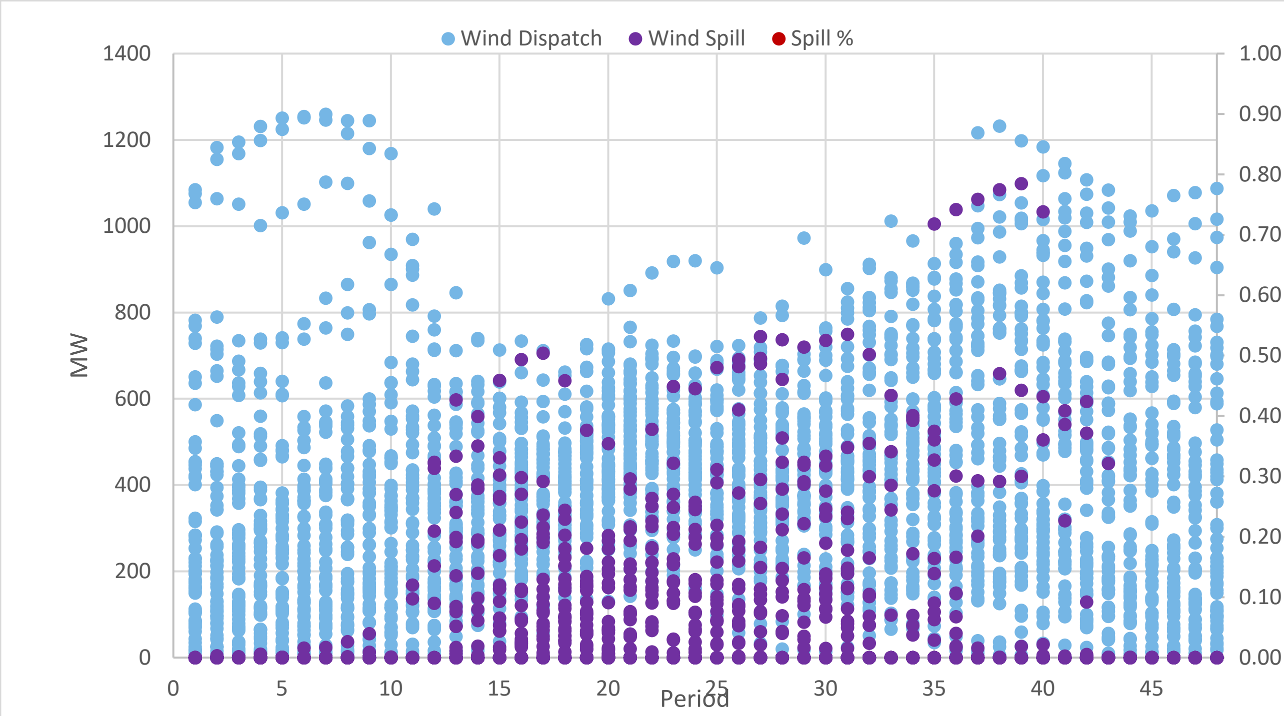

Figure 38: BALLARAT wind dispatch and curtailment under sB (without QLD Pump Hydro)

5. HORSHAM details for summer weekdays

Table 37 summarises generating capacity assumptions for Horsham (HOR) node

Table 37: HORSHAM capacity assumptions under sB (without QLD Pump Hydro)

HOR Capacity assumptions	Current [19] (MW)	2030 (MW)	Notes
Solar		292	Capacity Factor: 45%, Max dispatch 292MW Curtailment: 2%, Max curtailment 295MW
Wind	31	765	Capacity Factor: 38%, Max dispatch765MW Curtailment: 7%, Max curtailment 755MW
Storage/Other		-	
TOTAL	31	1,057	

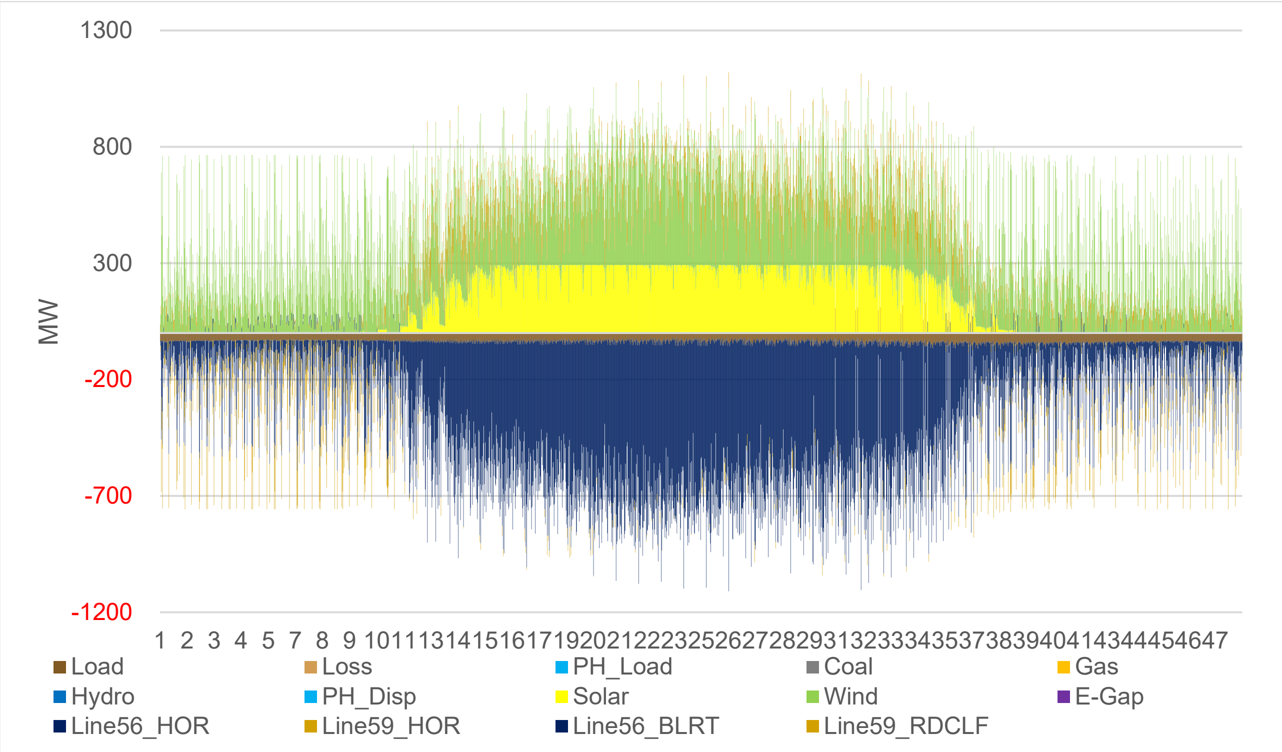

Figure 39: HORSHAM energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 39 provides detail on the flow of energy through HOR node by time-of-day period by type of supply and demand. Of note:

[19] Source: AEMO Generation Information July 2020

- the dark gold coloured series indicates imports and exports from and to Red Cliffs node, where there is solar (1000MW) capacity
- the navy-blue coloured series indicates exports (primarily) to BLRT and ultimately to MELB node
- the steel-blue coloured series indicates HOR load which is very small
- the light green coloured series indicates generation from 765MW of wind capacity. Figure 41 shows detail showing relatively good wind resource in HOR, resulting in a capacity factor of 38%
- the yellow coloured series indicates generation from 292MW of solar capacity. Potential solar resource in HOR is very high during summer (45% CF) compared to 15% CF during winter, and 30% over the full year. Figure 40 gives detail indicating excellent dispatch from the solar resource during Summer WD with little curtailment
- E-G in the HOR node is negligible
- Table 38 details statistics for HOR energy flows

Table 38: HORSHAM salient statistics under sB (without QLD Pump Hydro)

HOR STATISTICS	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(53)	(44)	(37)	(69)	53%	(36)
Solar	187	86	130	292	45%	76
Wind	420	270	291	765	38%	266
E-G	0	0	0	0	9%	0
Exports	(610)	(359)	(424)	(1,066)	40%	(453)
Imports	65	52	45	254	18%	25
Solar_spill	4	5	2	295	1%	0
Solar spill %	2%	5%	2%			
Wind_spill	33	26	23	755	3%	32
Wind spill %	7%	9%	7%			

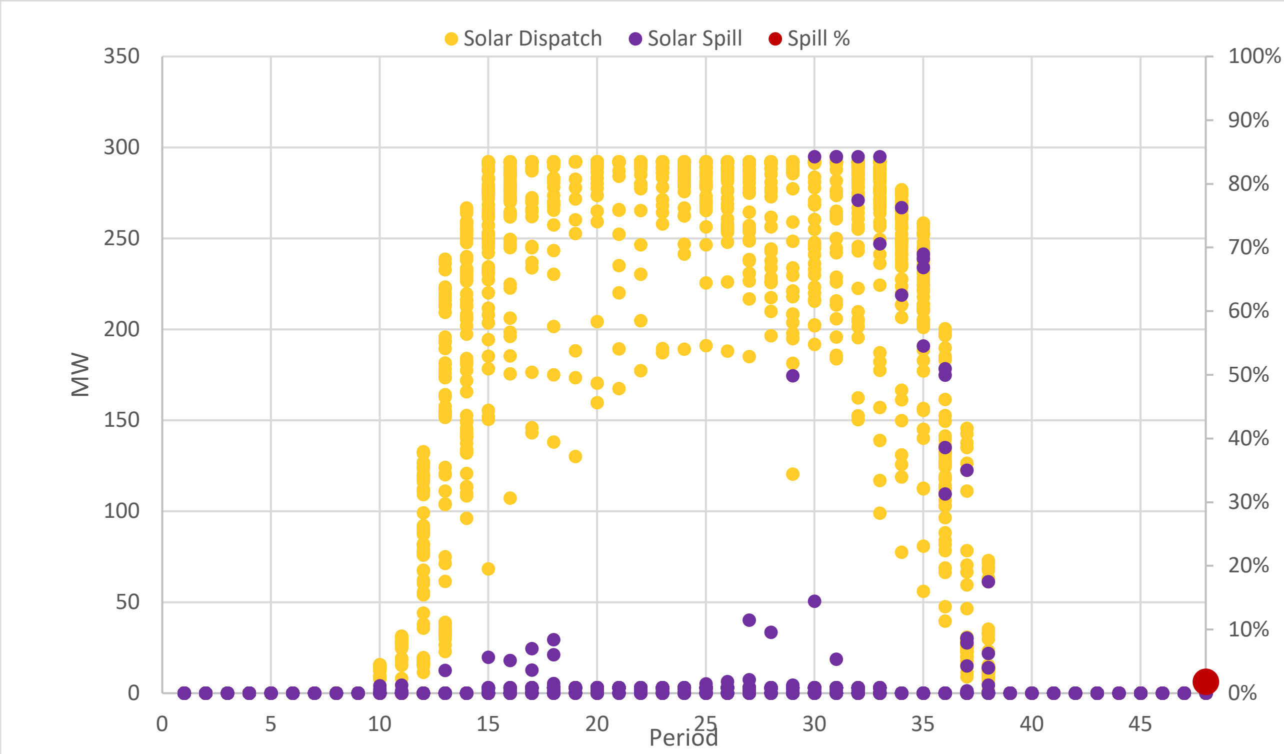

Figure 40: HORSHAM solar dispatch and curtailment under sB (without QLD Pump Hydro)

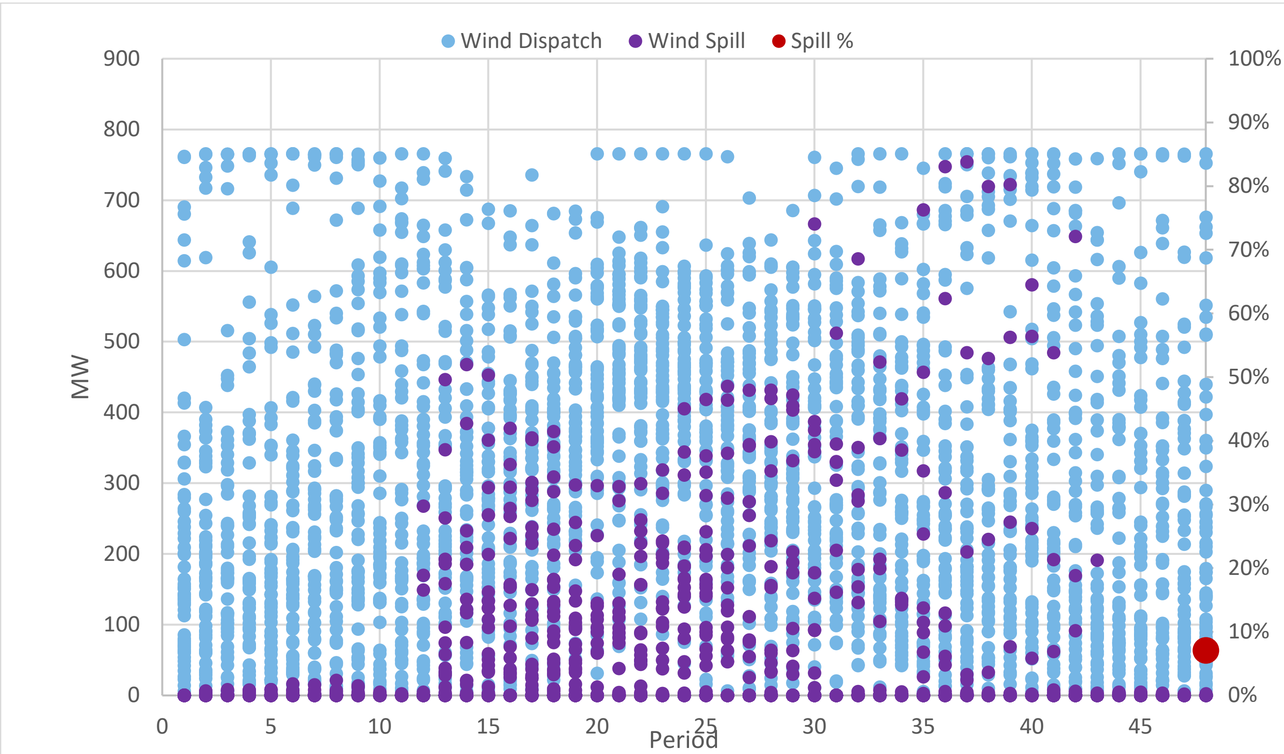

Figure 41: HORSHAM wind dispatch and curtailment under sB (without QLD Pump Hydro)

6. RED CLIFFS details for summer weekdays

Table 39 summarises generating capacity assumptions for Red Cliffs (RDCLF) node

Table 39: RED CLIFFS capacity assumptions under sB (without QLD Pump Hydro)

RDCLF Capacity assumptions	Current [20] (MW)	2030 (MW)	Notes
Solar	294	1,000	Capacity Factor: 24%, Max dispatch 1000MW Curtailment: 47%. Max curtailment 1000MW
Storage/Other		-	
TOTAL	294	1,000	

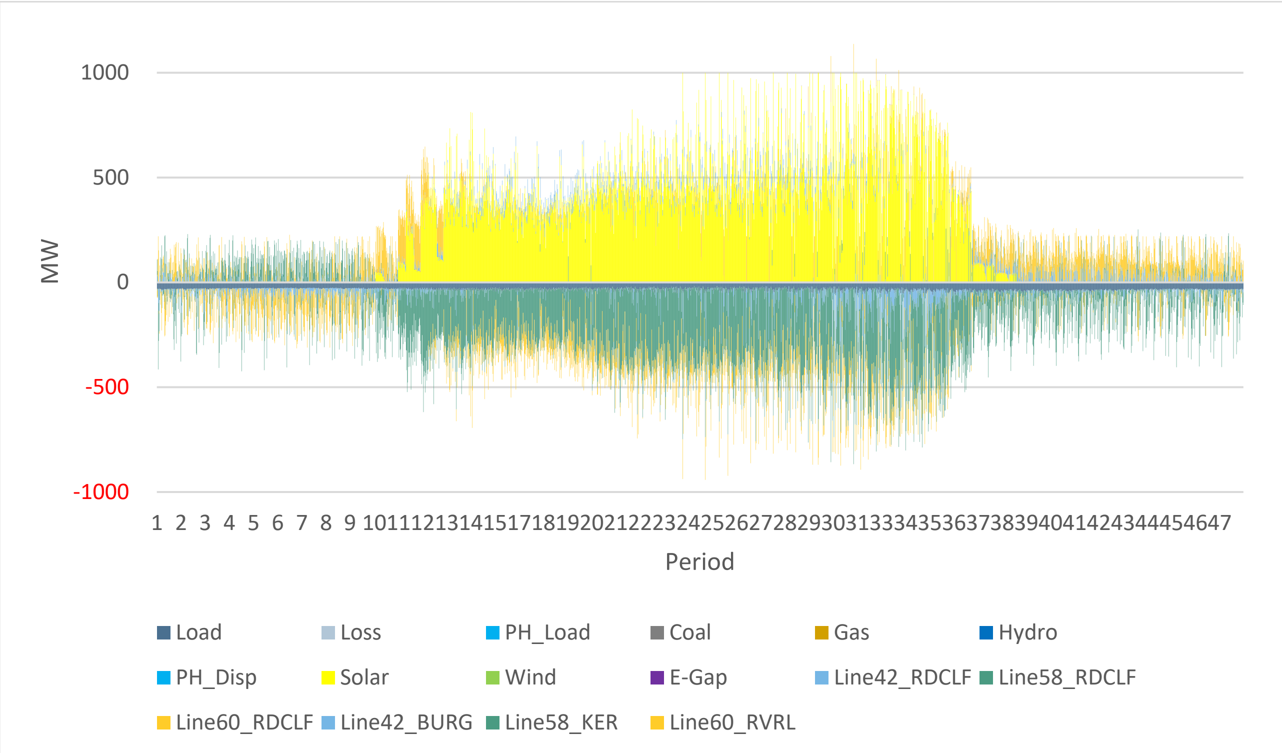

Figure 42: RED CLIFFS energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 42 provides detail on the flow of energy through RDCLF node by time-of-day period by type of supply and demand. Of note:

- the gold coloured series indicates imports and exports from and to Riverlands node, where there is solar (1230MW) capacity
- the green-blue coloured series indicates exports (primarily) to Kerang node

[20] Source: AEMO Generation Information July 2020

- the steel-blue coloured series indicates RDCLF load which is very small
- the yellow coloured series indicates generation from 1000MW of solar capacity. Potential solar resource in RDCLF is very high during summer (45% CF) compared to 18% CF during winter, and 32% over the full year. Figure 43 gives detail indicating limited dispatch and high curtailment from the solar resource resulting in a capacity factor of 24% despite excellent solar resource
- E-G in the RDCLF node is negligible
- Table 40 details statistics for RDCLF energy flows

Table 40: RED CLIFFS salient statistics under sB (without QLD Pump Hydro)

RED CLIFFS SALIENT STATISTICS	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(49)	(40)	(34)	(64)	53%	(33)
Solar	344	215	239	1,000	24%	95
E-G	0	0	0	0	2%	0
Exports	(446)	(302)	(309)	(1,086)	28%	(289)
Imports	159	134	111	445	25%	88
Solar_spill	309	68	215	1,000	21%	0
Solar spill %	47%	24%	47%			

