SOUTH AUSTRALIAN GENERATION FORECASTS

SOUTH AUSTRALIAN ADVISORY FUNCTIONS

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AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

IMPORTANT NOTICE

Purpose

AEMO publishes this South Australian Generation Forecasts report in accordance with its additional advisory functions under section 50B of the National Electricity Law. This publication is based on information available to AEMO as at 7 July 2017, as modelled for the 2017 Electricity Statement of Opportunities.

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Version control

Version	Release date	Changes
1	15/12/2017	

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1. INTRODUCTION

1.1 Purpose and key insights

The purpose of this publication is to provide forecasts of the possible future electricity generation mix in South Australia, over the next ten years.

The projections are based on analysis conducted using the Neutral demand scenario and the Dispersed and Concentrated renewables pathways for the 2017 *Electricity Statement of Opportunities* (ESOO)[1] for the National Electricity Market (NEM). These renewable development pathways present two possible futures, considered reasonable given incentives to expand renewable generation currently provided within the market, driven by supportive state and federal renewable energy targets.

The key insights based on these assumptions are:

- By 2020-21 approximately 73% of generation in South Australia is projected to be produced by renewable sources, increasing from approximately 49% of total region generation in 2016-17.
- By 2026-27 the generation produced by renewable sources is projected to increase to approximately 75% to 80% in South Australia, depending on the renewable pathway. The increase in renewable generation is expected to reduce gas-powered generation (GPG) down from approximately 50% in 2016-17 to 20% to 25% of regional generation in 2026-27, continuing the trend observed in the 2016 South Australian Generation Forecast[2].
- The location of renewable developments across Victoria and South Australia will determine if South Australia remains a net importer over the 10-year modelling period.

The two renewable development pathways have been designed to reflect a mix of potential generation requirements driven by federal and state targets, including the Large-Scale Renewable Energy Target (LRET), the Victorian Renewable Energy Target (VRET), the Queensland low carbon transition and the mix of advanced and committed projects identified as at July 2017. This modelling is based on the existing transmission network. Additional interconnection with other regions, as being investigated by ElectraNet's South Australian Energy Transformation (SAET) Regulatory Investment Test for Transmission (RIT-T), could unlock further renewable development in South Australia.

1.2 Background

Changes to generation supply

South Australia's electricity landscape has been through major changes in recent years. In particular, there has been an increase in invertor based wind and rooftop PV solar capacity and a reduction in synchronous generation such as coal and gas-fired generation. South Australia now also has Australia's first large transmission connected battery storage system. South Australia, and the NEM, will continue to see a transformation of the generation mix to meet Australia's state and federal energy and emissions targets and meet the ongoing need for system support services, such as frequency and voltage support potential, with new and innovative methods.

As of 7 July 2017, 1,515 megawatts (MW) of large-scale solar generation and 3,178 MW of new wind generation projects are either committed or proposed in South Australia.[3] Electricity generation mix forecasts used in this report are sourced from the 2017 ESOO Neutral scenario renewable pathways,

[1] AEMO. *Electricity Statement of Opportunities for the National Electricity Market*, September 2017. Available at http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/NEM-Electricity-Statement-of-Opportunities.

[2] AEMO, 2016 *South Australian Generation Report.* Available at https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/South-Australian-Advisory-Functions

[3] For more information on recent developments and proposed projects for South Australia's supply mix, refer to Chapter 3 of the 2017 *South Australian Electricity Report* (SAER), November 2017, available at: http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/South-Australian-Advisory-Functions.

which are informed by proposed generation projects incentivised by federal and state renewable targets:

- The Concentrated renewables pathway assumes an additional 657 MW of renewables above committed and existing generation[4] in South Australia by 2026–27.
- The Dispersed renewables pathway assumes an additional 1,437 MW of renewables above committed and existing generation in South Australia by 2026–27.

The pathways are described in the following sections.

Concentrated renewables pathway

The Concentrated renewables pathway includes renewable developments across the NEM to meet the Federal Large Scale Renewable Energy Target (LRET)[5]. Additional developments after 2020 are geographically concentrated particularly in Victoria, driven by the Victorian Renewable Energy Target (VRET).[6]

Dispersed renewables pathway

The Dispersed renewables pathway includes renewable developments to meet the LRET (as above), and further assumes additional renewable capacity incentivised from 2021 onwards is driven through nationally set (or at least co-ordinated) targets, rather than state-based schemes. For modelling purposes, this pathway targeted 45% renewables by 2029–30, a mid-point of the proposed outcomes announced by the Queensland and Victorian governments.[7]

This pathway results in a more evenly dispersed geographic development of renewable generation across the NEM regions, as well as greater overall penetration of renewable generation than in the Concentrated renewables pathway.

