ACIL ALLEN CONSULTING

REPORT TO

ESSENTIAL SERVICES COMMISSION OF SOUTH AUSTRALIA

22 OCTOBER 2015

ESTIMATED VALUE OF PV EXPORTS

CALENDAR YEAR 2016 ESTIMATE FROM MARKET MODELLING

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1 INTRODUCTION

From time to time the Essential Services Commission of South Australia (the Commission) determines the amount that retailers should pay small energy customers for electricity generated using solar photovoltaic (PV) systems and exported to the grid (exported PV output). It does this pursuant to the Electricity Act 1996.

In October 2015 the Commission engaged ACIL Allen Consulting (ACIL Allen) to estimate the fair and reasonable value of exported PV output in (calendar) 2016 as an input to the Commission's consideration. This report summarises the estimate, which is was based on:

1. the projected wholesale spot price of electricity
2. *weighted by* the net system load profile
3. *adjusted for* avoided network losses
4. *adjusted for* market and ancillary services fees.

A more detailed description of the methodology used is provided in an accompanying report that is available from the Commission's website (the methodology report).

2 WHOLESALE SPOT PRICE OF ELECTRICITY IN SOUTH AUSTRALIA

Our projected value of PV output is based on a projection of the wholesale spot price of electricity prepared using *PowerMark*, ACIL Allen's proprietary model of the National Electricity Market. Information regarding the process used is in the methodology report.

Projected wholesale spot price

Our estimate of the value of exported PV output is based on an hourly projection of the wholesale spot price of electricity in South Australia. That hourly projection could be summarised in a number of ways. In our view the most helpful is the load weighted average.

The wholesale (spot) market for electricity is inherently uncertain. Prices can, and do, vary widely. The price is constrained by legal limits at -$1000 per MWh and $13,800 per MWh (in 2015/16).

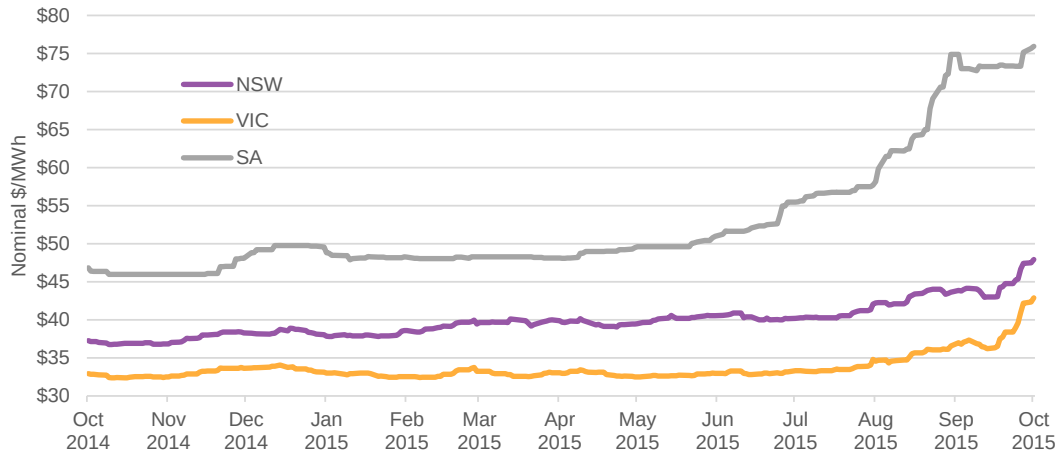
The current projection of the wholesale spot price has increased since that prepared in July 2014. This is due to changes in the South Australian supply mix, most notably the impending closure of Northern Power station on or about 31 March 2016.

In the modelling the closure was assumed to happen on that date. It was also assumed that, after this, the Pelican Point power station, which has effectively been mothballed since April 2015, would return to more active service.

A moderating factor for SA prices is the upgrade to the Heywood interconnector which is currently under construction. The modelling assumes this upgrade (which will result in increased nominal limits of 190 MW in either direction) is completed by mid-2016.