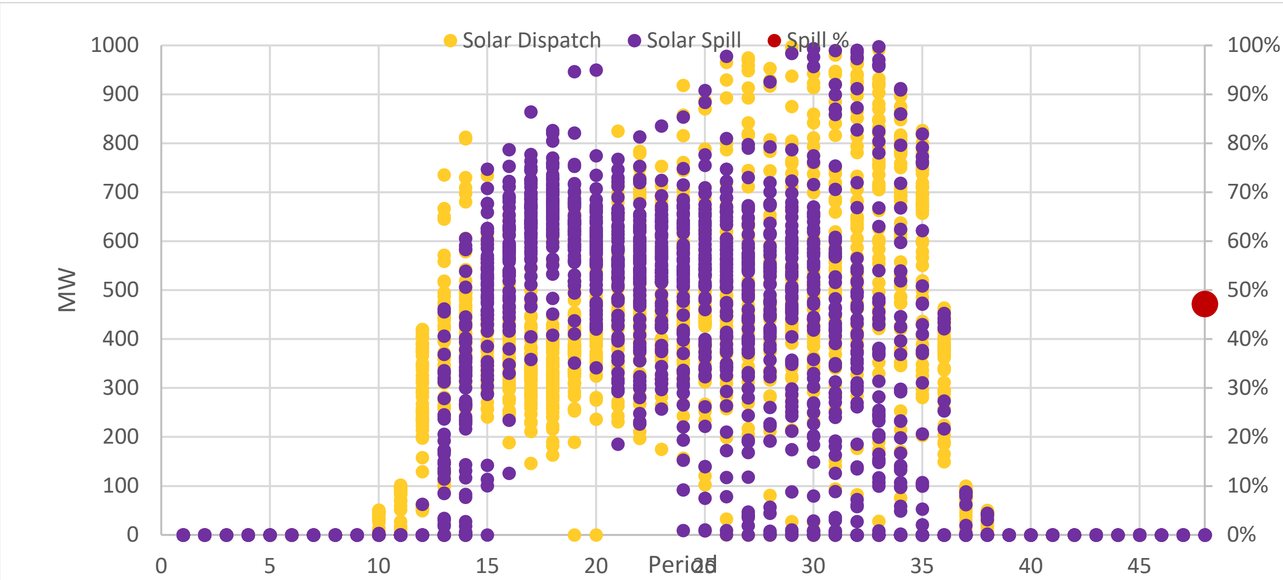

Figure 43: RED CLIFFS solar dispatch and curtailment under sB (without QLD Pump Hydro)

7. MURRAY details for summer weekdays

Table 41 provides a summary of generating capacity assumptions for Murray (MURR) node

Table 41: MURRAY capacity assumptions under sB (without QLD Pump Hydro)

MURR Capacity assumptions	Current [21] (MW)	2030 (MW)	Notes
Hydro	1,531	1,562	Capacity factor: 11%, Max dispatch 1467MW
Storage/Other/ E-G		-	
TOTAL	1,531	1,562	

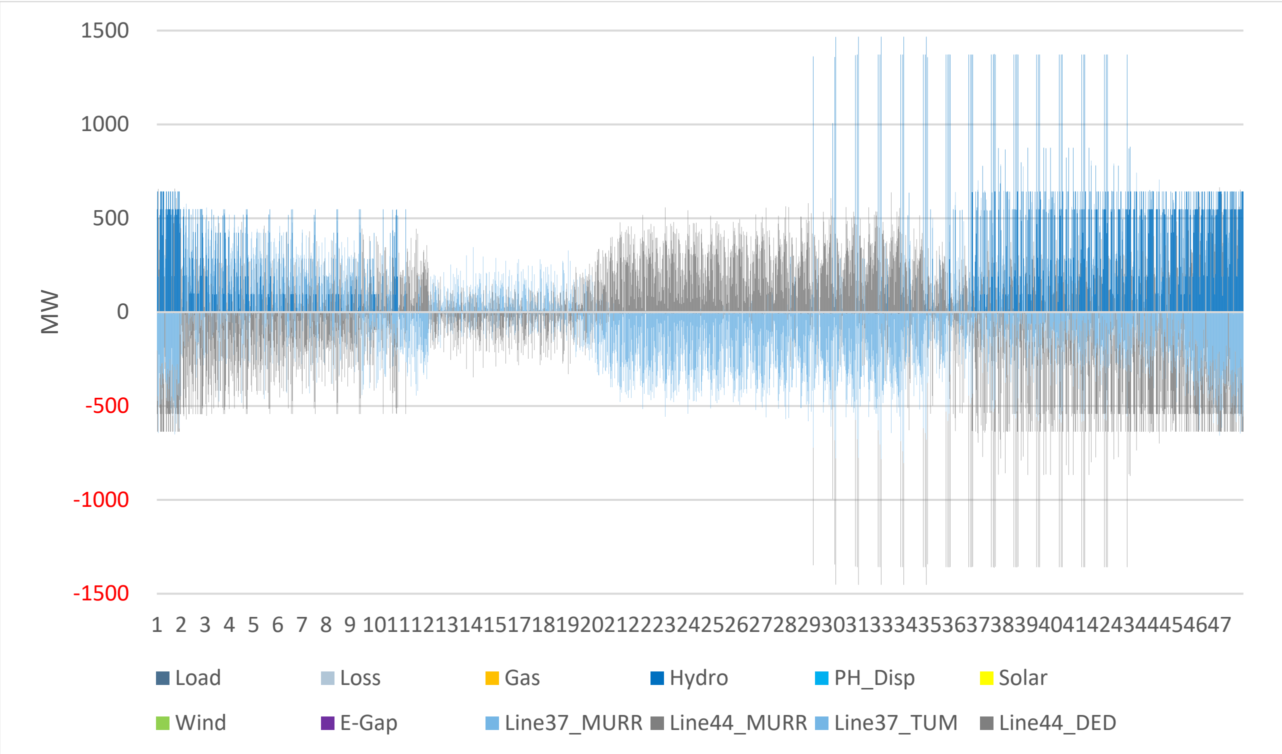

Figure 44: MURRAY energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 44 provides statistics on the flow of energy through MURR node by time-of-day period by type of supply and demand. Of note:

- Murray hydro, dark blue coloured series, is generally dispatched from 5pm through to morning peak, although seldom at maximum capacity. The periods of very high dispatch correspond with the high demand periods over Christmas – New Year.

[21] Source: AEMO Generation Information July 2020

- the light blue coloured series indicates the imports-exports from-to TUM node in NSW;
- the grey coloured series indicates the imports-exports from-to Dederang node
- E-G is non-existent in MURR node
- Table 42 details statistics for MURR energy flows

Table 42: MURRAY salient statistics under sB (without QLD Pump Hydro)

MURR Statistics	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	0	0	0	0	0%	0
Hydro	240	286	167	1,467	11%	0
E-G	0	0	0	0	0%	0
Exports (node)	(426)	(385)	(296)	(1,453)	20%	(243)
Imports (node)	191	103	132	638	21%	85

8. CONCLUDING OBSERVATIONS for VIC nodal supply-demand balance

There is evidence of significant curtailment of solar in VIC, indicative of over-supply during the day during Summer WD. Surprisingly wind resource in VIC is fairly low during summer months, averaging 24% CF in SWV and 31% in BLRT. The concerns for low wind resource during summer would be that expectations of high wind resource outside of sunlight hours may not be met.

4. SOUTH AUSTRALIA: Nodal Supply-Demand Balance for Summer Weekdays in 2030

a) Pipeline Scenario B (without Queensland Pump Hydro)

i. SA Underlying assumptions

- N transmission network
- Direction of Flow loss method estimation
- There will be no coal generation in SA Coal power in 2030. In the other states, coal generation will decline (VIC 3,144MW from 4,775MW; NSW 4,040MW from 10,210MW; QLD 4,839MW from 8,059MW)
- Coal unit closures by 2030 include:
  - QLD: Units 1-2 Callide B; Units 1-2 Stanwell; Units 1-2,5-6 Gladstone; Units 1-2 Tarong;
  - NSW: Units 1-4 Liddell; Units 1-4 Eraring; Units 5-6 Vales Point
  - VIC: Units 1-4 Yallourn
- Gas power in 2030 will increase to 2,785MW in SA from 2,368MW currently. Gas generation in other states will total NSW 3,048MW; VIC 2,364MW; QLD 2,691MW
- Pump hydro (PHES) in 2030 will be 610MW including Baroota (240MW), Goats Hill (240MW) and Middleback Ranges (110MW). PHES in other states will total (QLD 820MW; NSW 3,180MW)
- Wind power in 2030 will reach 3,652MW in SA (VIC, 8,470MW; NSW 5,671MW; QLD 4,820MW, TAS 2,302MW)
- Solar power in 2030 will reach 4,213MW in SA (VIC 2,141MW; NSW 8,021MW; QLD 8,736MW)
- A summary of the generating capacity assumptions for SA is detailed in Table 43
- Transmission augmentation assumed for:
  - QNI to 5436MW
  - corridor from Armidale to Newcastle and Sydney to accommodate 5+GW of energy flows
  - Energy Connect from NSW to VIC and SA
  - Kerang-Link in Victoria
  - Battery of the Nation augmentation VIC to TAS

Table 43: SOUTH AUSTRALIA capacity assumptions under sB (without QLD Pump Hydro)

SA Capacity assumptions	Current [22] (MW)	2030 (MW)	Notes
Gas	2,368	2,785	Additions: Barkers Inlet 210MW; TGN 226MW; TGS 120MW Capacity factor: 15% (full year); 16% (Summ WD)
Diesel	609	207	
Hydro	3	-	
Solar	366	4,213	Capacity factor: 14% (full year); 17% (Summ WD) Curtailment: 63%, Max curtailment 3547MW
Wind	2,053	3,652	Capacity factor: 28% (full year); 27% (Summ WD) Curtailment: 33%, Max curtailment 2789MW
PHES	-	610	Capacity factor: 6% (full year); 3% (SummWD)
Storage/Other	890	1,296	Capacity factor: 11% (full year); 10% (SummWD)
TOTAL	6,289	12,762	

[22] Source: AEMO Generation Information July 2020

ii. SA modelling outcomes for Summer Weekdays in 2030

1. SA Fuel share (Summer Weekdays)

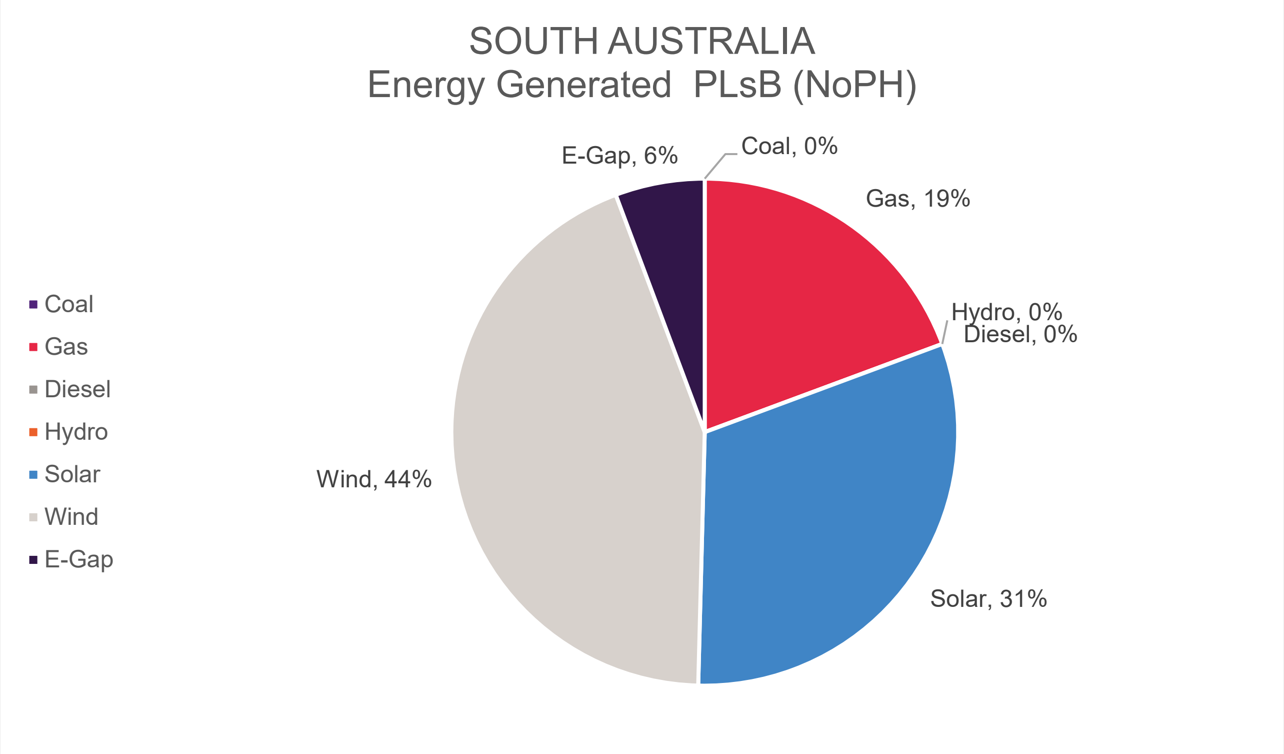

Figure 45: SA fuel share during SummerWD under sB (without QLD Pump Hydro)

Modelling outcomes predict that 44% of electricity generated in SA in 2030 will be sourced from wind, 31% from solar, and 19% from gas as shown in Figure 45. Six percent of energy generated comes from the E-G which is persistent overnight, with a handful of highly elevated levels during evening peak, resulting in an overall capacity factor of 21%. The max capacity of E-G required in Upper North SA node is 500MW, Mid North SA node is 245MW, Eyre Peninsula is 110MW, and Riverlands is 122MW.

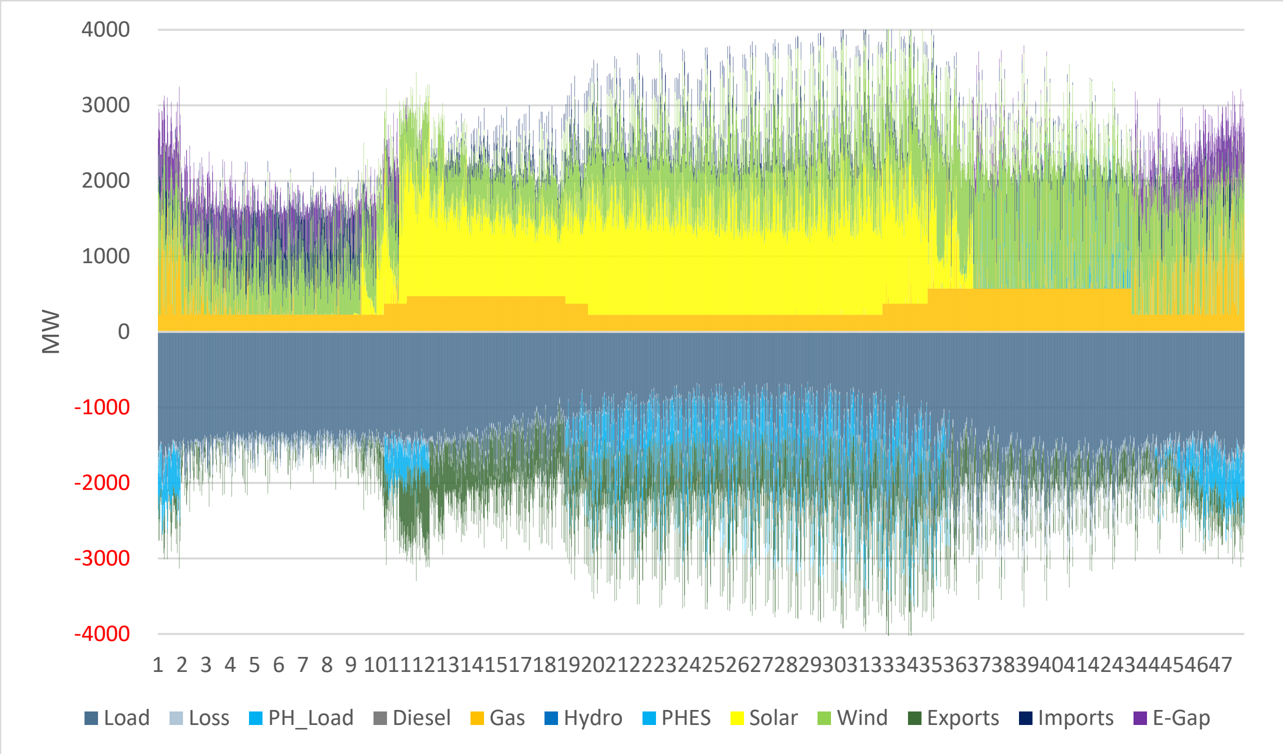

Figure 46: SA energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 46 provides detail on the flow of energy through SA by time-period according to source. Of note:

- the dark green coloured series indicates exports to SWV node in VIC (predominantly) which are ongoing all day but increase during daylight hours. Flows of energy between NSW and SA are not large – exports of 66GWh from Riverlands to BURG with corresponding imports of 70GWh from BURG to Riverlands. Transfers are maximised at 338MW for exports and 279MW for imports, which is considerably lower than the transfer capacity. This depressed level of activity results in significant curtailment of wind and solar
- the dark blue coloured series indicates imports from VIC which are small and scattered throughout the day and night
- the gold coloured series indicates gas generation within SA which tends to dispatch during morning and evening peaks
- the light green and yellow coloured series indicate solar and wind generation, which are lower than expected due to significant levels of curtailment, especially for solar. Figures 47 and 48 show detail
- the grey-blue coloured series indicates SA load
- the purple coloured series indicates E-G which occurs predominantly overnight

Table 44 provides totals and averages of the summer weekday energy flows. Wind is the source of the largest proportion of generation in SA (3,652MW) and achieves a 42% capacity factor, even with 33% curtailment from potential generation. Solar is the next largest source of generation in SA (4,213MW), achieving 27% capacity factor after 63% curtailment from potential generation - a remarkable result due to excellent solar resource during Summer. Gas generation of 2.8GW across the state, achieves 21% capacity factor. SA imports 234GWh mainly from VIC (164GWh) during Summer Weekdays and exports 666 GWh primarily to VIC (600GWh), which highlights the important role that interconnection with VIC plays in supporting energy flows as large quantities of VRE enter the system.

E-G is large (610MW) relative to the fleet capacity of 11,466MW. It maximises at 500MW in Upper North SA which hosts Baroota (240MW) and Goats Hill (240MW) PHES and is relatively persistent with a capacity factor of 20%. Although the E-G in Eyre Peninsula is smaller at 110MW it is also relatively persistent with a capacity factor of 21%. The cause of the E-G will be discussed in greater detail below.