Modelling assumptions

The results presented in this report assume that, over the next ten years[8]:

- There are no changes to existing transmission network infrastructure. Whilst the 2016 NTNDP showed the potential benefits for transmission upgrades, the implementation timeframes push these benefits to outside this modelling timeframe. The impact of transmission development and the subsequent generation mix, including the identification of renewable energy zones, will be developed as part of AEMO's Integrated Grid Plan (IGP), which will be released mid-2018.
- Potential developments from the SAET RIT-T and Western Victorian RIT-T are also not included, given uncertainty regarding the specific augmentation options that may be recommended.
- There will be available gas supply for GPG. The recent Heads of Agreement between the Australian Government and East Coast Liquefied Natural Gas (LNG) Exporters[9] formally acknowledges the commitment of industry to maintain a secure and affordable supply of gas in the

[4] Committed and Existing generation means generation operating now, and generation projects that meet AEMO's commitment criteria. These are listed in state summaries on AEMO"s Generation Information webpage, at: http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/Generation-information.

[5] The LRET mandates that 33,000 gigawatt hours (GWh) be derived from eligible renewable sources by 2020. The profile used in AEMO's modelling meets the mandated target, plus additional estimated demand for renewable energy, for instance driven by generators successful in the Australian Capital Territory (ACT) renewable energy target auctions, and by GreenPower sales.

[6] The VRET seeks to achieve 40% renewable energy generation in Victoria by 2025. The modelling assumed close to 4,800 MW of new wind and solar capacity is built by 2026–27. In the ESOO modelling, the VRET is more closely aligned to the 5,150 MW considered in the high scenario in the modelling released by the Victorian Government 23 August 2017, see: https://www.energy.vic.gov.au/__data/assets/pdf_file/0018/80505/VRET-fact-sheet-Modelling.pdf.

[7] Overall, Victoria sees ~3,400 MW installed by the end of 2025 in this pathway, consistent with the low scenario released by the Victorian Government on 23 August 2017, see: https://www.energy.vic.gov.au/__data/assets/pdf_file/0018/80505/VRET-fact-sheet-Modelling.pdf.

[8] For further modelling assumptions, refer to *2017 NEM ESOO Methodology*, September 2017. Available at: https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NEM_ESOO/2017/2017-NEM-ESOO-Methodology.pdf

[9] Heads of Agreement, the Australian East Coast Domestic Gas Supply Commitment, 3 October 2017: https://industry.gov.au/resource/UpstreamPetroleum/AustralianLiquefiedNaturalGas/Documents/Heads-of-Agreement-The-Australian-East-Coast-Domestic-Gas-Supply.pdf

domestic market, including GPG. AEMO will further analyse the impact of potential GPG growth on supply in the 2018 *Gas Statement of Opportunities* for eastern and south-eastern Australia, and 2018 *Victorian Gas Planning Report*.

- The Rate of Change of Frequency (RoCoF) requirement of the South Australian power system in relation to the non-credible double circuit trip of the Heywood Interconnector, continues to be maintained at or below 3 Hz per second in accordance with regulation 88A of the Electricity (General) Regulations 2012.
- A sufficient number of synchronous units are connected to ensure fault levels remain at or above the minimum necessary to maintain power system security. The potential for synchronous condenser installations in the South Australian network will further improve system security. ElectraNet has committed to addressing this limitation as a fault level shortfall from 30 March 2018[10]. By maintaining system security in South Australia through contracting synchronous generators and the procurement of two synchronous condensers, it is expected that ElectraNet will reduce the need to enforce constraints on wind output. Therefore, constraint equations that maintain system strength in South Australia by limiting wind generation were not modelled.
- The South Australia energy security target is not included in the model. The target itself has been delayed until 1 January 2020, and additional measures have been developed to deliver greater energy reliability including[11]:
  - The South Australian Energy Plan's 100 MW / 129 MWh battery.[12]
  - The South Australian Energy Plan's 276 MW diesel generation.
  - The joint AEMO and Australian Renewable Energy Agency (ARENA) DSP project.[13]
- AEMO has not investigated revenue sufficiency of the current fleet of scheduled generation over the modelling period.

[10] Second Update to the 2016 National Transmission Network Development Plan. See: http://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NTNDP/2017/Second_Update_to_the_2016_NTNDP.pdf
[11] These measures are aimed to increase reliability and do not significantly impact the generation mix, therefore the 2017 South Australia Generation Forecasting report only includes the South Australian Energy Plans 100 MW / 129 MWh battery.
[12] South Australian Government Energy Plan for Battery. Available at http://ourenergyplan.sa.gov.au/battery.html
[13] Joint ARENA and AEMO DSP Project. Available at: https://arena.gov.au/funding/programs/advancing-renewables-program/demandresponse/

2. ELECTRICITY FORECASTS

2.1 Forecast energy supply mix

AEMO's 2017 NEM ESOO[14] modelled three pathways for renewable generation developments in the NEM. The generation forecast in this publication is based on meeting demand using the Dispersed renewables and Concentrated renewables pathways.