Futures markets for South Australian wholesale electricity are broadly consistent with this projection as illustrated in Figure 2.1 which have also seen a significant price rise over this period.

FIGURE 2.1 – **PRICE HISTORY FOR SOUTH AUSTRALIAN CAL 16 BASELOAD FUTURES**



SOURCE: HTTPS://ASXENERGY.COM.AU/

The price rises for South Australia are in contrast with Victoria and New South Wales, where the outlook for wholesale prices for calendar year 2016 has been reasonably flat over the last 12 months.

Estimating a range of wholesale spot prices

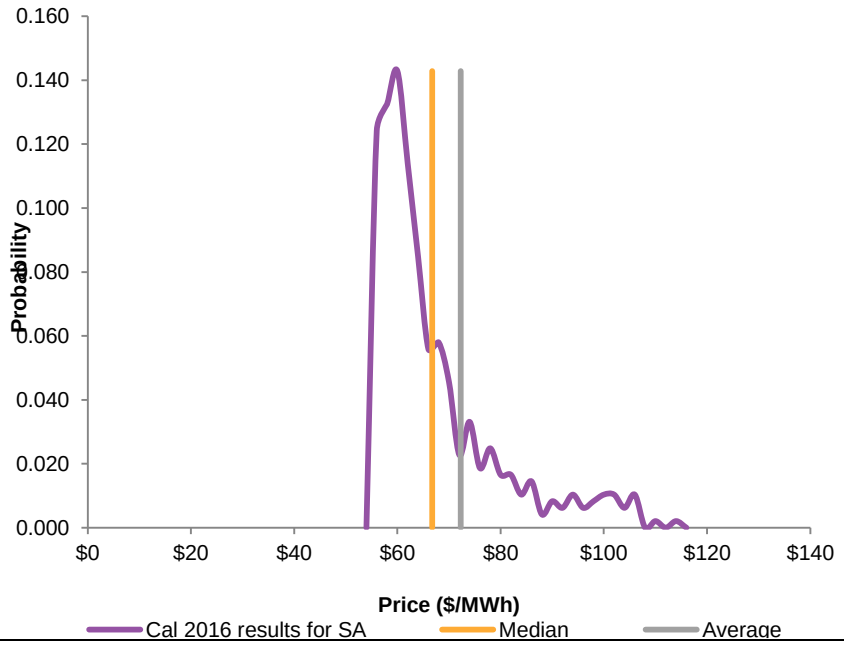
ACIL Allen applied Monte Carlo techniques to the projection of the wholesale (spot) price of electricity. The projected wholesale price was simulated 483 times to capture the uncertainty associated with these stochastic factors (giving 484 simulations including the model reference case). The results are summarised in Figure 2.2 and Table 2.1.

The resulting price distribution of annual load weighted South Australian prices are skewed to the right (high price), which is to be expected. This reflects the propensity for prices to spike to very high levels during times of generator outage coinciding with high demand periods, whereas low price events are generally bound by marginal generator costs. However, the 'loose' supply demand balance in the NEM at present reduces the extent to which this skew occurs.

The reference case projection

In this instance the reference case is around 9% below the median from the stochastic analysis. It should be recognised that due to skewed nature of the distribution, the median is likely to sit below the expected (mean) price outcome.

FIGURE 2.2 – **PROJECTED LOAD WEIGHTED WHOLESALE SPOT PRICE OF ELECTRICITY IN SOUTH AUSTRALIA (483 SCENARIOS)**



SOURCE: ACIL ALLEN CONSULTING

TABLE 2.1 – **PROJECTED LOAD WEIGHTED WHOLESALE SPOT PRICE OF ELECTRICITY IN SOUTH AUSTRALIA (483 SCENARIOS AND REFERENCE CASE)**

Value	Projected price ($ per MWh)
	$ per MWh
Minimum	$57.79
90 percentile	$59.43
50 percentile	$66.74
Mean	$72.25
10 percentile	$93.58
Maximum	$124.75