Table 44: SOUTH AUSTRALIA salient statistics under sB (without QLD Pump Hydro)

SA STATISTICS	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(2,197)	(1,798)	(1,526)	(2,901)	53%	(1,478)
PH_Load	(378)	(153)	(263)	(590)	45%	(55)
Gas	633	582	439	2,082	21%	373
Diesel	0	0	0	1	2%	0
PH_Disp	24	60	17	610	3%	0
Solar	1,016	446	706	2,606	27%	866
Wind	1,435	1,440	997	2,392	42%	890
E-G	187	28	130	610	21%	0
Exports	(666)	(436)	(462)	(1,183)	39%	(563)
Imports	234	96	163	994	16%	73
Solar_spill	1,761	322	1,223	3,547	34%	91
Wind_spill	717	661	498	2,789	18%	275
Solar spill %	63%	42%	63%			
Wind spill %	33%	31%	33%			

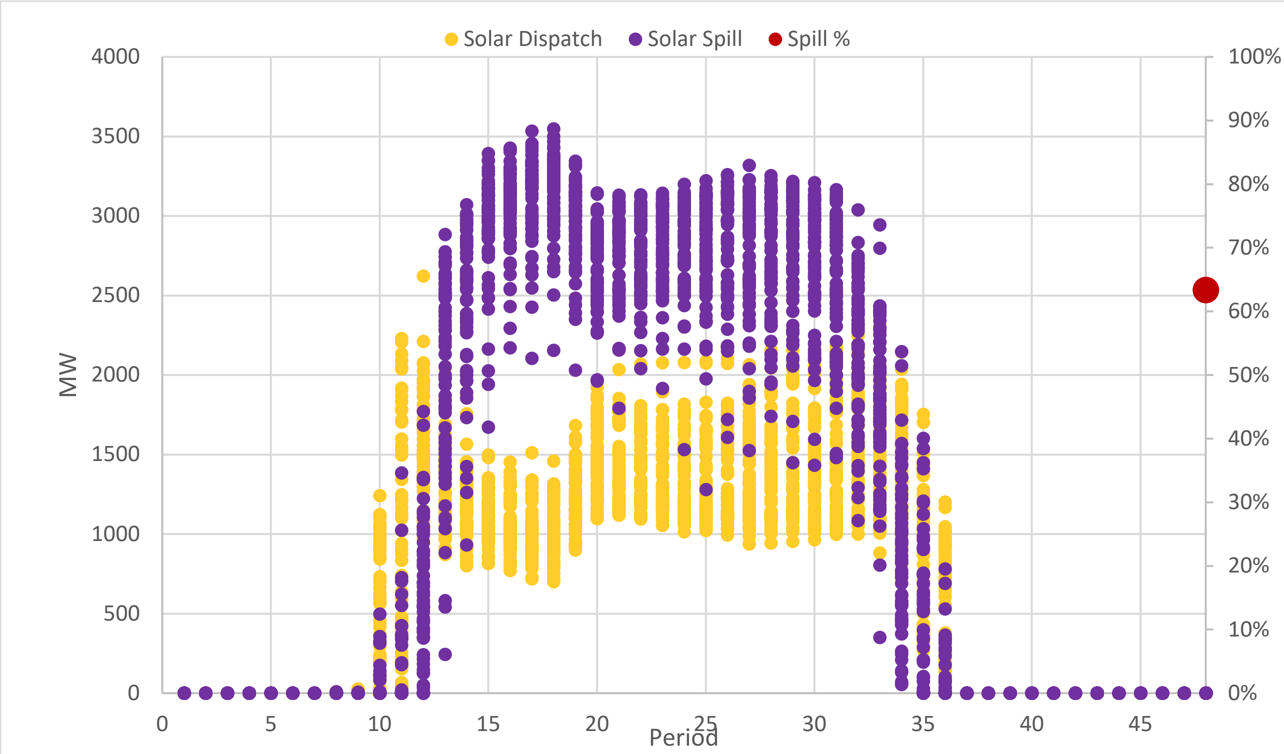

Figure 47: SA coincident solar dispatch and curtailment under sB (without QLD Pump Hydro)

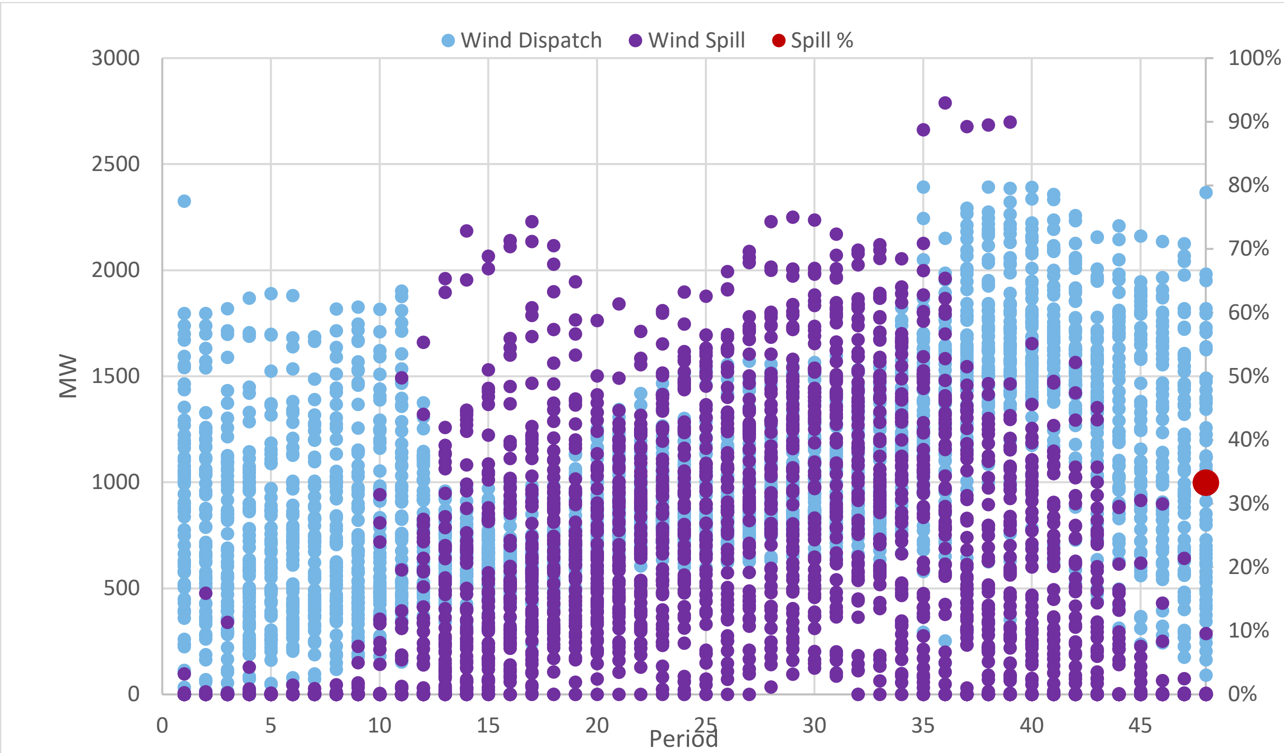

Figure 48: SA coincident wind dispatch and curtailment under sB (without QLD Pump Hydro)

2. ADELAIDE details for summer weekdays

Table 45 provides a summary of generating capacity assumptions for Adelaide (ADEL) node

Table 45: ADELAIDE capacity assumptions under sB (without QLD Pump Hydro)

ADEL Capacity assumptions	Current [23] (MW)	2030 (MW)	Notes
Gas	2,201	2,394	Capacity factor: 18%
Diesel	22	20	Capacity factor: 2%
Wind	33	667	Capacity factor: 40%, Curtailment 13%
Storage/Other	30	12	Capacity factor: 0%
TOTAL	2,285	3,093	

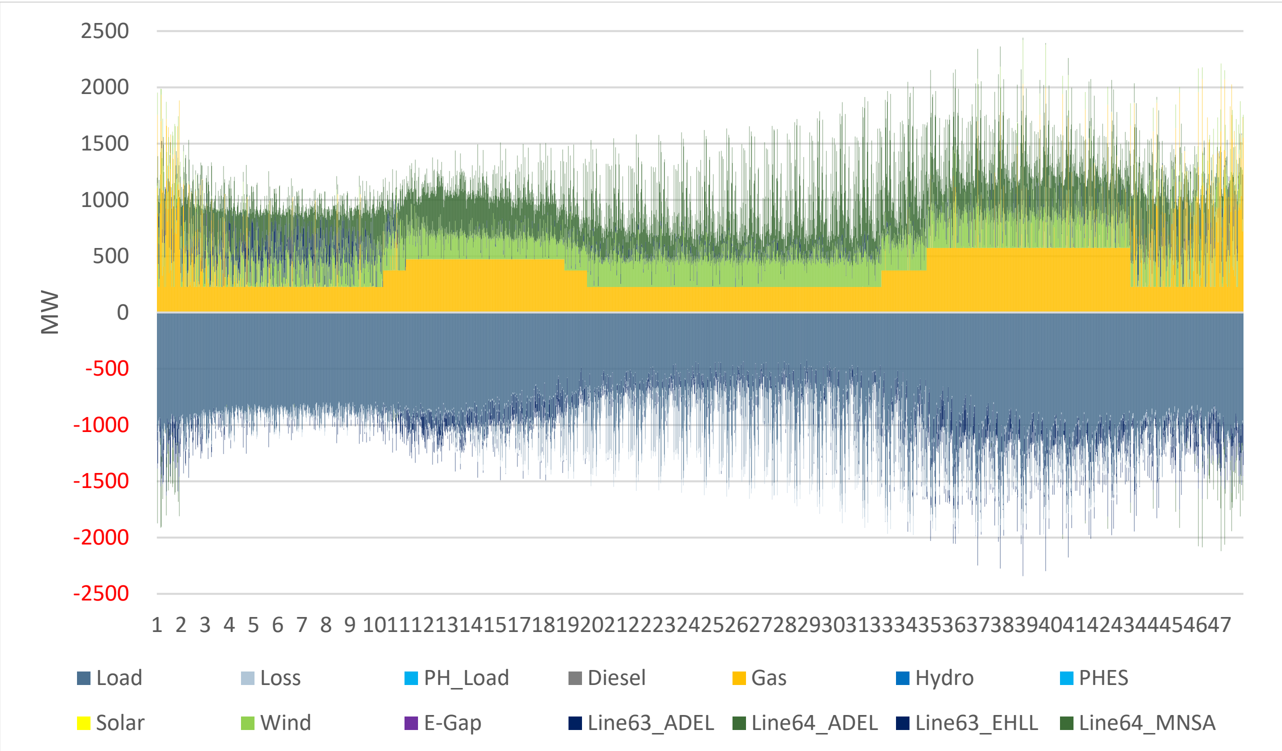

Figure 49: ADELAIDE energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 49 provides detail on the flow of energy through ADEL node by time-of-day period by type of supply and demand. Of note:

[23] Source: AEMO Generation Information July 2020

- the dark green coloured series indicates imports from Mid North SA node, where there is significant wind (2,112MW), solar (990MW) and gas (311MW) generation capacity.
- the navy-blue coloured series indicates exports from ADEL node to Eastern Hills node, where there is no generation capacity (1,270MW). Energy flows are small but generally flow onwards from Eastern Hills to South East South Australia and then into SWV node
- the steel-blue coloured series indicates ADEL load
- the gold coloured series indicates generation from gas including Pelican Point (478MW), Quarantine (224MW), New Osborne (180MW), Torrens Island B (800MW) and Dry Creek (156MW). With the quantity of wind and solar available from Mid North SA, gas generators dispatch primarily at morning and evening peak
- the light green coloured series indicates generation from wind (667MW) within the ADEL node. 13% of potential wind generation is curtailed resulting in a capacity factor for SummWD of 36%. Figure 50 shows detail
- E-G in the ADEL node is negligible
- Table 46 details statistics for ADEL energy flows

Table 46: ADELAIDE salient statistics under sB (without QLD Pump Hydro)

ADELAIDE Statistics	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(1,407)	(1,168)	(977)	(1,891)	52%	(937)
Gas	631	576	438	2,070	18%	373
Diesel	0	0	0	0	2%	0
Wind	343	267	238	591	36%	240
E-G	0	0	0	12	0%	0
Exports	(121)	(117)	(84)	(944)	9%	(56)
Imports	627	511	435	1,483	29%	403
Wind_spill	52	9	36	453	8%	0
Wind spill %	13%	3%	13%			

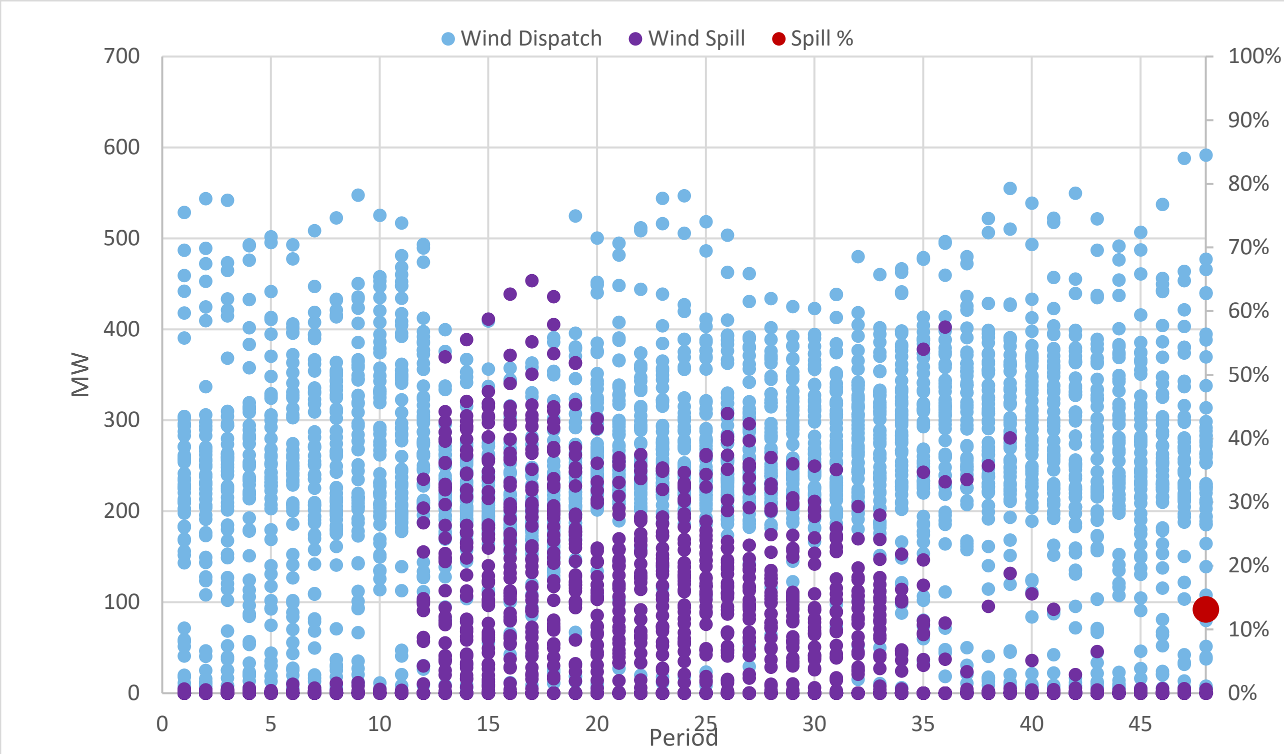

Figure 50: ADELAIDE wind dispatch and curtailment under sB (without QLD Pump Hydro)

3. SOUTH EAST SOUTH AUSTRALIA details for summer weekdays

Table 47 provides a summary of generating capacity assumptions for South East South Australia (SESA) node

Table 47: SOUTH EAST SOUTH AUSTRALIA capacity assumptions under sB (without QLD Pump Hydro)

SESA Capacity assumptions	Current [24] (MW)	2030 (MW)	Notes
Gas/Diesel	164	143	Capacity factor: 2%
Wind	325	315	CF (full year) 32%, (SummWD) 26%; Curtail (full year) 4% , (SummWD) 2%
Solar	108	363	CF (full year): 25%; (SummWD) 35% Curtail (full year) 19%GWh, (SummWD) 22%
Storage/Other	25	3	Capacity factor: 0%
TOTAL	622	824	

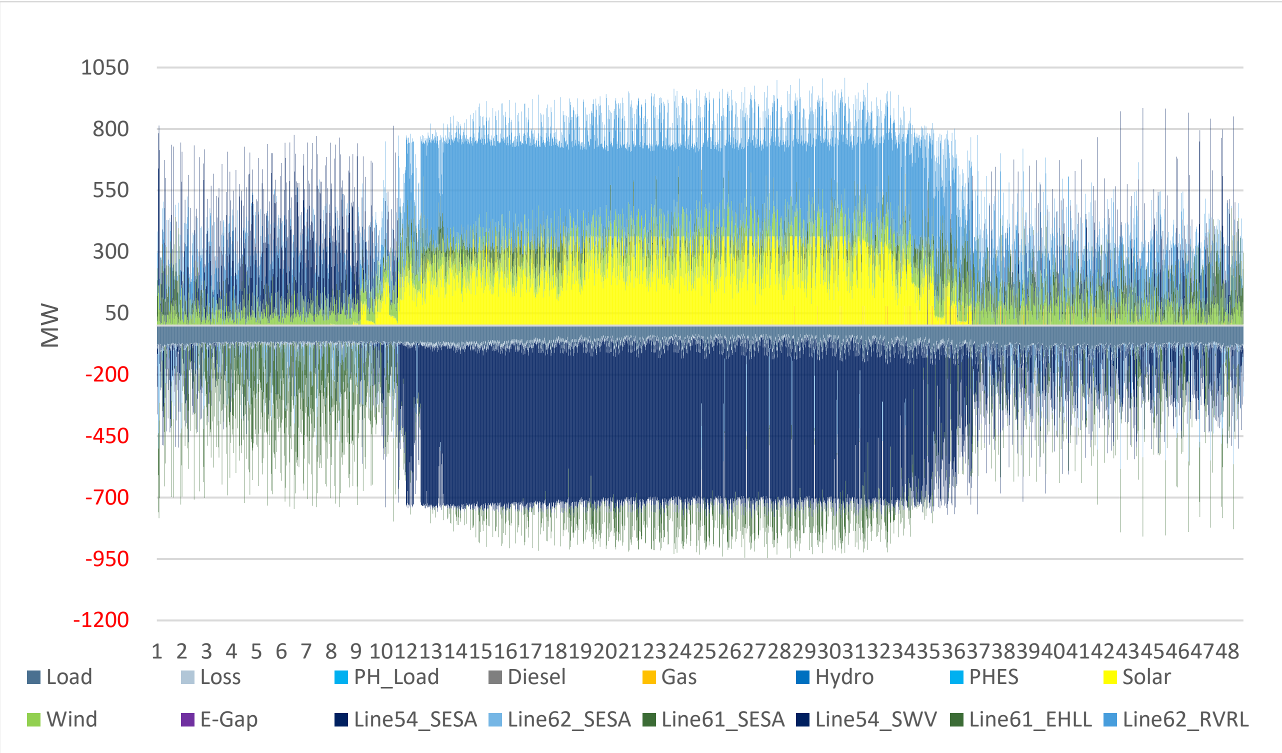

Figure 51: SE SOUTH AUSTRALIA energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 51 provides detail on the flow of energy through SESA node by time-of-day period by type of supply and demand. Of note:

[24] Source: AEMO Generation Information July 2020

- the dark green coloured series indicates exports (mainly) to Eastern Hills node, where there is no generation capacity.
- the navy-blue coloured series indicates exports to SWV node, even though there is 4GW of wind generation capacity in SWV
- the light blue coloured series indicates imports (primarily) from Riverlands node in SA where there is 1,230MW of solar capacity
- the steel-blue coloured series indicates SESA load
- the light green coloured series indicates generation from wind (315MW) within the SESA node. Potential dispatch has CF of 27% during summer (42% in winter and 31% over the year). 2% of potential wind generation is curtailed resulting in a capacity factor for SummWD of 26%. Figure 53 shows detail
- the yellow coloured series indicates generation from solar (363MW) within the SESA node. Potential dispatch has CF of 45% during summer (16% in winter and 31% over the year), but 22% of potential solar generation is curtailed resulting in a capacity factor for SummWD of 35%. Figure 52 shows detail
- E-G in the SESA node is negligible
- Table 48 details statistics for SESA energy flows

Table 48: SOUTH EAST SOUTH AUSTRALIA salient statistics under sB (without QLD Pump Hydro)

SESA STATISTICS	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(111)	(92)	(77)	(154)	50%	(73)
Gas	2	5	1	80	2%	0
Diesel	0	0	0	0	2%	0
Solar	184	60	128	363	35%	102
Wind	118	91	82	246	26%	78
E-G	0	0	0	3	0%	0
Exports	(666)	(354)	(462)	(834)	55%	(533)
Imports	525	330	364	714	51%	429
Solar_spill	52	5	36	281	13%	0
Wind_spill	2	3	2	238	1%	0
Solar spill %	22%	7%	22%			
Wind spill %	2%	4%	2%			