Table 1 shows South Australian projected generation and net interconnector flow[15] estimates under these two renewables pathways.

The concentrated renewables pathway depicts a future were South Australia developments slow after the LRET target stops increasing post 2020, whilst Victorian renewable generation continues to grow. Under the concentrated renewables pathway scenario key observations include:

- In South Australia, by 2026-27 wind is projected to account for approximately 51% of generation output and large-scale solar approximately 7%.
- Scheduled South Australian generation (predominantly GPG) is projected to decrease from 6,400 GWh (47%) in 2016–17 to 3,598 GWh (25%) in 2026–27.
- Rooftop PV generation is forecast to approximately double over the outlook period to 2,212 GWh[16] by 2026–27.
- Small non-scheduled generation (SNSG) is forecast to increase by approximately 73% over the modelling horizon due to growth in small non-scheduled renewable generation.
- South Australia is forecast to continue to be a net importer over the modelling period.

Alternatively, the dispersed renewable pathway portrays a future where there is greater renewable penetration in South Australia encouraged by a more national approach to emissions reduction. Under the dispersed renewables pathway scenario key observations include:

- In South Australia, by 2026-27, wind is projected to account for approximately 54% of generation output, large-scale solar approximately 10%, both higher than the concentrated renewable pathway.
- Scheduled South Australian generation is projected to decrease from 6,401 GWh (47%) in 2016–17 to 3,158 GWh (20%) in 2026–27.
- Rooftop PV and SNSG is unchanged from the concentrated renewable pathway.
- With more large-scale renewable generation becoming available in South Australia, the region is forecast to become a net exporter from 2022–23.

[14] AEMO. 2017 *Electricity Statement of Opportunities,* September 2017. Available at https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NEM_ESOO/2017/2017-Electricity-Statement-of-Opportunities.pdf

[15] Interconnector results in this report are net energy flows over a period of time, and do not highlight any periods of extreme import or extreme export.

[16] Minor differences between the rooftop PV data in these figures and in the 2017 ESOO forecast are due to variations in the treatment of rooftop PV in the modelling.

Table 1 Forecast annual energy supply mix (GWh)

Financial year	South Australia generation						Interconnector flows		
	Wind (SS, NS)	SNSG	Rooftop PV	Solar (SS)	Scheduled (S)	Total generation	Imports (Victoria to South Australia)	Exports (South Australia to Victoria)	Net interchange (positive = imports, negative = exports)
2016–17 (actual)	4,343	95	1016	0	5,623	11,078	2,889	164	2,725
Neutral economic growth scenario - Concentrated renewables pathway									
2017–18	5,898	106	1,181	0	6,400	13,585	1,243	997	246
2018–19	5,979	111	1,282	411	5,601	13,383	1,371	1,029	342
2019–20	7,246	126	1,393	972	4,503	14,240	1,520	1,483	37
2020–21	7,367	134	1,508	1,097	3,756	13,863	1,978	1,514	464
2021–22	7,361	141	1,623	1,084	3,447	13,656	2,322	1,576	746
2022–23	7,456	151	1,724	1,060	3,644	14,035	2,137	1,707	431
2023–24	7,513	159	1,848	1,044	3,504	14,068	2,221	1,743	478
2024–25	7,295	166	1,972	1,026	3,529	13,988	2,323	1,682	641
2025–26	7,254	175	2,092	1,007	3,605	14,134	2,301	1,699	602
2026–27	7,249	183	2,212	993	3,598	14,235	2,327	1,717	611
Neutral economic growth scenario - Dispersed renewables pathway									
2017–18	5,898	106	1,181	0	6,401	13,586	1,242	997	245
2018–19	5,979	111	1,282	411	5,601	13,383	1,371	1,029	342
2019–20	7,246	126	1,393	972	4,503	14,240	1,520	1,483	37
2020–21	7,368	134	1,508	1,097	3,737	13,843	2,003	1,518	486
2021–22	7,498	141	1,623	1,166	3,419	13,847	2,200	1,650	550
2022–23	7,859	151	1,724	1,290	3,507	14,531	1,890	1,956	-66
2023–24	8,175	159	1,848	1,407	3,277	14,865	1,857	2,171	-315
2024–25	8,119	166	1,972	1,487	3,233	14,977	1,875	2,215	-340
2025–26	8,249	175	2,092	1,554	3,238	15,309	1,782	2,344	-562
2026–27	8,481	183	2,212	1,617	3,158	15,651	1,723	2,511	-788