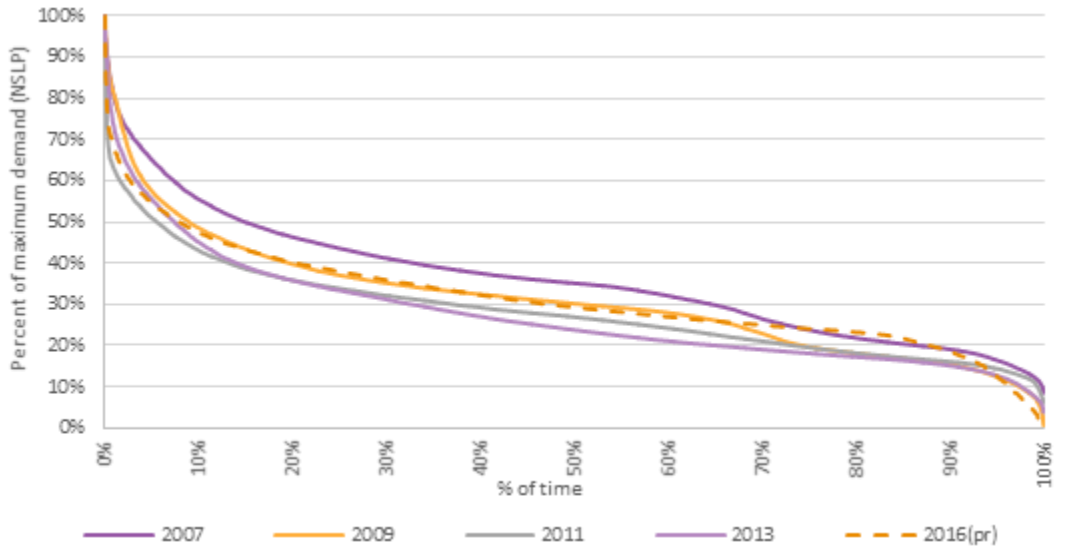
SOURCE: ACIL ALLEN CONSULTING

3 THE NET SYSTEM LOAD PROFILE

Our projection of the NSLP is developed using a regression based approach as described in the methodology report. We apply the regression parameters obtained there to our load projection for the SA NEM region used in developing the *PowerMark* price projection for 2015 as well as information about peak periods and calendar quarters.

As is shown in Figure 3.1, the shape of this forecast NSLP is consistent with the shape of historic NSLPs for calendar years 2007, 2009, 2011, and 2013.

FIGURE 3.1 – **COMPARISON OF PROJECTED NSLP SHAPE AND HISTORIC NSLP SHAPES**



[a] Note: All NSLPs sorted into descending order and expressed as a percentage of maximum load in the relevant year

SOURCE: ACTUAL NSLP DATA FROM AEMO; FITTED VALUES DERIVED BY ACIL ALLEN

This process yields a projection of the half hourly demand of small customers in South Australia. The retailers of these customers purchase wholesale electricity based upon their proportionate share of the NSLP load shape). However, this is not the demand profile that determines the wholesale cost of electricity to retailers. Rather, that cost is determined by the NSLP *less* the total amount of electricity generated by PV systems.

To calculate this we take two steps. First, in the regression described above we adjust both the NSLP (dependent variable) and SA regional load (one of several independent variables) to 'add back' our estimate of the output of solar PV systems. Therefore we use the estimated regression parameters

outlined above to project the underlying electricity demand of customers that make up the NSLP, rather than the NSLP itself.

We then remove the projected output of PV systems from this projection leaving a projection of the NSLP that would be used to allocate the wholesale cost of electricity to retailers.