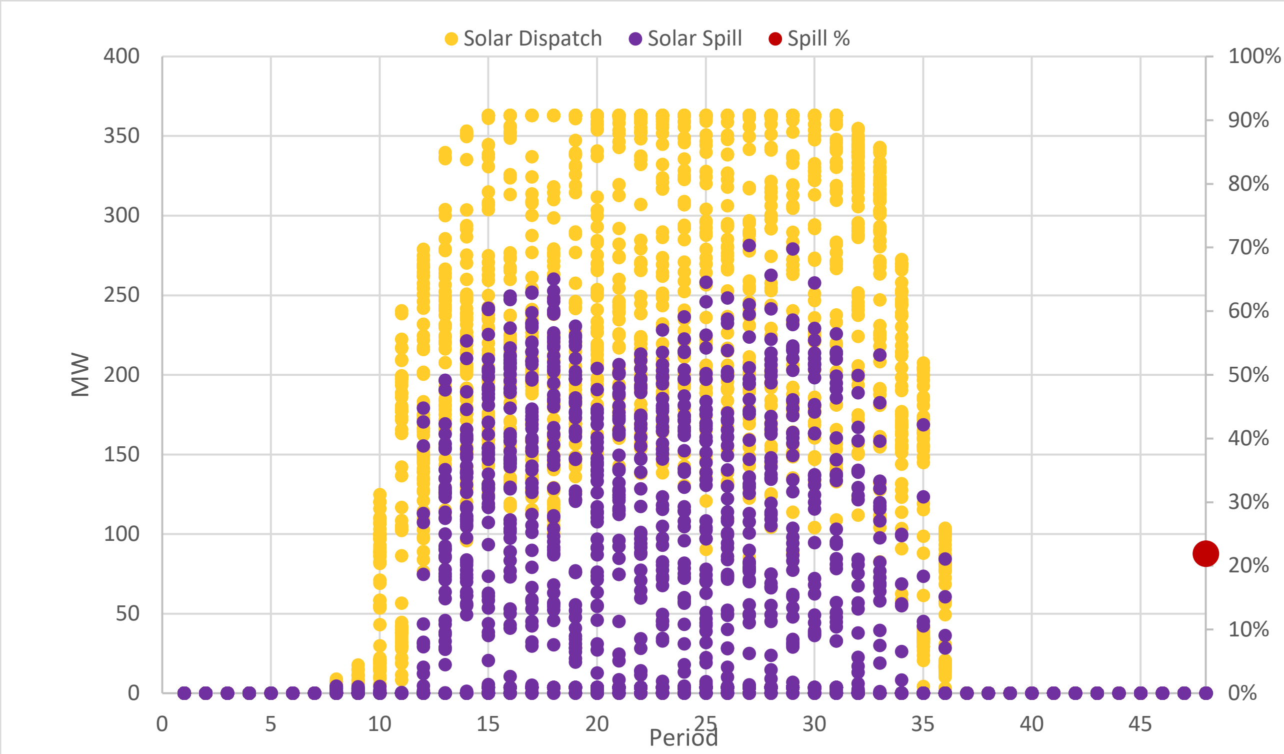

Figure 52: SE SOUTH AUSTRALIA solar dispatch and curtailment under sB (without QLD Pump Hydro)

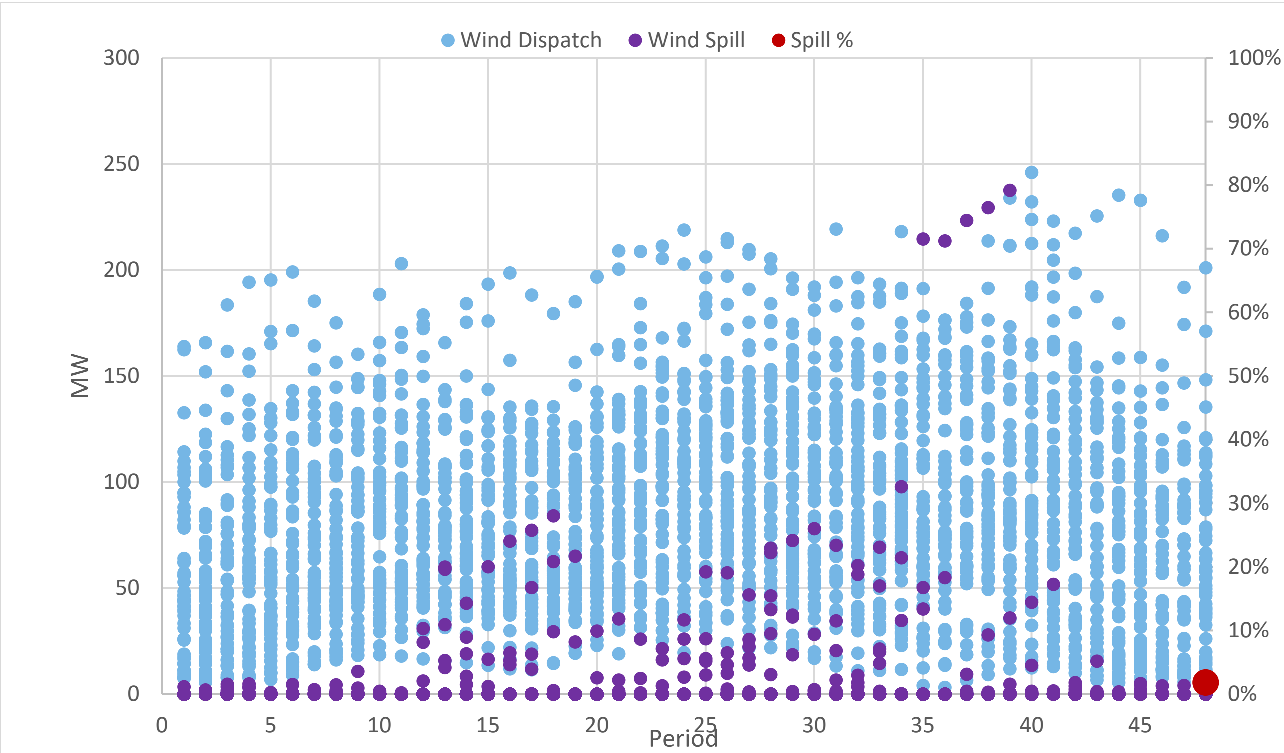

Figure 53: SE SOUTH AUSTRALIA wind dispatch and curtailment under sB (without QLD Pump Hydro)

4. MID NORTH SOUTH AUSTRALIA details for summer weekdays

Table 49 provides a summary of the generating capacity assumptions for Mid North South Australia (MNSA) node

Table 49: MID NORTH SOUTH AUSTRALIA capacity assumptions under sB (without QLD Pump Hydro)

MNSA Capacity assumptions	Current [25] (MW)	2030 (MW)	Notes
Gas/Diesel	391	361	Capacity factor: -%
Solar	-	990	CF (full year) 15%, (SummWD) 17% Curtail (full year) 54%, (SummWD) 64%
Wind	1,414	2,112	CF (full year) 24%, (SummWD) 23% Curtail (full year) 42%, (SummWD) 48%
Storage/Other	100	245	Capacity factor; 2%
TOTAL	1,905	3,708	

[25] Source: AEMO Generation Information July 2020

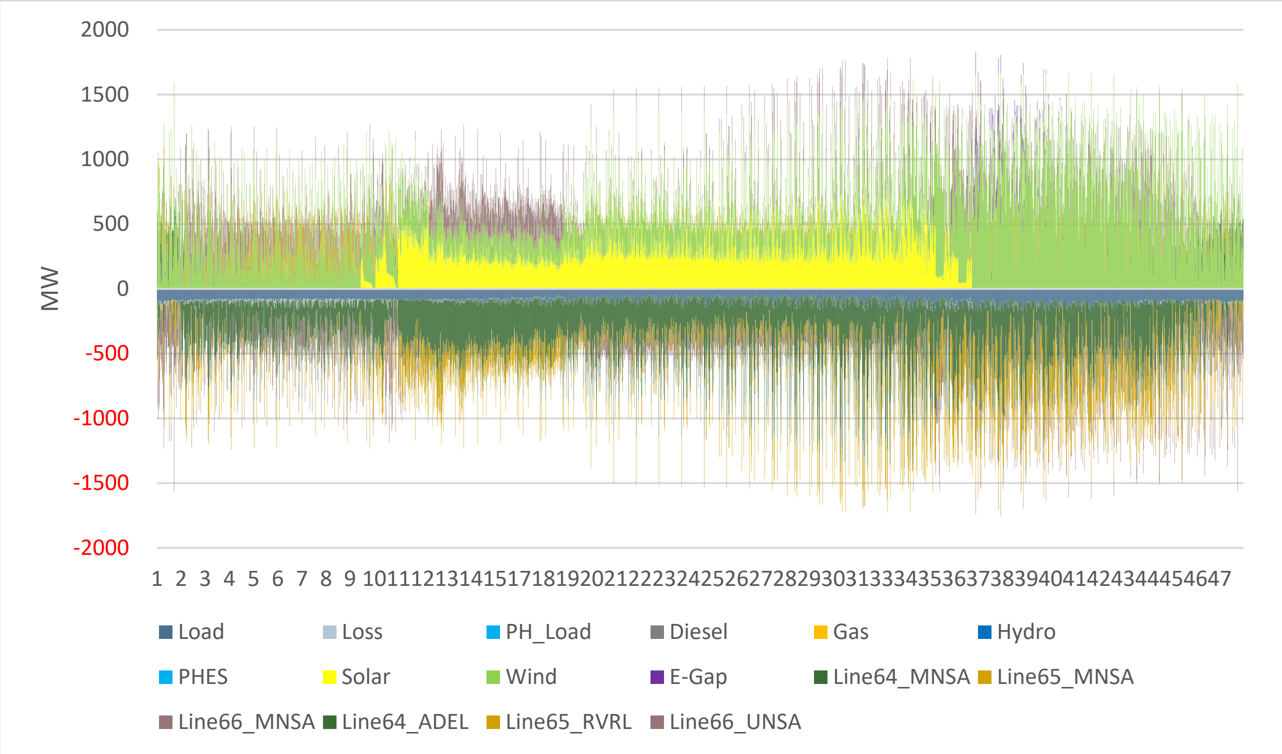

Figure 54: MID NORTH SOUTH AUSTRALIA energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 54 provides detail on the flow of energy through MNSA node by time-of-day period by type of supply and demand. Of note:

- the dark green coloured series indicates exports (mainly) to ADEL node, the primary load centre
- the dark gold coloured series indicates exports to Riverlands node, even though there is 1.2GW of solar generation capacity in Riverlands. Exports to Riverlands occur roughly equally between evening peak (87GWh), overnight (89GWh) and during daylight (87GWh) as Riverlands has no wind generation
- the light brown coloured series indicates exports and imports to and from Upper North SA node in SA where there is 1,270MW of solar, 422MW of wind and 500MW of PHES capacity
- the steel-blue coloured series indicates MNSA load which is modest
- the light green coloured series indicates generation from wind (2,112MW) within the MNSA node. Potential dispatch has CF of 44% during summer (34% in winter and 41% over the year). 48% of potential wind generation is curtailed resulting in a capacity factor for SummWD of 23%. Figure 57 shows detail
- the yellow coloured series indicates generation from solar (990MW) within the MNSA node. Potential dispatch has CF of 46% during summer (18% in winter and 32% over the year). 64% of potential solar generation is curtailed resulting in a capacity factor for SummWD of 17%. Figure 56 shows detail
- E-G in the MNSA node is maximised at 245MW, and is persistent during evening peak, periods 37-41 during SummWD. Figure 55 gives detail

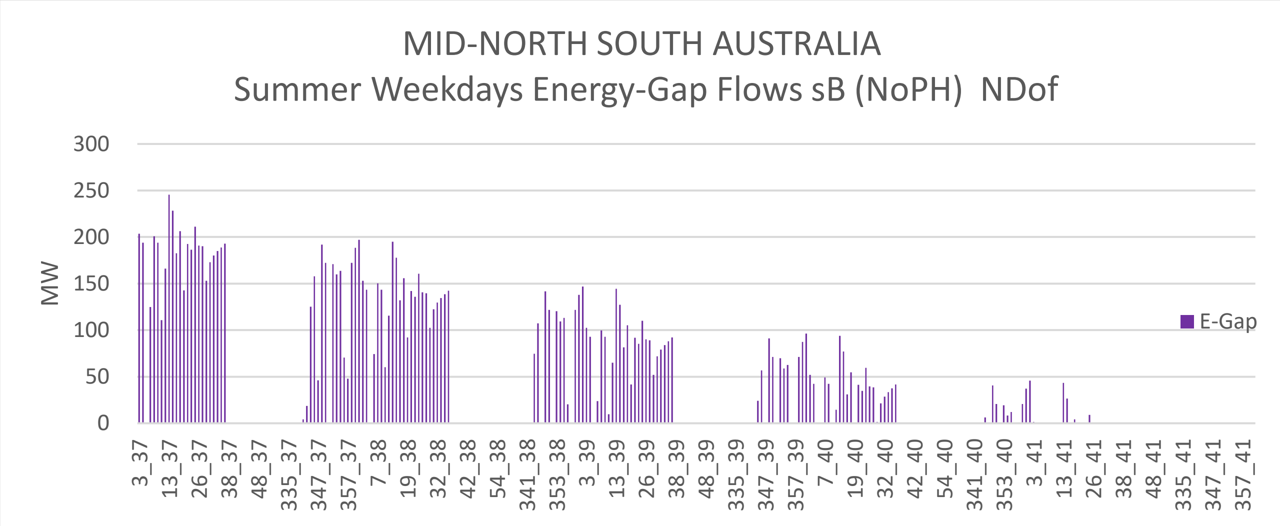

Figure 55: MNSA Energy-Gap during SummWD under sB (without QLD Pump Hydro)

- Table 50 details statistics for MNSA energy flows

Table 50: MID NORTH SOUTH AUSTRALIA salient statistics under sB (without QLD Pump Hydro)

MNSA Statistics SALIENT STATISTICS	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(129)	(108)	(90)	(182)	49%	(86)
Gas	0	0	0	3	-%	0
Diesel	0	0	0	0	-%	0
Solar	238	125	165	808	20%	183
Wind	688	790	478	1,670	23%	334
E-G	7	24	5	245	2%	0
Exports	(935)	(868)	(649)	(1,590)	41%	(562)
Imports	195	94	135	660	20%	89
Solar_spill	415	61	288	874	33%	0
Wind_spill	640	619	444	1,936	23%	243
Solar spill %	64%	33%	64%			
Wind spill %	48%	44%	48%			

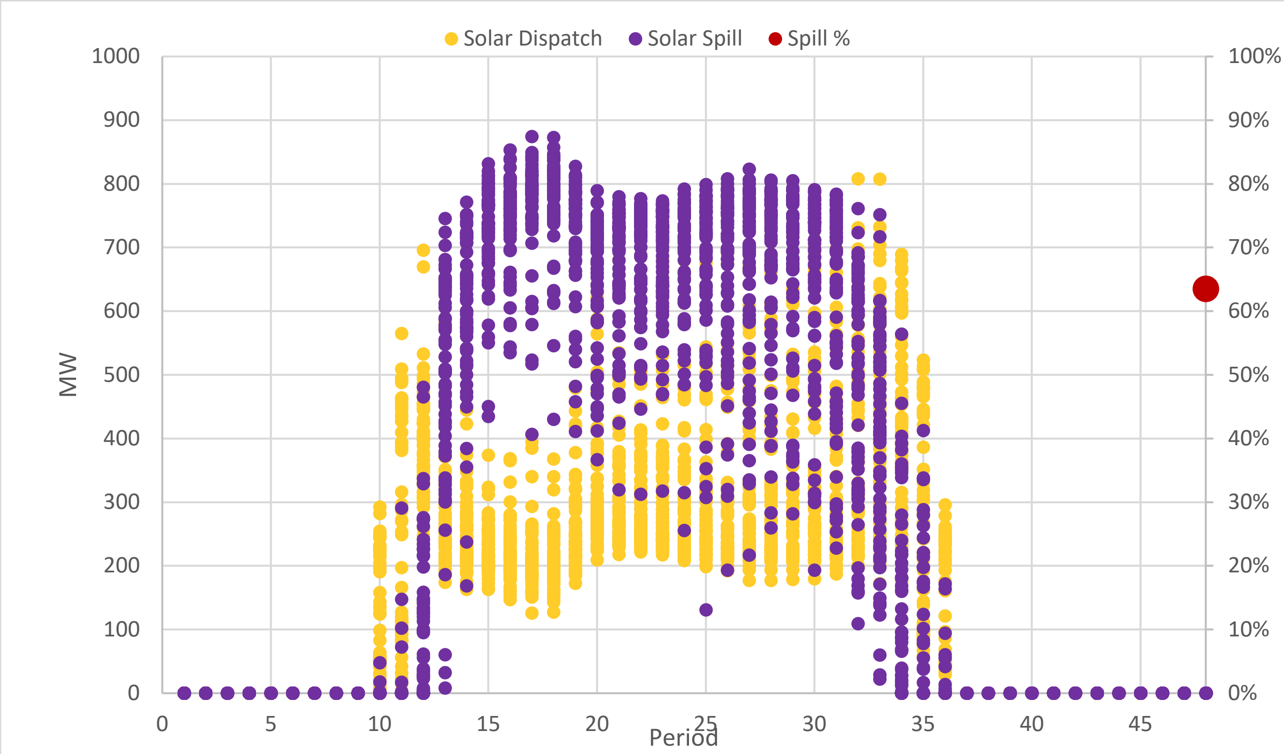

Figure 56: MID NORTH SOUTH AUSTRALIA solar dispatch and curtailment under sB (without QLD Pump Hydro)

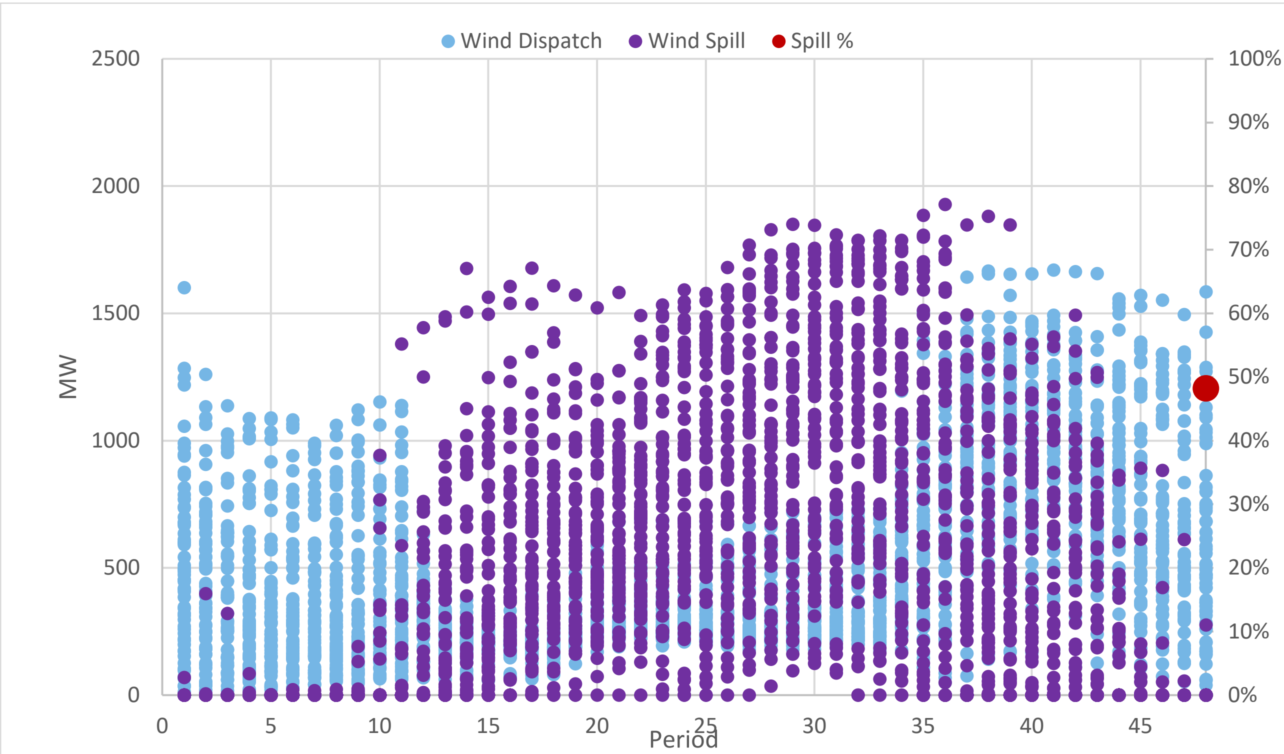

Figure 57: MID NORTH SOUTH AUSTRALIA wind dispatch and curtailment under sB (without QLD Pump Hydro)