In this table:

- SS stands for Semi-scheduled, as defined in section 2.2.7 of the National Energy Rules (NER) [17]
- NS stands for Non-scheduled as defined in section 2.2.3 of the NER
- S for Scheduled as defined in section 2.2.2 of the NER and includes gas and liquid powered generation,
- SNSG for Small Non-scheduled Generation (SNSG covers non-scheduled generating units typically less than 30 MW).
- Rooftop PV estimates are based on the 2017 NEM ESOO forecasts.
- 2016–17 actual data additionally includes the following notes:
  - Wind generation includes generation that occurred during commissioning of the site.
  - Scheduled includes Angaston power station, including periods when it was registered as non-scheduled.

[17] National Energy Rules: http://www.aemc.gov.au/getattachment/151b8916-cfb7-4556-9fce-89c80b9fbda3/National-Electricity-Rules-Version-103.aspx

2.2 Forecast energy generation by fuel type

The figures below present more granular analysis of observed trends in the two renewables pathways.

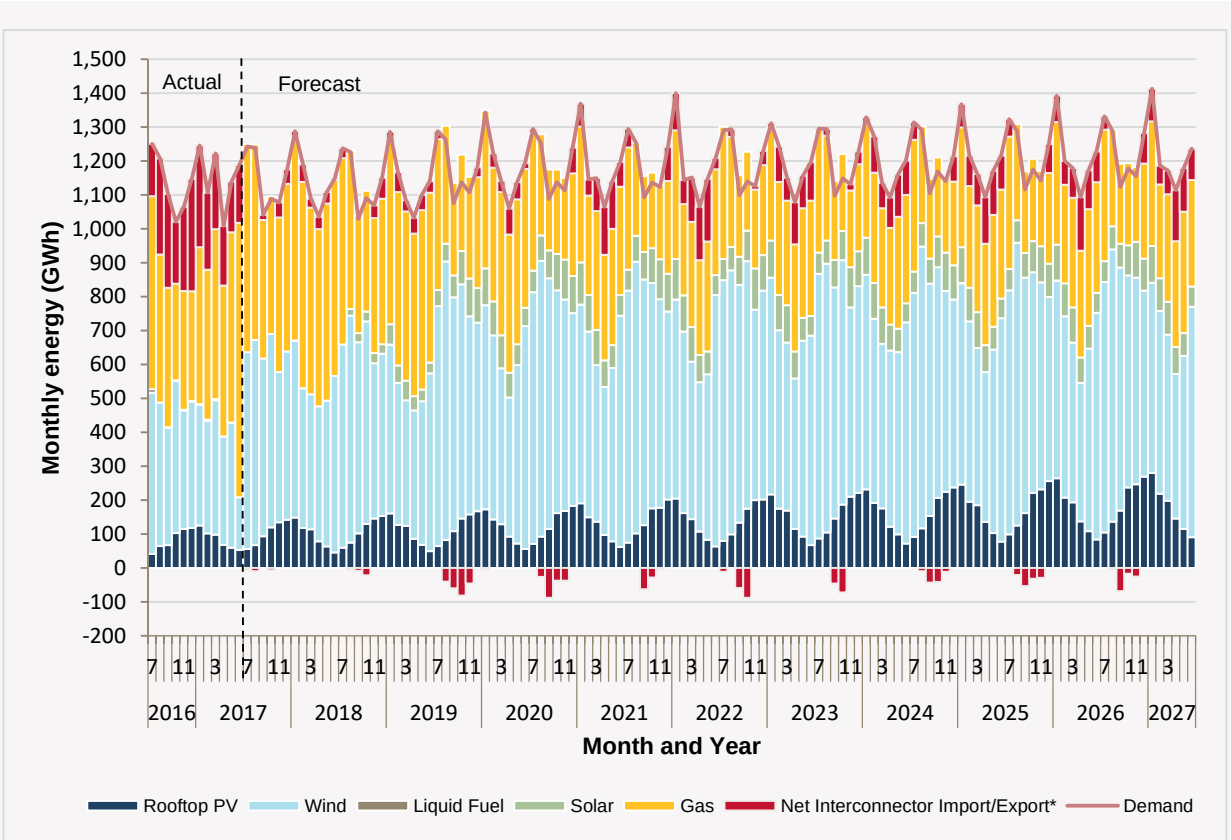
2.2.1 Concentrated renewables pathway

Figure 1 shows generation by fuel source each month under the Concentrated renewables pathway. Seasonal analysis of the data is shown in Figure 2 and Figure 3, which present the summer (defined as 1 November to 31 March) and winter (defined as 1 June to 31 August) forecasts for gas, wind (SS, NS), liquid fuel, solar (SS), rooftop PV generation, and the net interconnector flow.