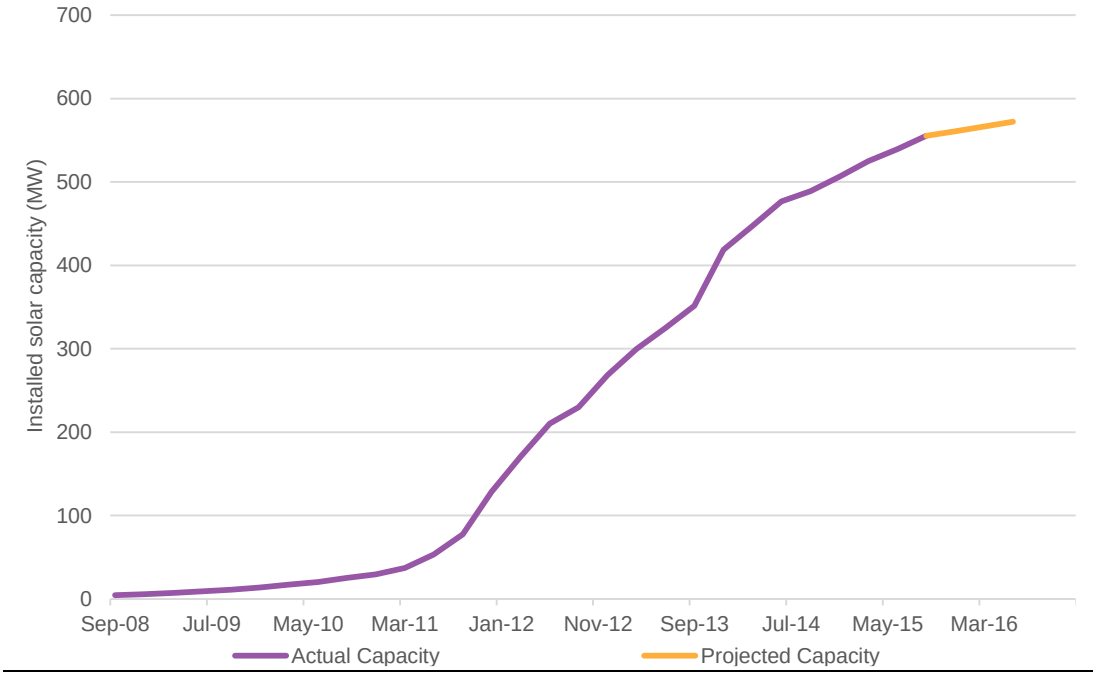
In both cases our estimate of the output of solar panels is developed based on two inputs:

1. solar insolation data for North West Bend developed by 3TIER for Renewables SA.[1]
2. unpublished solar PV uptake data from SA Power Networks and the Clean Energy Regulator.

We projected the solar PV uptake on a straight line basis into the future by assuming that the monthly rate of uptake of PV systems in future will be the same (on average) as it was from February to June 2015. Where the rate of uptake was calculated using SA Power Networks data on monthly PV approvals and average approval size. The projection is shown in Figure 3.2.

We note that the Feed-in payment received in South Australia dropped for systems that had not been approved by 30 September. This is likely the cause of the large spike in approvals prior to this date, and the significantly higher installations in the September 2013, December 2013 and March 2014 quarters.