5. UPPER NORTH SOUTH AUSTRALIA details for summer weekdays

Table 51 provides a summary of generating capacity assumptions for Upper North SA (UNSA) node

Table 51: UPPER NORTH SOUTH AUSTRALI capacity assumptions under sB (without QLD Pump Hydro)

UNSA Capacity assumptions	Current [26] (MW)	2030 (MW)	Notes
Solar	135	1,270	Capacity factor: 13%, curtailment: 71%
Wind		422	Capacity factor: 39%; curtailment: 8%
PHES		500	Capacity factor: 3%
Storage/Other		500	Capacity factor: 19%
TOTAL	135	2,692	

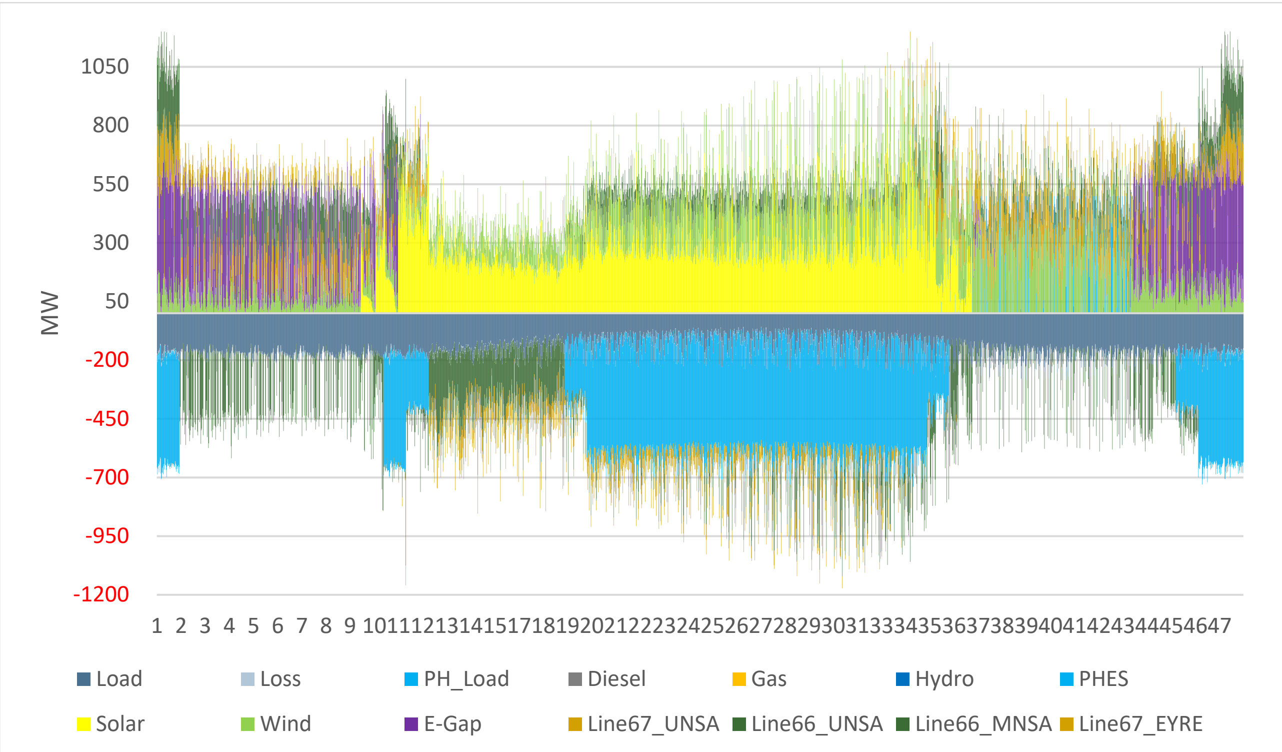

Figure 58: UPPER NORTH SOUTH AUSTRALIA energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 58 provides detail on the flow of energy through UNSA node by time-of-day period by type of supply and demand. Of note:

- the dark green coloured series indicates exports and imports between UNSA and MNSA nodes.

[26] Source: AEMO Generation Information July 2020

- the dark gold coloured series indicates imports and exports between UNSA and Eyre Peninsula.
- the light green coloured series indicates wind dispatched from 422MW in UNSA. Curtailment of wind generation is 8% during SummWD, resulting in a capacity factor of 39% for wind generation. Figure 61 shows detail
- the yellow coloured series indicates solar dispatched from 1,270MW in UNSA. Solar dispatch is maximised at 868MW during SummWD which is significantly lower than full capacity, resulting in very high (71%) curtailment of solar in the node from potential dispatch. Figure 60 shows detail.
- the cyan coloured series indicates PHES (500MW) pumping load if negative and dispatch if positive
- UNSA has high levels of solar (1,270MW) and 422MW of wind within the node and MNSA has high levels of solar (990MW) and 2,112MW of wind within its node, resulting in significant transfer between the nodes as resources vary in each node, but also significant curtailment of both wind and solar.
- the steel-blue coloured series indicates UNSA load which is modest at an average of 159MW over SummWD
- there is evidence of a persistent E-G overnight. Figure 59 shows detail. The E-G is, in effect, dispatch from Baroota (250MW) and Goats Hill (250MW) which is outside of the dispatch strategy and assumed to be E-G because dispatch is only possible at high spot price. The associated reason for classifying this dispatch as E-G, is because night-time dispatch would deplete potential for dispatch during morning and evening peak. However, it is apparent that there is a significantly large requirement for supply overnight (due to the lack of solar energy, and unreliable generation from wind) in addition to evening peak. This implies a greater requirement for storage to meet demand overnight. (New version of ANEM, which pumps based on VRE resource and dispatches based on storage, will provide greater clarity with respect to real E-G).

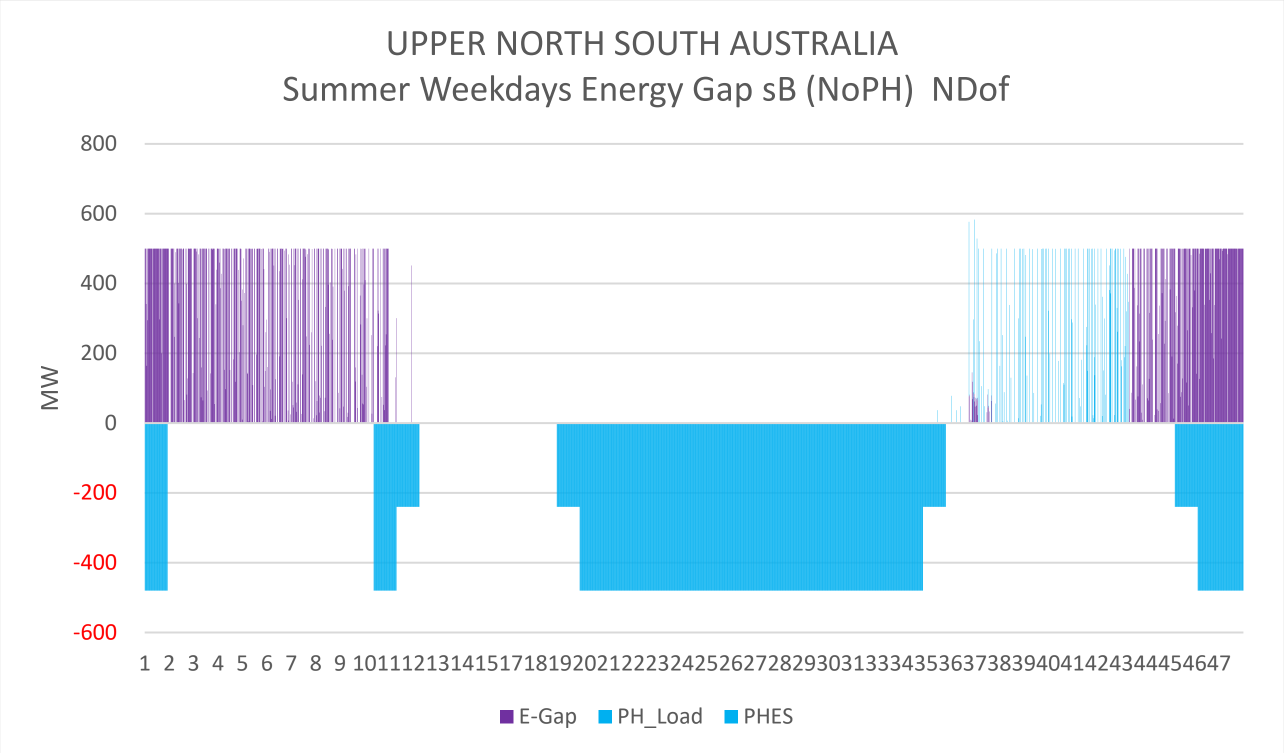

Figure 59: Upper North South Australia Energy-Gap for SummWD under sB (without QLD Pump Hydro)

- Table 52 details statistics for UNSA energy flows

Table 52: UPPER NORTH SOUTH AUSTRALIA salient statistics under sB (without QLD Pump Hydro)

UNSA STATISTICS	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(223)	(169)	(155)	(283)	55%	(160)
PH_Load	(302)	(120)	(210)	(480)	44%	0
PHES	20	49	14	500	3%	0
Solar	244	134	170	868	13%	185
Wind	237	250	165	422	39%	157
E-G	146	3	102	500	20%	0
Exports	(251)	(206)	(174)	(659)	26%	(170)
Imports	139	64	97	808	12%	80
Solar_spill	593	102	412	1,157	36%	0
Wind_spill	21	25	15	390	4%	0
Solar spill %	71%	43%	71%			
Wind spill %	8%	9%	8%			

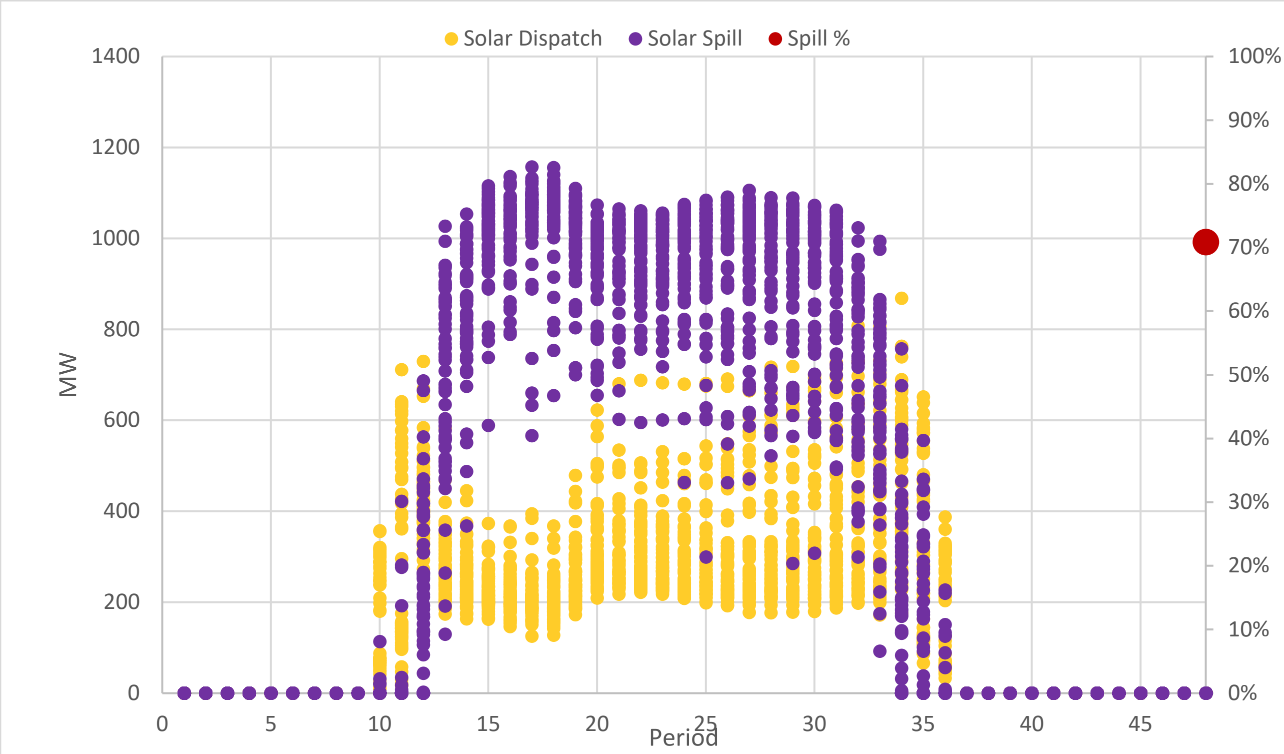

Figure 60: UPPER NORTH SOUTH AUSTRALIA solar dispatch and curtailment under sB (without QLD Pump Hydro)

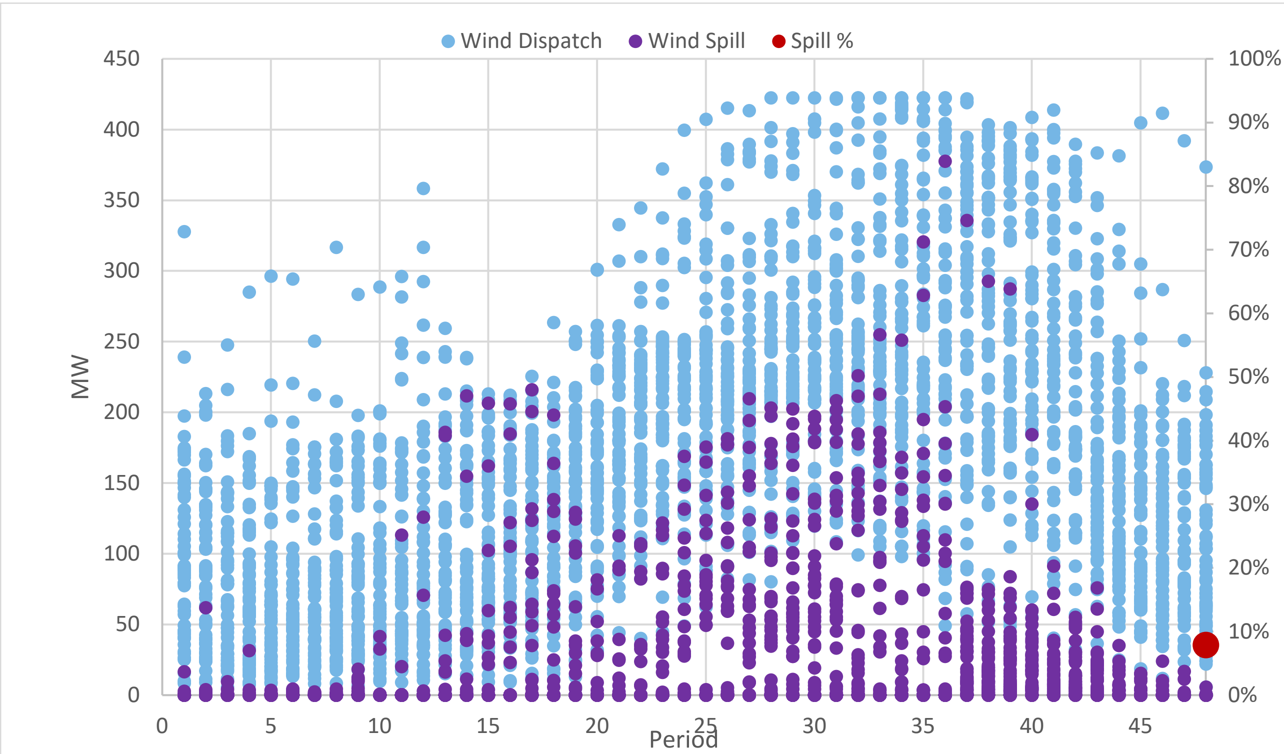

Figure 61: UPPER NORTH SOUTH AUSTRALIA wind dispatch and curtailment under sB (without QLD Pump Hydro)

6. RIVERLANDS details for summer weekdays

Table 53 provides a summary of generating capacity assumptions for Riverlands (RVRL) node

Table 53: RIVERLANDS capacity assumptions under sB (without QLD Pump Hydro)

RVRL Capacity assumptions	Current [27] (MW)	2030 (MW)	Notes
Solar	-	1,230	Capacity factor: 9%; curtailment: 80%
Storage/Other		101	Capacity factor: 0%
TOTAL	-	1,331	

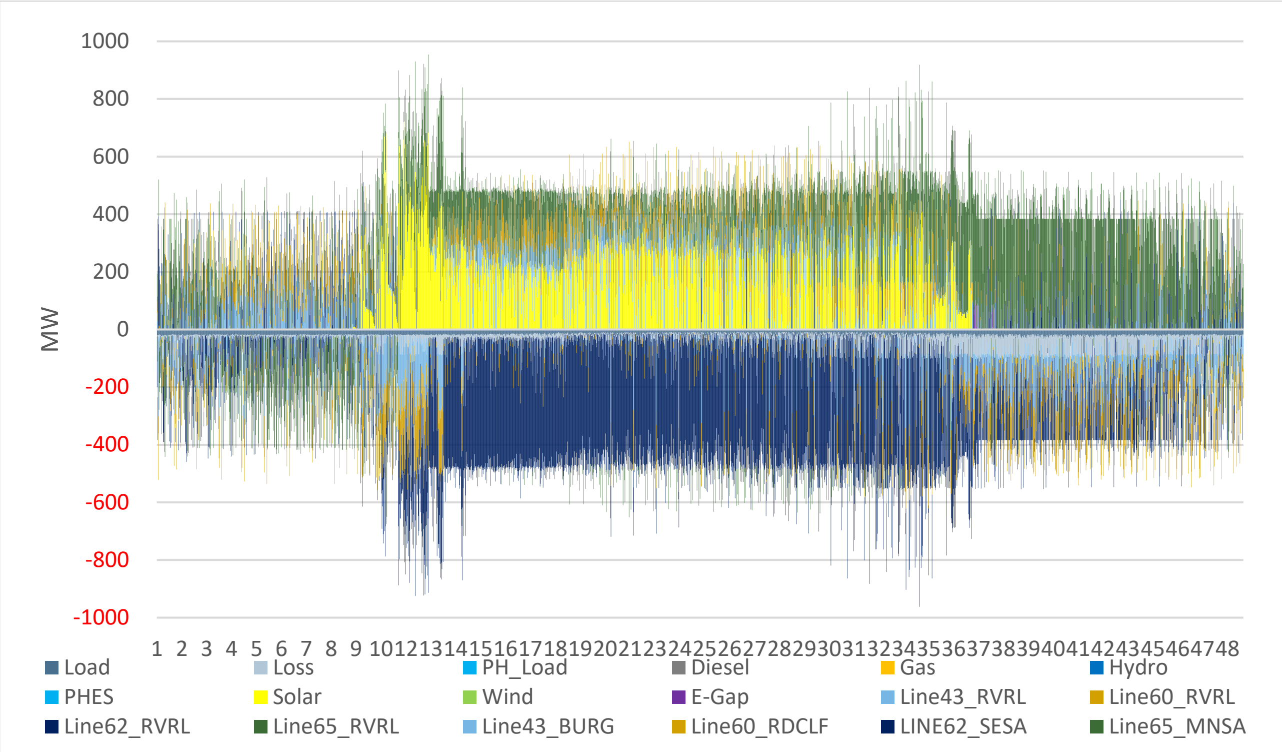

Figure 62: RIVERLANDS energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 62 provides detail on the flow of energy through RVRL node by time-of-day period by type of supply and demand. Of note:

- the dark green coloured series indicates exports and imports between RVRL and MNSA nodes.
- the dark gold coloured series indicates imports and exports between RVRL and RDCLF nodes.
- the yellow coloured series indicates solar dispatched from 1,230MW in RVRL. Solar dispatch is maximised at 722MW during SummWD which is significantly lower than full capacity, resulting in very high (80%) curtailment of solar in the node from potential dispatch. Figure 64 shows detail.