These figures show:

- With the withdrawal of Hazelwood Power Station in Victoria, GPG is projected to increase from 2016–17 to 2017–18. GPG's market share is projected to trend downward from then until the end of the modelling horizon, due to the projected increase in wind and solar farm installations from 2018–19.
- Under this scenario, additional renewable generation in South Australia is limited to that which is incentivised by the LRET[18]. South Australian wind generation is forecast to increase from 5,898 GWh in 2016–17 to 7,249 GWh in 2026–27. Large scale solar generation is forecast to increase to 993 MWh in 2026–27.

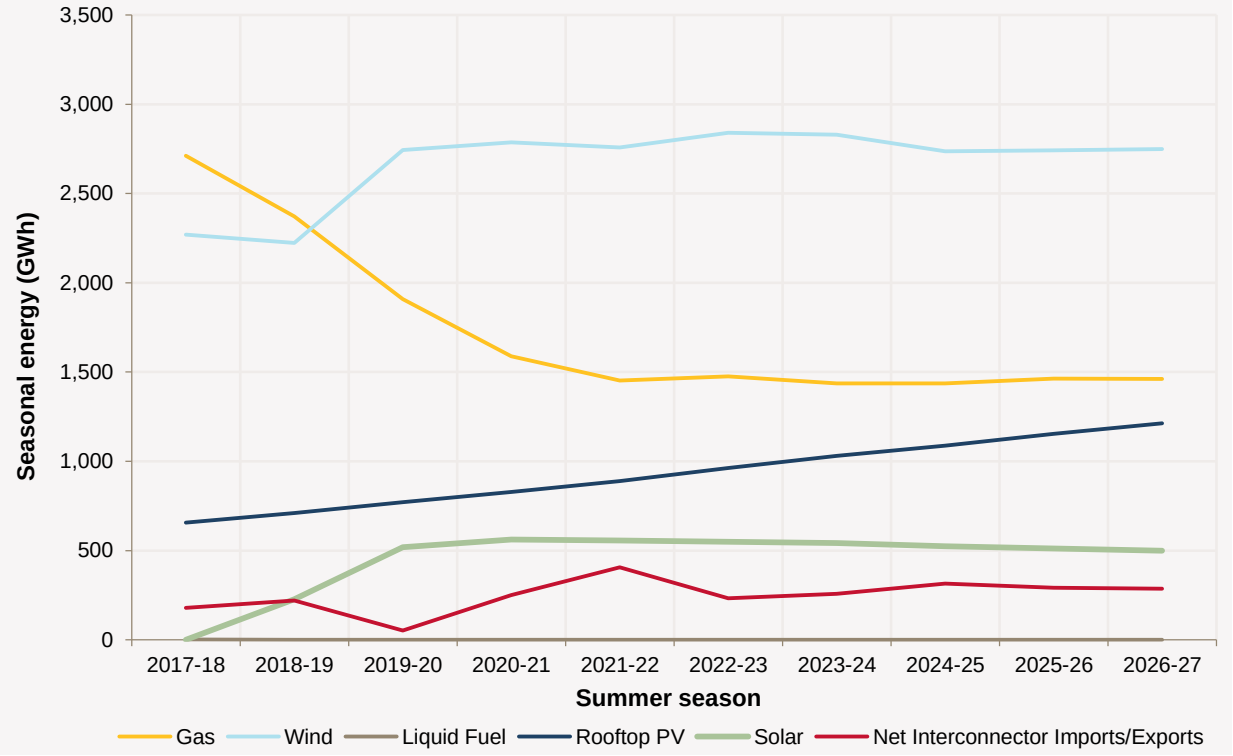
Figure 1 South Australian forecast energy generation by fuel source (Concentrated renewables pathway)



Note: Net Interconnector Imports are shown above the x-axis (0 GWh line) and Net Interconnector Exports are shown below the x-axis. Small Non-Scheduled Generation (SNSG) is netted off the demand shown in this figure.