Figure 3.2 – **Domestic solar PV in South Australia, installed capacity**



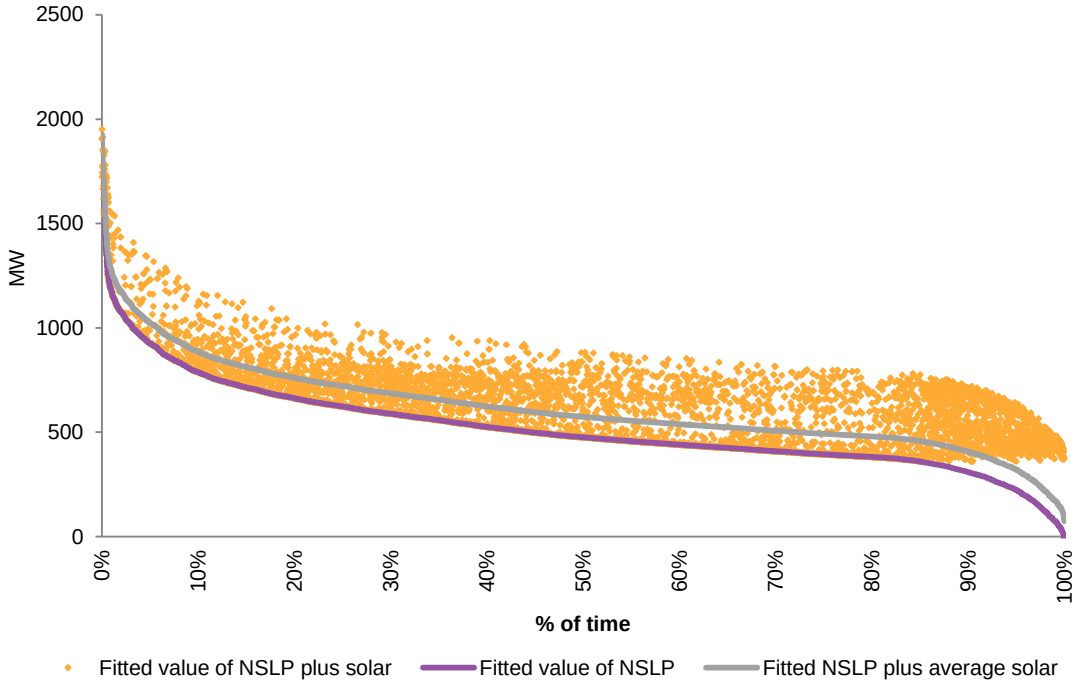
SOURCE: SA POWER NETWORKS, PROJECTION, ACIL ALLEN CONSULTING

The impact of adjusting the NSLP to account for the output of PV systems in the projection period is illustrated in Figure 3.3. In the figure, the 'NSLP plus solar' is shown as a scatter plot because the output of PV systems varies independently of the NSLP demand.[2]

[1] See Renewables SA, Renewable Energy Resource Maps available at http://www.renewablessa.sa.gov.au/investor-information/resources#Solar

[2] In other words, the chart shows the NSLP (blue line) in descending order. The red dots are calculated by adding our estimate of solar output to each dot that makes up the blue line.

FIGURE 3.3 – **NSLP PROJECTION WITH AND WITHOUT SOLAR OUTPUT**



SOURCE: ACIL ALLEN CONSULTING

4 THE VALUE OF AVOIDED NETWORK LOSSES

We analysed historic distribution loss factors for South Australia as published by the Australian Energy Market Operator (AEMO). As Table 4.1 shows, historically these have been approximately eight per cent. While there is some annual variation, it is small and there is no discernible pattern. Therefore we have assumed that eight per cent is a central level that will not change over time and our estimates of the value of exported PV output are based on the assumption that distribution losses are 8.00 per cent. [3]

TABLE 4.1 – **HISTORIC LOSS FACTORS IN SOUTH AUSTRALIA**

	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
	%	%	%	%	%	%	%	%	%
Low voltage customer DLF	1.0799	1.079	1.074	1.0814	1.0765	1.0800	1.0770	1.0790	1.0790
SA VTN MLF	1.0001	1.0009	1.0057	1.0003	1.003	0.9981	1.0005	1.0049	1.0012
Combined loss factor (= DLF × MLF)	1.0800	1.0800	1.0801	1.0817	1.0797	1.0779	1.0775	1.0843	1.0803
Implied losses	**8.00%**	**8.00%**	**8.01%**	**8.17%**	**7.97%**	**7.78%**	**7.75%**	**8.43%**	**8.03%**

NOTE: DLF MEANS DISTRIBUTION LOSS FACTOR. MLF MEANS MARGINAL LOSS FACTOR AND APPLIES TO THE TRANSMISSION NETWORK. VTN MEANS VIRTUAL TRANSMISSION NODE AND IS AN AGGREGATED REPRESENTATION OF MOST CONSUMPTION MLFS IN THE SA NEM REGION.

DATA SOURCE: AEMO

[3] Assuming that losses remain close to the historic range, any errors introduced by this assumption will be minimal and within the error margin of the wholesale electricity price projection.