[27] Source: AEMO Generation Information July 2020

- the navy blue coloured series indicates exports (primarily) to SESA node
- the light blue coloured series indicates imports and exports between RVRL and Buronga in NSW
- RVRL has 1,273MW of solar within the node, connecting nodes MNSA and RDCLF (VIC) have high levels of solar 990MW and 1000MW respectively in addition to wind capacity of 2112MW in MNSA, resulting in significant surplus capacity during the day for RVRL but also MNSA and RDCLF
- there is evidence of an incidental E-G during evening peak, specifically during period 37. Figure 63 shows detail.

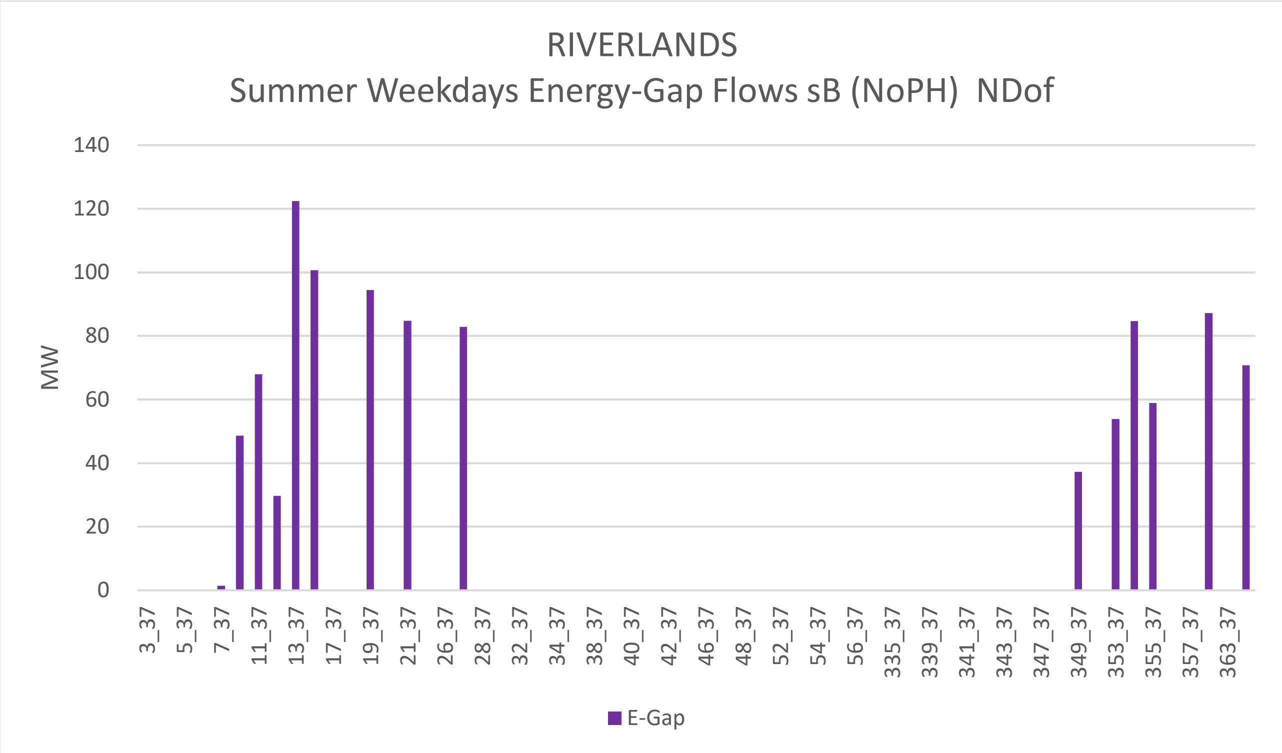

Figure 63: Riverlands Energy Gap during SummWD under sB (without QLD Pump Hydro)

- Half of the incidence of E-G is during the Christmas-New Year period. The remaining E-Gs are related to periods of low wind resource in VIC and TAS, 15% and 12% respectively, of nameplate capacity, which result in energy flows away from SA towards VIC.
- Table 54 details statistics for RVRL energy flows

Table 54: RIVERLANDS salient statistics under sB (without QLD Pump Hydro)

RVRL SALIENT STATISTICS	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(27)	(21)	(19)	(36)	52%	(18)
Solar	161	58	112	722	9%	0
E-G	1	2	0	122	0%	0
Exports	(544)	(382)	(378)	(887)	43%	(415)
Imports	445	393	309	566	55%	311
Solar_spill	651	151	452	1,242	36%	26
Solar spill %	80%	72%	80%			

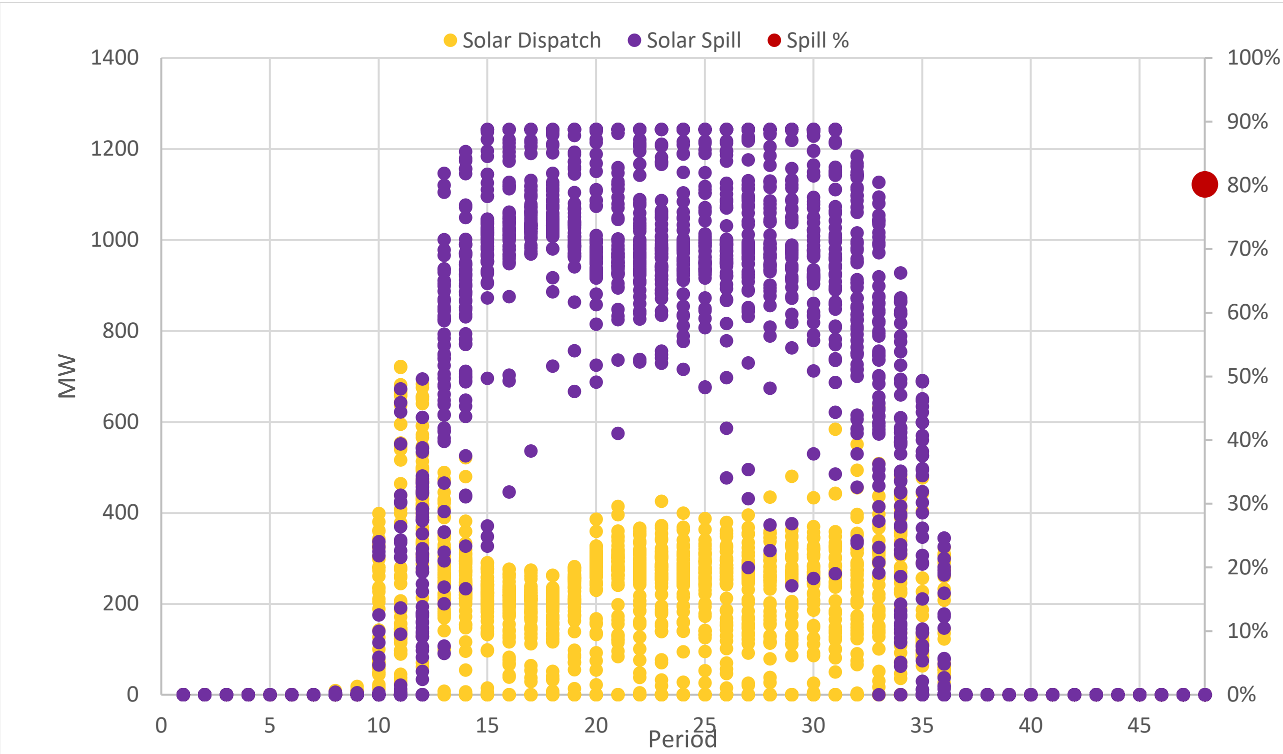

Figure 64: RIVERLANDS solar dispatch and curtailment under sB (without QLD Pump Hydro)

7. EYRE PENINSULA details for summer weekdays

Table 55 provides a summary of generating capacity assumptions for Eyre Peninsula (EYRE) node

Table 55: EYRE PENINSULA capacity assumptions under sB (without QLD Pump Hydro)

EYRE Capacity assumptions	Current [28] (MW)	2030 (MW)	Notes
Diesel	74	74	Capacity factor: -%
PHES		110	Capacity factor: 3%
Solar		360	CF(full year) 27%, (SummWD) 36% Curtail (full year) 19%, (SummWD) 22%
Wind	136	136	CF (full year) 26%, (SummWD) 26% Curtail (full year) 9%, (SummWD) 4%
Storage/Other		110	Capacity factor: 21%
TOTAL	210	790	

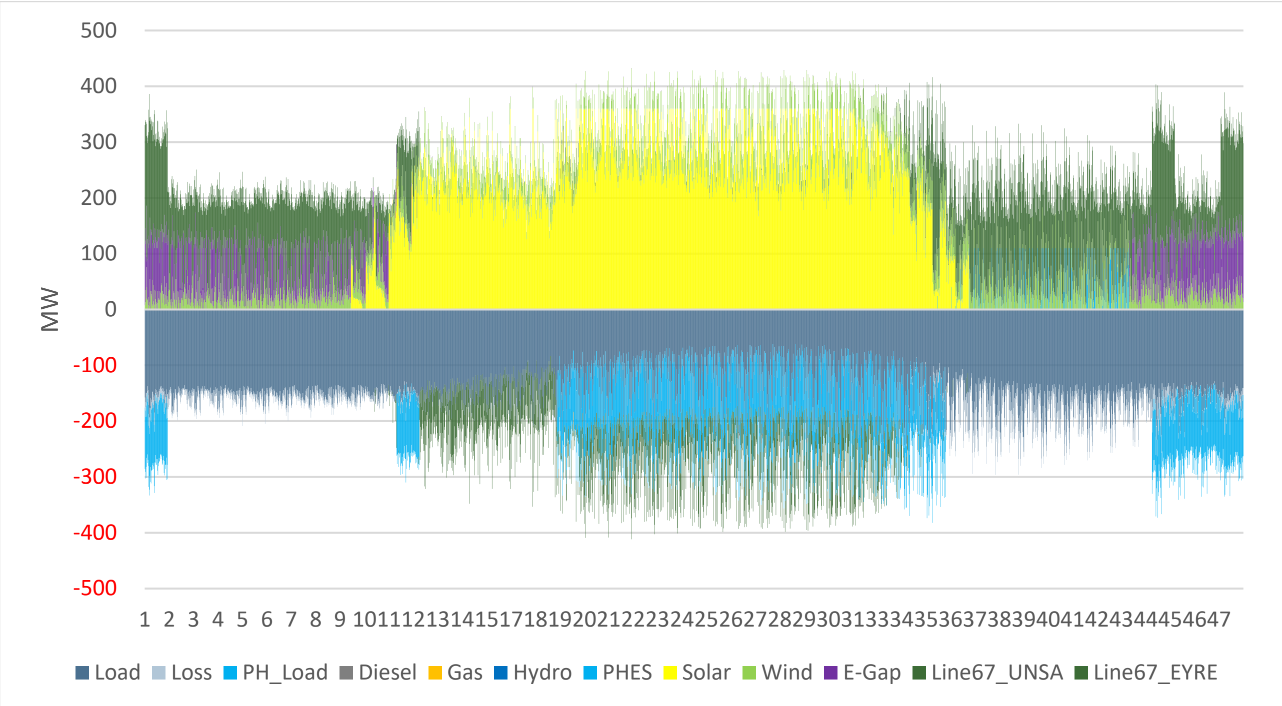

Figure 65: Eyre Peninsula energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 65 details the flow of energy through EYRE node by time-of-day period by type of supply and demand. Of note:

[28] Source: AEMO Generation Information July 2020

- EYRE has a single transmission link to UNSA. The dark green coloured series indicates the flow of energy between EYRE and UNSA
- the yellow coloured series indicates solar dispatched from 360MW in EYRE. Potential dispatch has CF of 46% during summer (20% in winter and 33% over the year). With 21% curtailment of potential dispatch, capacity factor for solar dispatch reduces to 37%.
- the steel blue coloured series indicates load in EYRE, in average 148MW
- there is evidence of a persistent E-G after evening peak and before morning peak. Figure 66 shows detail.

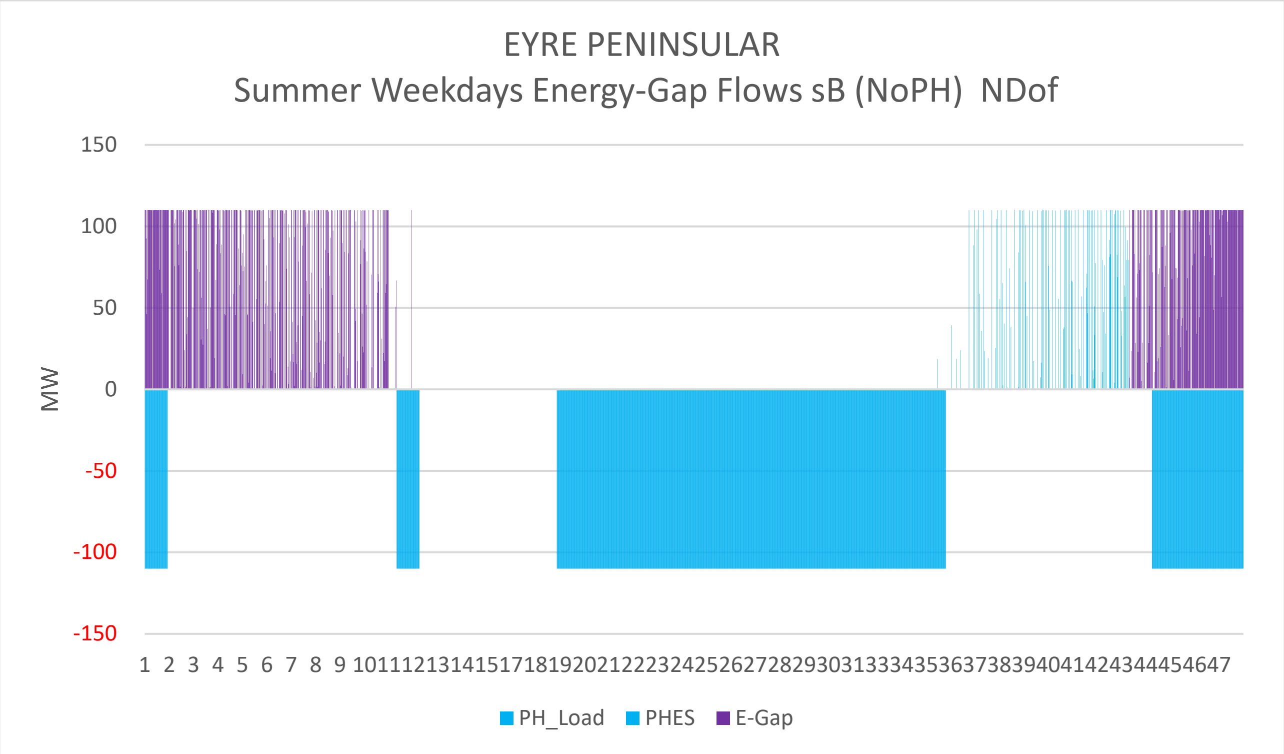

Figure 66: Eyre Peninsula energy-gap for SummWD under sB (without QLD Pump Hydro)

Similar to the E-G in UNSA, the E-G in EYRE is, in effect, dispatch from Middleback Ranges (110MW) which is outside of the dispatch strategy and assumed to be E-G because dispatch is only possible at high spot price. The associated reason for classifying this dispatch as E-G, is because night-time dispatch would deplete potential for dispatch during morning and evening peak. However, it is apparent that there is a significantly large requirement for supply overnight (due to the lack of solar energy, and unreliable generation from wind) in addition to evening peak. This implies a greater requirement for storage to meet demand overnight

- Table 56 details statistics for EYRE energy flows

Table 56: EYRE PENINSULA salient statistics under sB (without QLD Pump Hydro)

EYRE SALIENT STATISTICS	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(213)	(167)	(148)	(268)	55%	(148)
PH-Load	(76)	(33)	(53)	(110)	48%	0
Diesel	0	0	0	0	-%	0
PHES	5	11	3	110	3%	0
Solar	189	68	131	360	37%	105
Wind	50	42	35	110	26%	31
E-G	33	0	23	110	21%	0
Exports	(41)	(5)	(29)	(175)	16%	0
Imports	103	125	72	346	21%	54
Solar_spill	50	3	34	236	15%	0
Wind_spill	2	5	1	47	3%	0
Solar spill %	21%	4%	21%			
Wind spill %	4%	10%	4%			

8. CONCLUDING OBSERVATIONS for SA nodal supply-demand balance

There is significant curtailment for both wind and solar in SA, particularly in MNSA, UNSA and Riverlands. Energy Connect augmentation, 800MW of transfer capacity, and only marginal expansion of Heywood interconnection, does not appear to be sufficient to prevent high levels of curtailment in SA. Over the full year, 314GWh of energy flows from NSW to SA compared to 590GWh from SA to NSW. The interconnection results in exports from SA to NSW 58% of the time, and imports from NSW to SA 42% of the time. Energy Connect is providing opportunities for export of SA surplus VRE, but the interconnection is insufficient to avert very high levels of over-supply and curtailment. Consideration should be given to further transmission augmentation to avoid the wholescale curtailment predicted by the modelling.