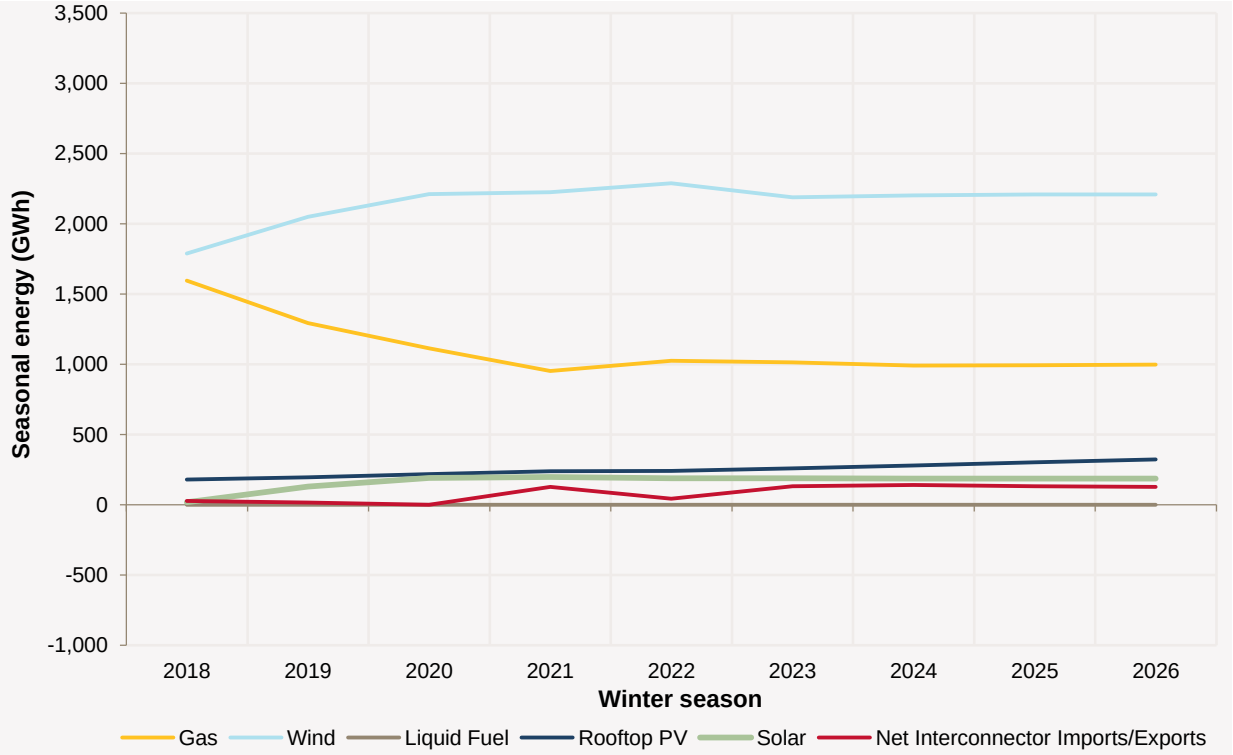
[18] For details of publicly announced and committed renewable generation projects in South Australia, refer to Section 1.4 of the 2017 *South Australian Renewable Energy Report*, November 2017. Available at: http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/South-Australian-Advisory-Functions.

Figure 2 Summer − South Australian supply mix and net interconnector flow (Concentrated renewables pathway)



Note: Net Interconnector Imports are shown above the x-axis (0 GWh line) and Net Interconnector Exports are shown below the x-axis.

Figure 3 Winter − South Australian supply mix and net interconnector flow (Concentrated renewables pathway)



Note: Net Interconnector Imports are shown above the x-axis (0 GWh line) and Net Interconnector Exports are shown below the x-axis.

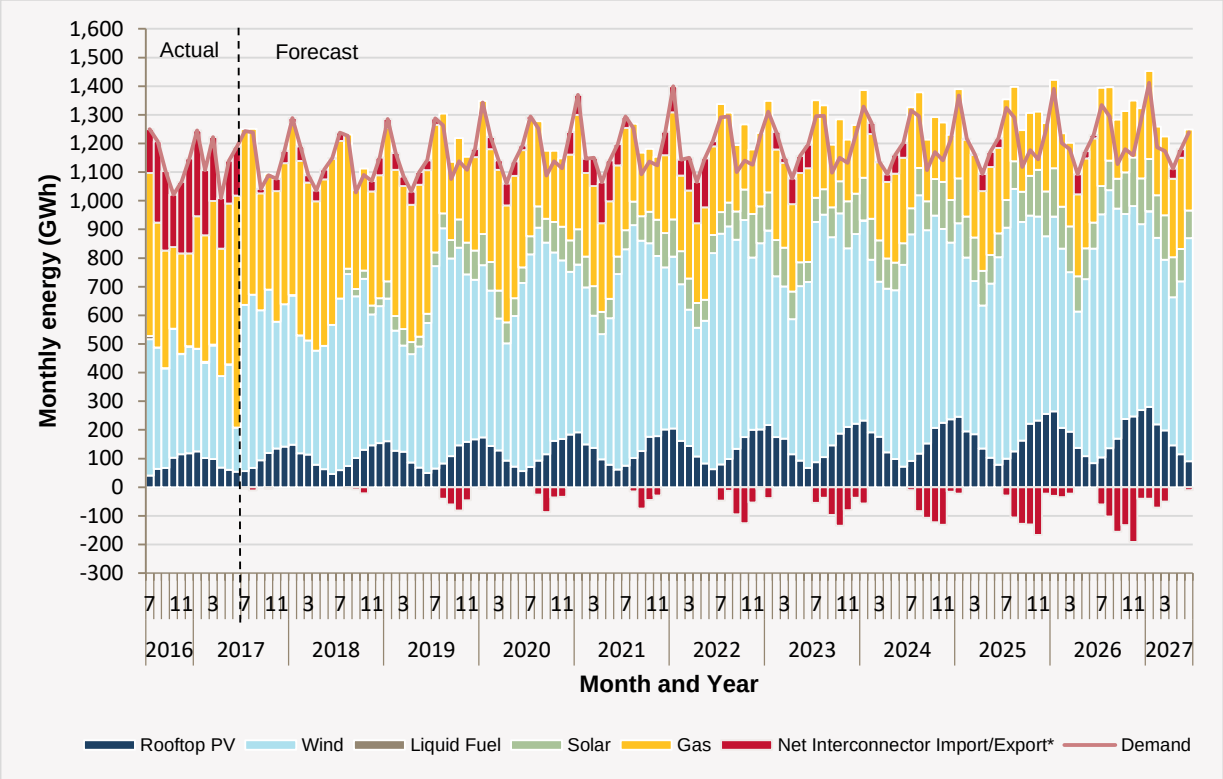
2.2.2 Dispersed renewables pathway

Figure 4 shows generation by fuel source each month of the forecast under the dispersed renewables pathway. Seasonal analysis of the data is shown in Figure 5 and Figure 6, which present the summer and winter forecasts for gas, wind (SS, NS), liquid fuel, solar (SS), rooftop PV generation, and the net interconnector flow.

These figures show:

- GPG's market share is projected to trend downward at a faster rate than the concentrated renewable pathway from 2020 until the end of the modelling horizon, due to the projected larger increase in wind capacity and solar installations in South Australia.
- Under this scenario, there is increased likelihood to build renewable generation in South Australia due to national emissions abatement targets.[19] South Australian wind generation is forecast to increase from 5,898 GWh in 2016–17 to 8,481 GWh in 2026-27, while large scale solar generation is forecast to increase to 1,617 MWh in 2026–27.

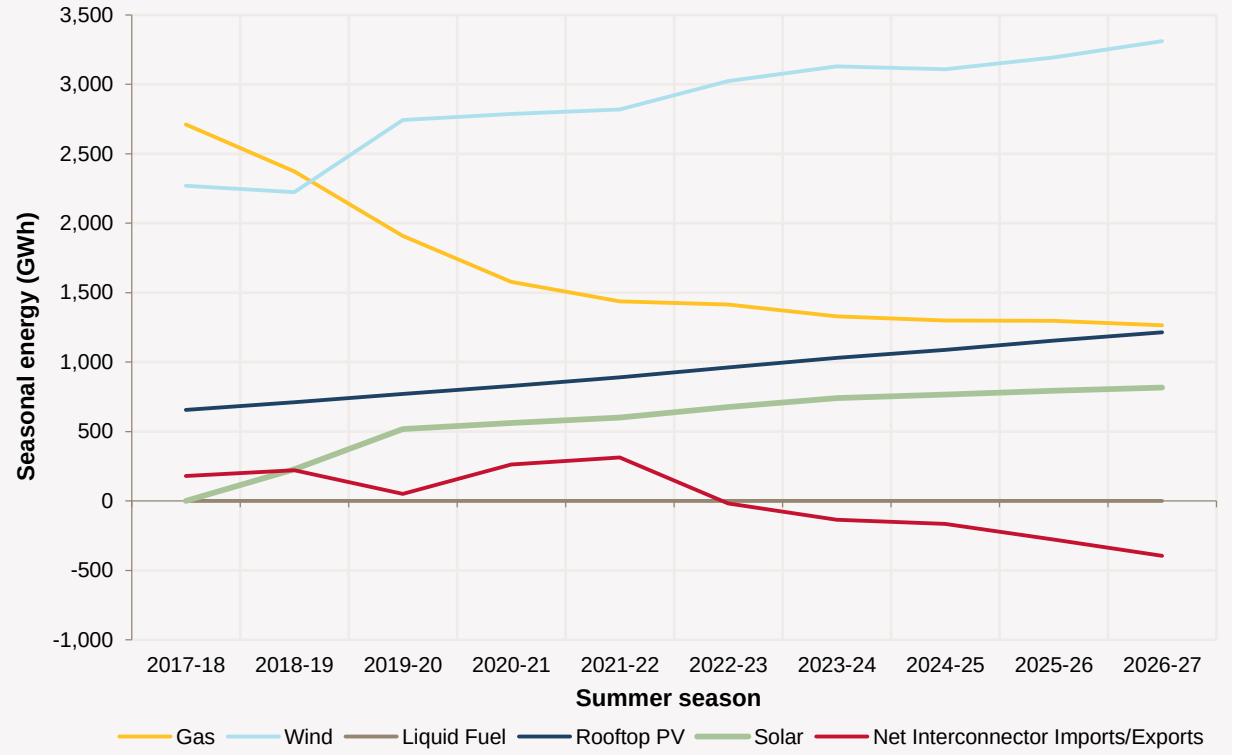
Figure 4 South Australian forecast energy generation by fuel source (Dispersed renewables scenario)