5. TASMANIA: Nodal Supply-Demand Balance for Summer Weekdays in 2030

a) Pipeline Scenario B (without Queensland Pump Hydro)

i. TAS Underlying assumptions

- N transmission network
- Direction of Flow loss method estimation
- There will be no coal generation in TAS in 2030. In the other states, coal generation will decline (VIC 3,144MW from 4,775MW; NSW 4,040MW from 10,210MW; QLD 4,839MW from 8,059MW)
- Coal unit closures by 2030 include:
    - QLD: Units 1-2 Callide B; Units 1-2 Stanwell; Units 1-2,5-6 Gladstone; Units 1-2 Tarong;
    - NSW: Units 1-4 Liddell; Units 1-4 Eraring; Units 5-6 Vales Point
    - VIC: Units 1-4 Yallourn
- Gas power in 2030 will remain at current capacity of 372MW in TAS. Gas generation in other states will total NSW 3,048MW; VIC 2,364MW; QLD 2,691MW; SA 2,368MW
- Wind power in 2030 will reach 2,302MW in TAS (SA 3,652MW; VIC 8,470MW: NSW 5,671MW; QLD 4,820MW;)
- There will be little solar power in 2030 in TAS (SA 4,213MW, VIC 2,141MW; NSW 8,021MW; QLD 8,736MW)
- Transmission augmentation assumed stage 1 of battery of the nation – 750MW line from Burnie (TAS) to HAZL (VIC)
- Table 57 provides a summary of generating capacity assumptions for TAS

Table 57: TASMANIA capacity assumptions under sB (without QLD Pump Hydro)

TAS Capacity assumptions	Current [29] (MW)	2030 (MW)	Notes
Gas	386	372	Capacity factor: 19% (full year); 20% (Summ WD)
Hydro	2,289	2,275	Capacity factor: 33% (full year); 31% (Summ WD)
Wind	573	2,302	Capacity factor: 39% (full year); 30% (Summ WD) Curtailment: 5%, Max curtailment 885MW
Storage/Other	7	65	Capacity factor: 0%
TOTAL	3,255	5,014	

[29] Source: AEMO Generation Information July 2020

ii. TAS modelling outcomes for Summer Weekdays in 2030

1. TAS Fuel share (Summer Weekdays)

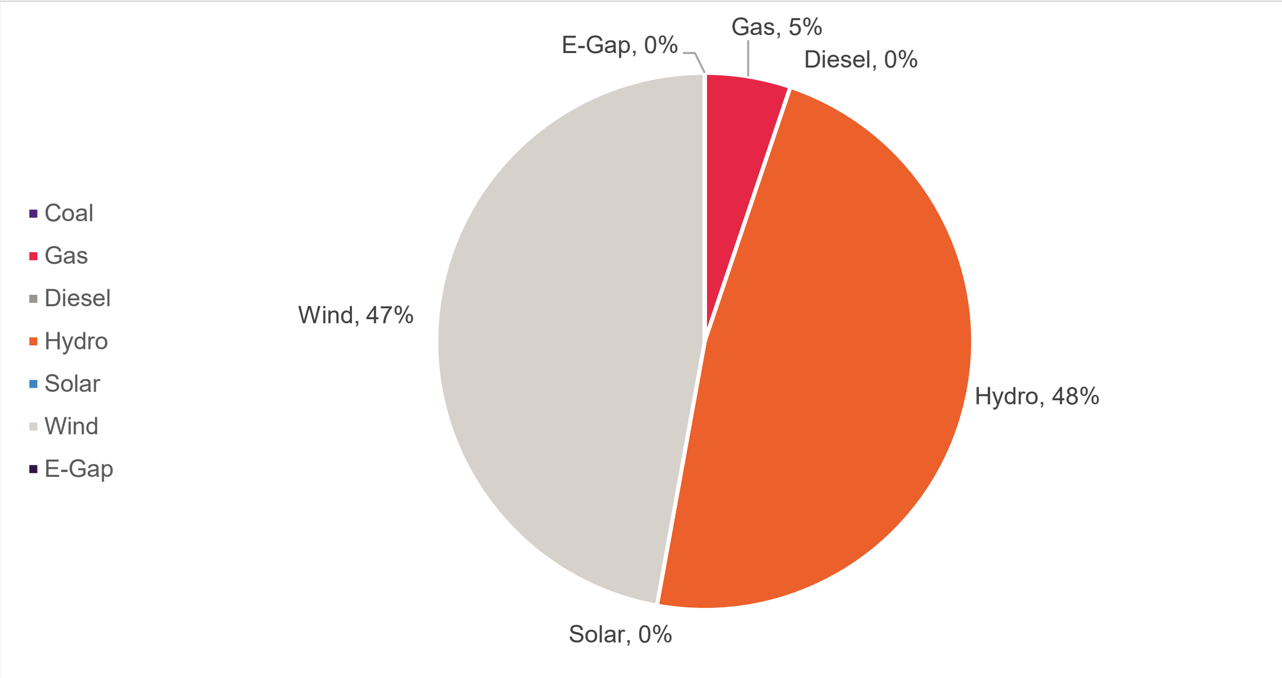

Figure 67: TAS fuel share during SummerWD under sB (without QLD Pump Hydro)

Modelling outcomes predict that 48% of electricity generated in TAS in 2030 is sourced from hydro, 47% from wind, and 5% from gas as shown in Figure 67. There is a negligible E-G.

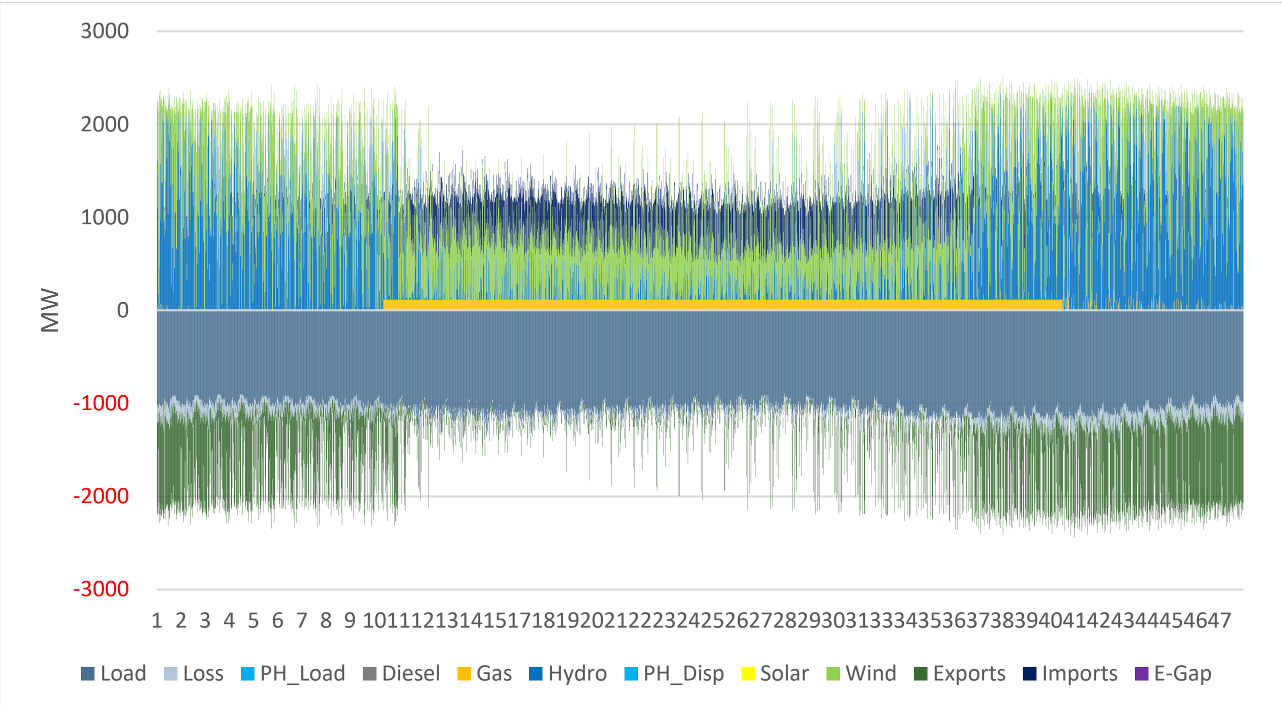

Figure 68: TAS energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 68 provides detail on the flow of energy through TAS by time-period according to source. Of note:

- the dark green coloured series indicates exports to VIC which are greatly reduced during sunlight hour, increasing from evening peak through to morning peak
- the navy blue coloured series indicates imports from VIC which are relatively small and predominantly during daylight hours
- the gold coloured series indicates gas generation within TAS from capacity of 372MW which tends to dispatch from morning to evening peak
- the royal blue coloured series indicates hydro generation within TAS from capacity of 2275MW which dispatches predominantly from evening peak through to morning peak with significantly reduced dispatch during sunlight hours
- the light green coloured series indicates wind generation from 2.3GW of capacity, which achieves a capacity factor of 31% with a 5% curtailment. Further detail can be seen in Figure 69
- the grey-blue coloured series indicates TAS load
- the purple coloured series indicates E-G which is negligible throughout all nodes in TAS.

Table 58 provides totals and averages of the summer weekday energy flows. Wind and hydro generate equal shares of total TAS supply with gas contributing a 5% share. Wind resource is fair and only 5% curtailed due to oversupply.

Table 58: TASMANIA salient statistics under sB (without QLD Pump Hydro)

TASMANIA SALIENT STATISTICS	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(1,532)	(1,126)	(1,064)	(1,372)	78%	(1,059)
Gas	109	98	76	237	20%	115
Hydro	1,004	922	697	2,146	32%	372
Wind	993	703	689	2,227	31%	566
E-G	0	0	0	4	0%	0
Exports	(643)	(562)	(446)	(1,235)	36%	(253)
Imports	284	132	197	577	34%	14
Wind_spill	56	5	39	885	4%	1
Wind spill %	5%	1%	5%			

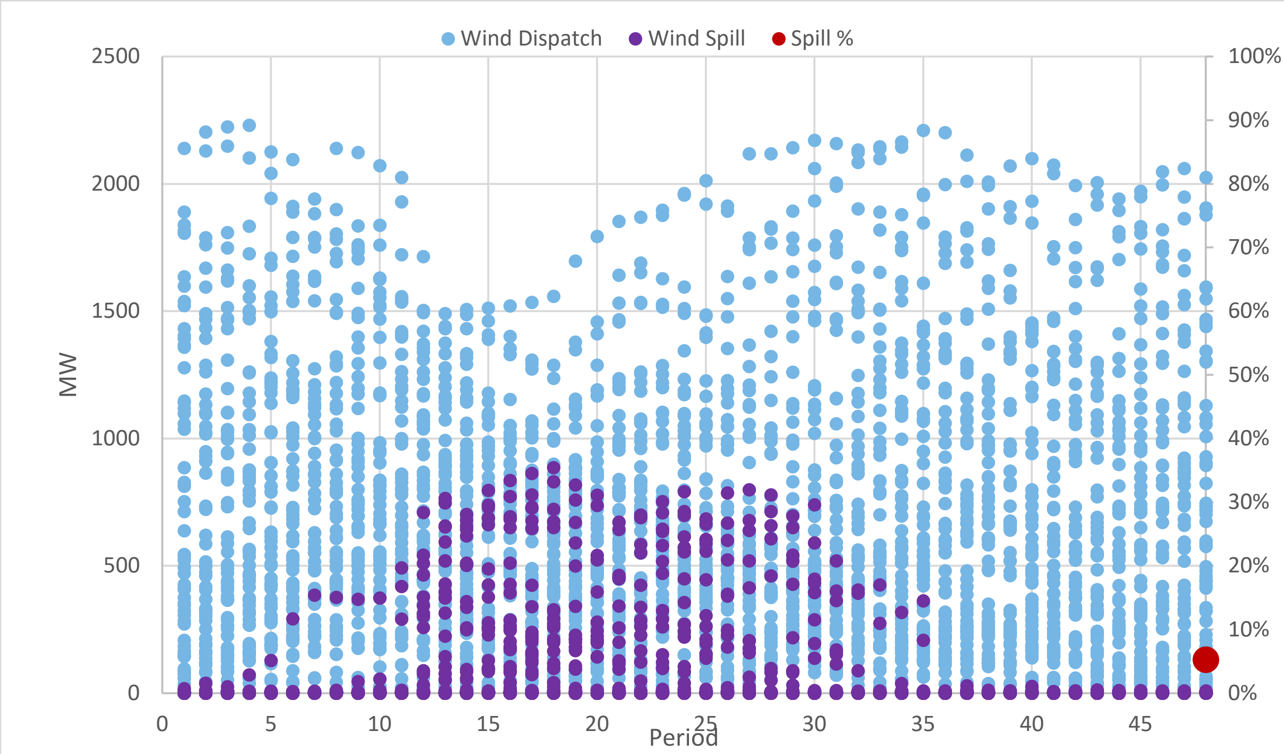

Figure 69: TAS coincident wind dispatch and curtailment under sB (without QLD Pump Hydro)

2. GEORGETOWN details for summer weekdays

Table 59 provides a summary of generating capacity assumptions for GeorgeTown (GT) node

Table 59: GEORGETOWN capacity assumptions under sB (without QLD Pump Hydro)

GT Capacity assumptions	Current [30] (MW)	2030 (MW)	Notes
Gas	386	372	Capacity factor: 20%
Wind		30	Capacity factor: 27%
Storage/Other		-	
TOTAL	386	402	

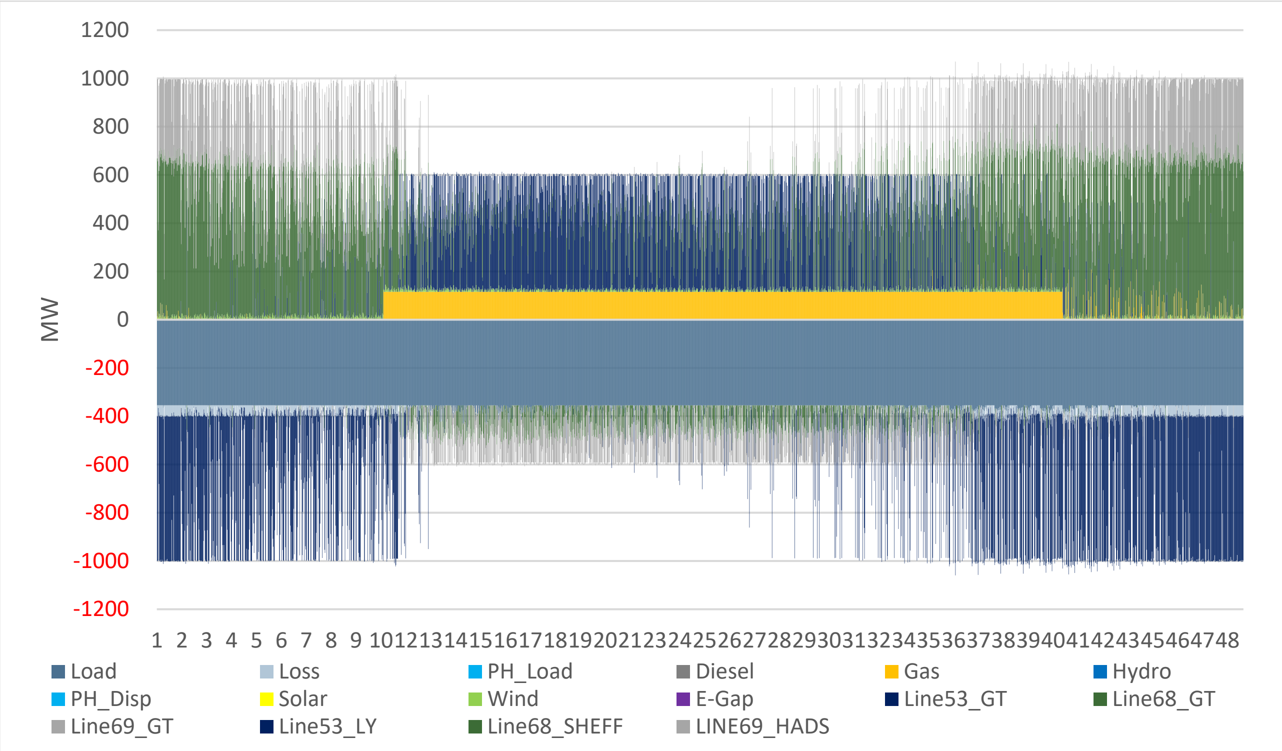

Figure 70: GEORGETOWN energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 70 provides detail on the flow of energy through GT by time-period according to source. Of note:

- the dark green coloured series indicates imports from Sheffield to the west which has wind (456MW) and hydro (308MW) capacity
- the navy blue coloured series indicates imports-exports from VIC. Imports tend to occur during the day whilst exports are predominantly overnight

[30] Source: AEMO Generation Information July 2020

- the light grey coloured series indicates imports-exports from Hadspen to the south-east of GT. Imports tend to occur overnight and exports during the day
- the light green coloured series indicates wind generation in GT. Generation capacity is only 30MW, so it is obscured in the details of Figure 69. Details of dispatch and curtailment can be found in Figure 71
- the gold coloured series indicates gas generation from Bell Bay and Tamar Valley GT within GT from capacity of 372MW which tends to dispatch from morning to the end of evening peak
- the steel-blue coloured series indicates GT load, at an average of 360MW
- there is no E-G

Table 60 details statistics for GT energy flows

Table 60: GEORGETOWN salient statistics under sB (without QLD Pump Hydro)

GT SALIENT STATISTICS	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(518)	(365)	(360)	(435)	83%	(355)
Gas	109	98	76	237	20%	115
Wind	12	7	8	30	27%	7
E-G	0	0	0	0	6%	0
Exports	(460)	(363)	(320)	(600)	53%	(237)
Imports	879	640	610	1,031	59%	480
Wind_spill	1	1	1	7	15%	0
Wind spill %	11%	13%	11%			

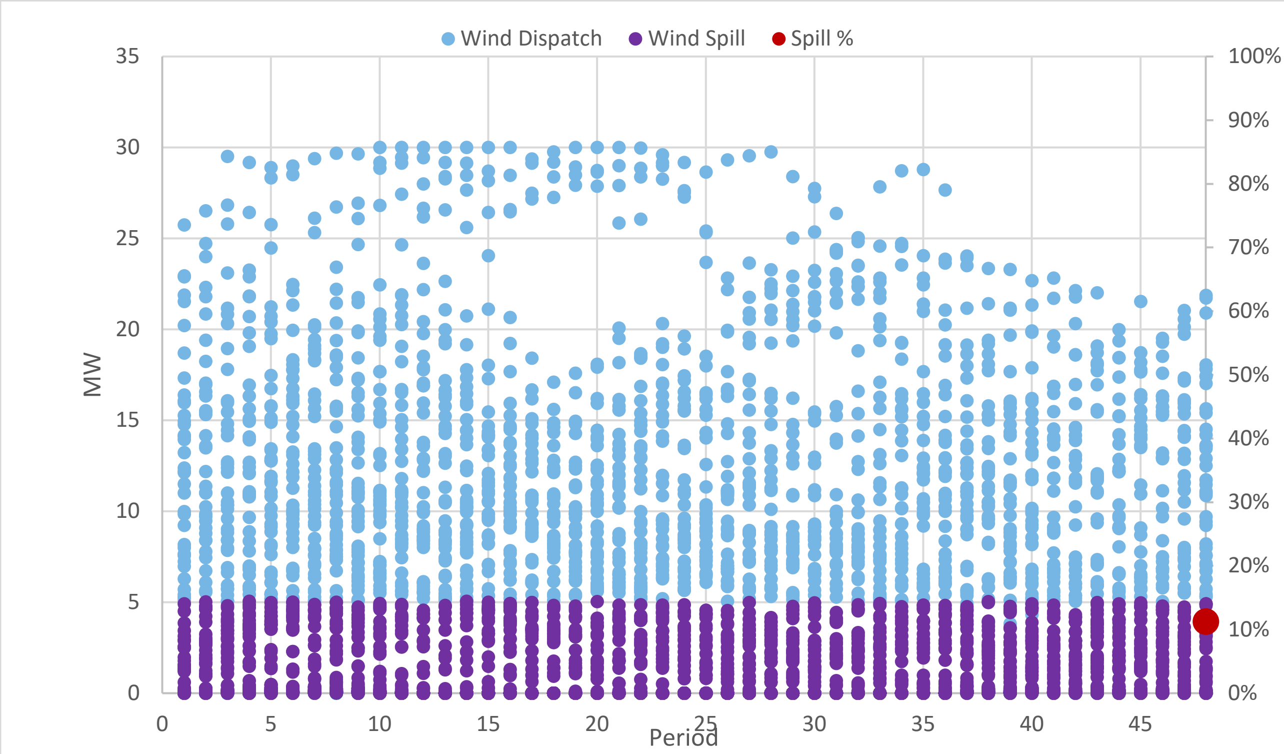

Figure 71: GEORGETOWN wind dispatch and curtailment under sB (without QLD Pump Hydro)

3. CHAPEL STREET details for summer weekdays

Table 61 provides a summary of generating capacity assumptions for Chapel Street (CHAP) node

Table 61: CHAPEL STREET capacity assumptions under sB (without QLD Pump Hydro)

CHAP Capacity assumptions	Current [31] (MW)	2030 (MW)	Notes
Gas		-	
Wind		-	
Storage/Other		-	
TOTAL		-	Load only node