Note: Net Interconnector Imports are shown above the x-axis (0 GWh line) and Net Interconnector Exports are shown below the x-axis.

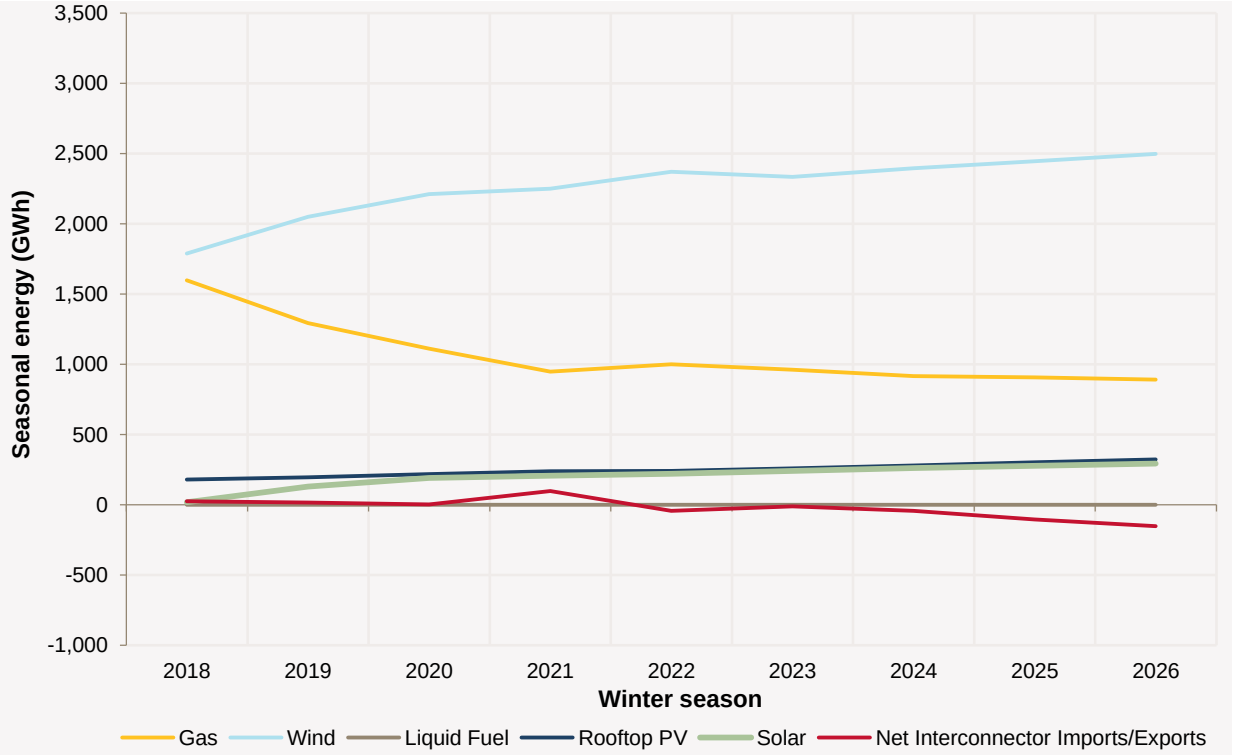
[19] For details of publically announced and committed renewable generation projects in South Australia, refer to Section 1.4 of the 2017 *South Australian Renewable Energy Report*, November 2017. Available at: http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/South-Australian-Advisory-Functions.

Figure 5 Summer − South Australian supply mix and net interconnector flow (Dispersed renewables pathway)



Note: Net Interconnector Imports are shown above the x-axis (0 GWh line) and Net Interconnector Exports are shown below the x-axis.

Figure 6 Winter − South Australian supply mix and net interconnector flow (Dispersed renewables pathway)



Note: Net Interconnector Imports are shown above the x-axis (0 GWh line) and Net Interconnector Exports are shown below the x-axis.