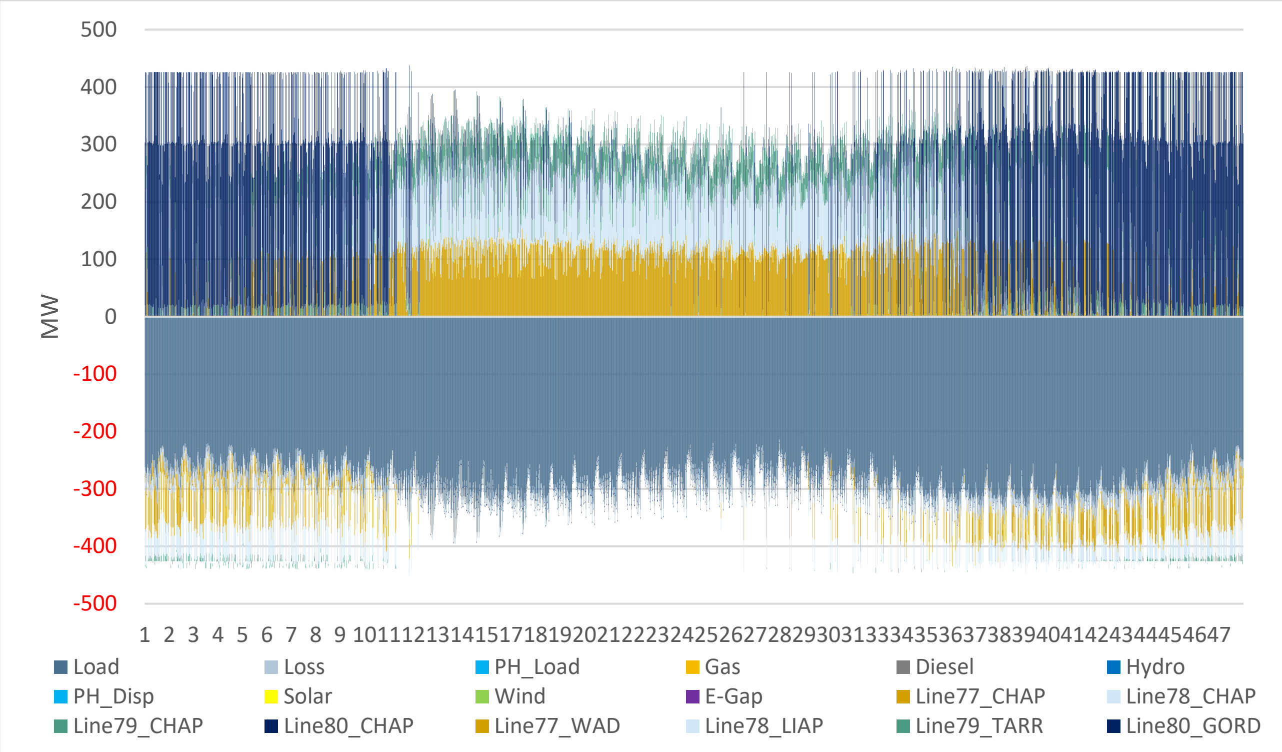

Figure 72: CHAPEL STREET energy flows for SummWD under sB (without QLD Pump Hydro)

CHAP is the demand centre for Hobart. Figure 72 provides detail on the flow of energy through CHAP by time-period according to source. Of note:

- the navy blue coloured series indicates imports from GORDON to the west which has 432MW of hydro capacity

[31] Source: AEMO Generation Information July 2020

- the dark gold coloured series indicates imports-exports from Wadamanna to the north and ultimately GT. Imports tend to occur during the day whilst exports are predominantly overnight
- the blue-green coloured series indicates imports-exports from Tarralea to the north
- the light blue coloured series indicates imports-exports from Liapootah which has 215MW of hydro capacity
- the steel-blue coloured series indicates CHAP load, at an average of 286MW
- there is no E-G

Table 62 details statistics for CHAP energy flows

Table 62: CHAPEL STREET salient statistics under sB (without QLD Pump Hydro)

CHAP SALIENT STATISTICS	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(412)	(309)	(286)	(386)	74%	(286)
Hydro	0	0	0	0	0%	0
Wind	0	0	0	0	0%	0
E-G	0	0	0	0	0%	0
Exports	(50)	(34)	(35)	(187)	18%	(2)
Imports	479	356	333	438	76%	314

4. BURNIE details for summer weekdays

Table 63 provides a summary of generating capacity assumptions for Burnie (BURN) node

Table 63: BURNIE capacity assumptions under sB (without QLD Pump Hydro)

BURN Capacity assumptions	Current [32] (MW)	2030 (MW)	Notes
Wind	65	1,387	Capacity factor: 30%
Storage/Other		-	
TOTAL	65	1,387	

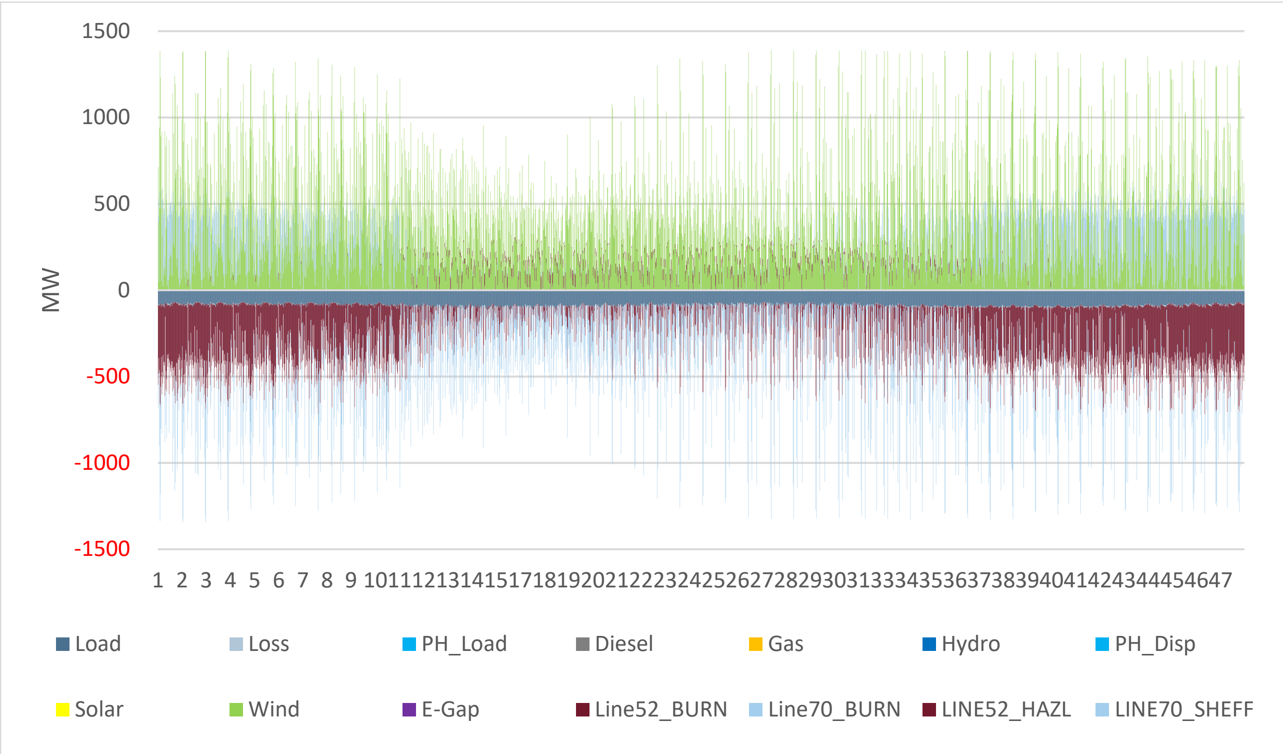

Figure 73: BURNIE energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 73 provides detail on the flow of energy through BURN by time-period according to source. Of note:

- the light blue coloured series indicates imports-exports from Sheffield to the south east which has 456MW of wind and 308MW of hydro capacity
- the maroon coloured series indicates imports-exports from VIC – primarily exports to VIC (303GWh) compared to 12GWh imported from VIC
- the light green coloured series indicates wind generated in the BURN node. Figure 74 provides detail on dispatch and curtailment

[32] Source: AEMO Generation Information July 2020

- the steel-blue coloured series indicates BURN load, at an average of 86MW
- E-G is negligible

Table 64 details statistics for BURN energy flows

Table 64: BURNIE salient statistics under sB (without QLD Pump Hydro)

BURN SALIENT STATISTICS	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(124)	(93)	(86)	(117)	74%	(87)
Wind	591	437	411	1,387	30%	332
E-G	0	0	0	0	8%	0
Exports	(509)	(393)	(353)	(1,267)	28%	(315)
Imports	118	107	82	423	19%	2
Wind_spill	53	3	37	885	4%	0
Wind spill %	8%	1%	8%			

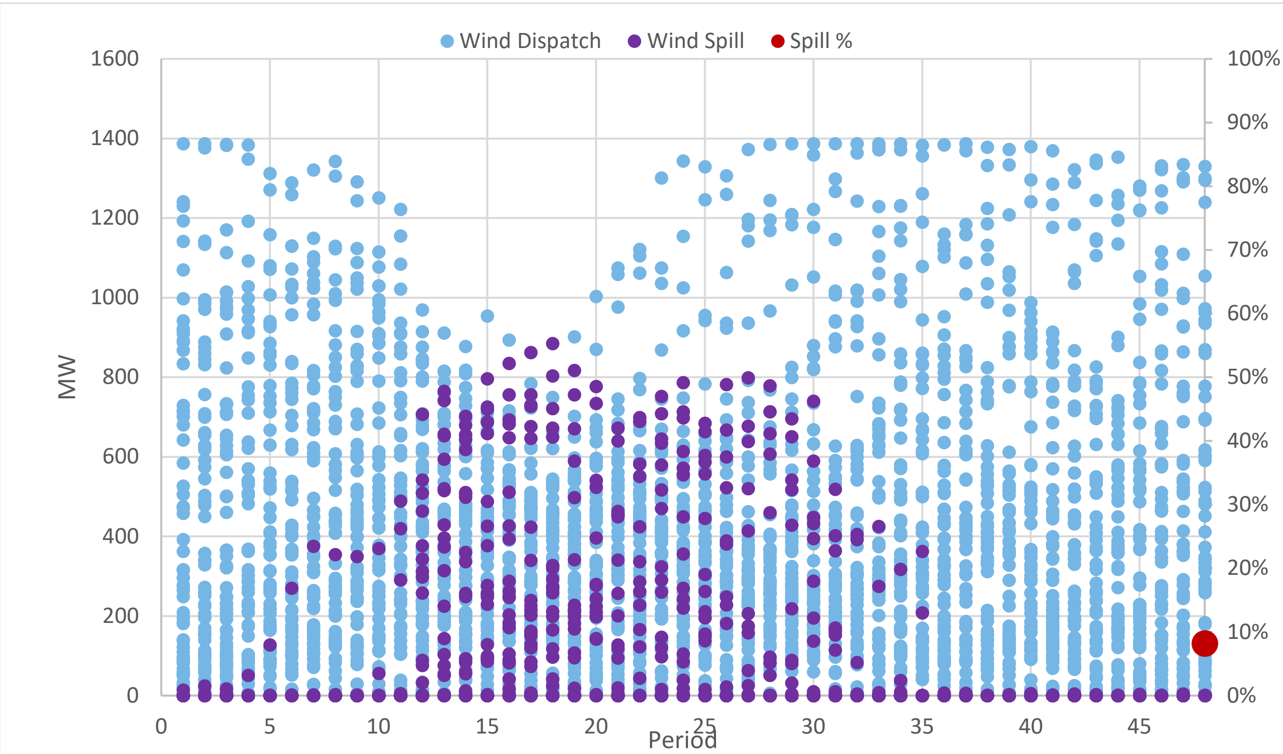

Figure 74: BURNIE wind dispatch and curtailment under sB (without QLD Pump Hydro)

5. SHEFFIELD details for summer weekdays

Table 65 provides a summary of generating capacity assumptions for Sheffield (SHEFF) node

Table 65: SHEFFIELD capacity assumptions under sB (without QLD Pump Hydro)

SHEFF Capacity assumptions	Current [33] (MW)	2030 (MW)	Notes
Hydro	298	308	Capacity factor: 31%
Wind		456	Capacity factor: 31%, curtailment: 0%
Storage/Other		4	Capacity factor: 0%
TOTAL	298	768	

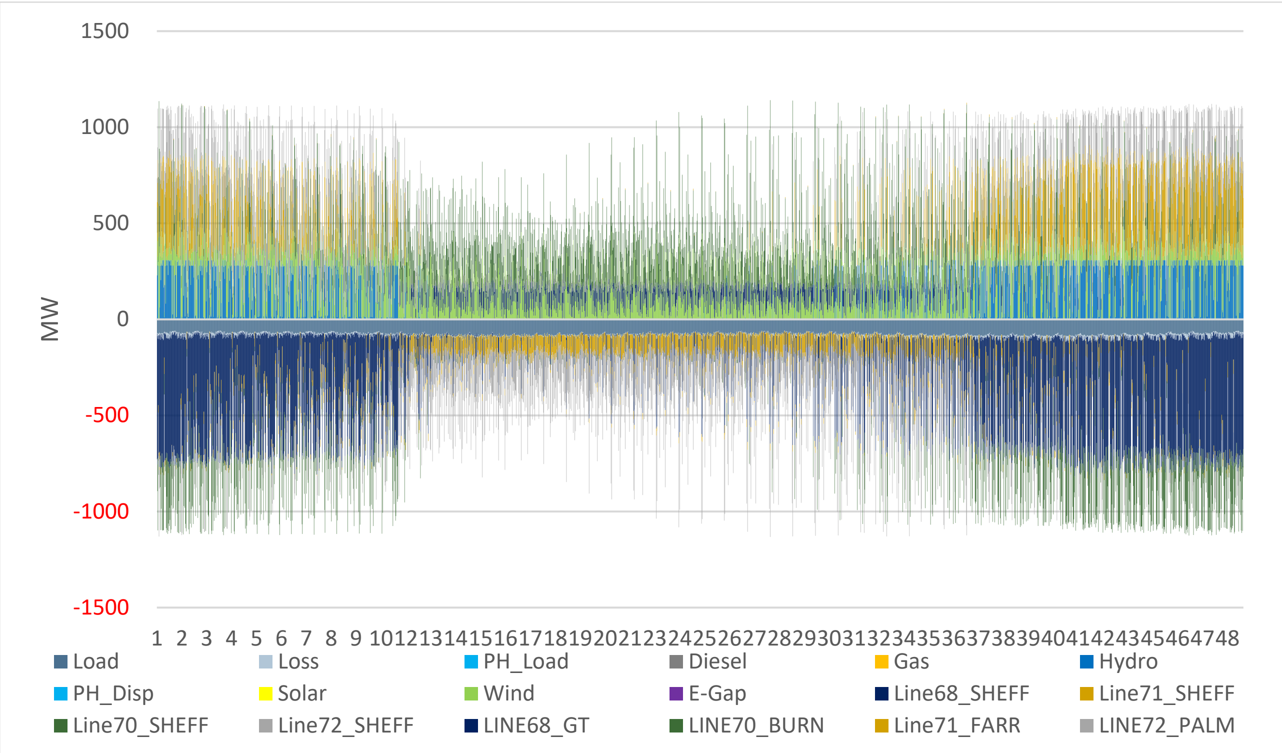

Figure 75: SHEFFIELD energy flows for SummWD under sB (without QLD Pump Hydro)

Figure 75 provides detail on the flow of energy through SHEFF by time-period according to source. Of note:

- the light grey blue coloured series indicates imports-exports from-to Palmerston to the south east which has 300MW of hydro capacity
- the dark green coloured series indicates imports-exports from-to BURN node with 1.4GW of wind capacity. Energy flows primarily BURN-SHEFF (205GWh) versus SHEFF-BURN (106GWh).

[33] Source: AEMO Generation Information July 2020

- the dark gold coloured series indicates imports-exports from-to FARRELL to the south west with 618MW of hydro and 112MW of wind capacity
- the light green coloured series indicates wind generated from 456MW capacity in the SHEFF node. Figure 76 provides detail on dispatch and curtailment
- the royal blue coloured series indicates hydro generated from 308MW of capacity. It is less evident in the graph but dispatch occurs primarily overnight
- the steel-blue coloured series indicates SHEFF load, at an average of 86MW
- E-G is negligible
- Table 66 details statistics for SHEFF energy flows

Table 66: SHEFFIELD salient statistics under sB (without QLD Pump Hydro)

SHEFF SALIENT STATISTICS	Energy (GWh)	EvenPeak (MW)	AveAll (MW)	Max (MW)	CF (%)	Median (MW)
Load	(110)	(83)	(77)	(104)	74%	(77)
Hydro	139	133	97	308	31%	0
Wind	204	139	142	456	31%	110
E-G	0	0	0	4	0%	0
Exports	(740)	(589)	(514)	(1,029)	50%	(477)
Imports	523	412	363	802	45%	292
Wind_spill	0	0	0	26	1%	0
Wind spill %	0%	0%	0%			

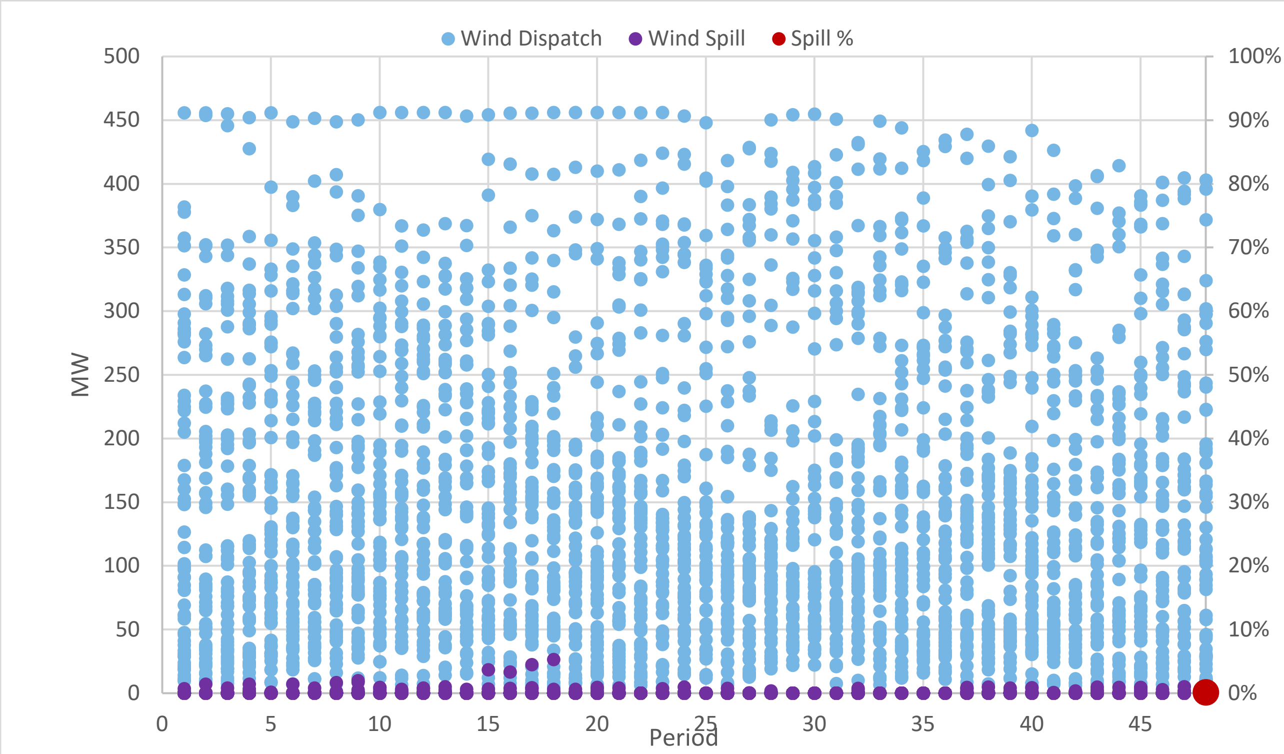

Figure 76: SHEFFIELD wind dispatch and curtailment under sB (without QLD Pump Hydro)

6. CONCLUDING OBSERVATIONS for TAS nodal supply-demand balance

TasHydro Battery of the Nation (BoN) proposal posited significant wind at both BURN and SHEFF to be the main power source for exports of energy to HAZL on the new BoN interconnection. This contrasts with the ISP findings, which assumed large wind installations in the central highlands, well away from the BoN interconnector. ANEM model predicts that energy will flow predominantly from SHEFF to BURN and on to HAZL. These findings tend to support the assumptions underpinning the BoN proposal.

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CREATE CHANGE

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