5 MARKET AND ANCILLARY SERVICES FEES

AEMO levies two sets of fees on market customers in the National Electricity Market. The first covers its general operational costs (market fees). The second covers the cost of various ancillary services that are provided to ensure the reliable operation of the system (ancillary service fees).[4]

Market fees are published annually in advance and are generally levied on market customers (including retailers) on a per megawatt-hour basis.[5] AEMO's published 2014-15 fees are shown in Table 5.1. They indicate costs for market customers with a retail licence of around $0.4 per MWh. We assumed for this exercise that these charges would be unchanged in the second half of (calendar) 2015.

TABLE 5.1 – **AEMO 2015-16 MARKET FEES**

Fee class	Rate	Paying participants
	$ per MWh	
General fees	$0.1126	Market customers
Allocated fees - market customers	$0.1419	Market customers
Full Retail Contestability – operations	$0.0400	Market customers with a retail licence
National Transmission Planner	$0.0205	Market customers
Electricity Consumers Australia	$0.0027	Market customers
Total	**$0.3177**	

NOTE: ENERGY CONSUMERS AUSTRALIA FEES ARE LEVIED ON A PER CUSTOMER BASIS. THEY WERE CONVERTED TO PER MWH BY ASSUMING N AVERAGE CONSUMPTION OF 4 MWH PER ANNUM FOR SMALL CUSTOMERS

SOURCE: AEMO, ELECTRICITY REVENUE REQUIREMENT AND FEE SCHEDULE 2013/14, HTTP://WWW.AEMO.COM.AU/ABOUT-AEMO/CORPORATE-PUBLICATIONS/CURRENT-ENERGY-MARKET-BUDGET-AND-FEES

Unlike market fees, AEMO seeks bids from market participants to provide ancillary services. Ancillary service fees are then set on a cost-recovery basis.

Ancillary service fees vary on a weekly basis. In South Australia they are generally in the range of $0.10 per MWh to $0.20 per MWh. However, on occasion they can spike to much higher levels. For example, in the two years to 13 July 2014, 90 per cent of weekly ancillary services charges were less than $0.20 per MWh. However, there were a few occasions when charges were much higher than this, including one week when the charge was more than $7.00 per MWh.

[4] These deal with issues such as frequency control.

[5] Other fees, such as for the registration of market participants, are levied on a user-pays basis, rather than on market customers specifically.

TABLE 5.2 – **LEVELS OF ANCILLARY SERVICE FEES, 14 JULY 2012 TO 13 JULY 2014**

Price (upper)	Occurrences	Percentage
$0.05	0	0%
$0.10	21	10%
$0.15	28	18%
$0.20	45	63%
$0.25	3	2%
$1.00	3	2%
$2.00	1	1%
$3.00	0	0%
$4.00	1	0%
$5.00	1	2%
$10.00	1	2%
$15.00	0	0%
$20.00	0	0%
	104	100.00%

SOURCE: AEMO, ANCILLARY SERVICES PAYMENTS, HTTP://WWW.AEMO.COM.AU/ELECTRICITY/DATA/ANCILLARY-SERVICES/PAYMENTS

Given this variability, we have assumed that the two year average level of ancillary service fees, which is $0.37 per MWh, reflects the likely future level of these costs.

Therefore, we make the adjustment shown in Table 5.3 for the impact of market and ancillary services fees.

TABLE 5.3 – **MARKET FEES AND ANCILLARY SERVICE FEES**

Fee category	Fee rate	
	$ per MWh	c per kWh
Market fees	$0.3177	0.03
Ancillary service fees	$0.37	0.04
Market fees and ancillary service fees (at RRN)	$0.068	0.07
Market fees and ancillary service fees (after adjustment for losses)	**$0.74**	0.07

Note: All prices are presented in nominal terms

SOURCE: ACIL ALLEN CONSULTING

6 VALUE OF EXPORTED PV OUTPUT

Table 6.1 summarises our current reference case projection of the value of exported PV output in 2015 based on the above inputs and compares them with the estimates produced in September 2013 and December 2012.

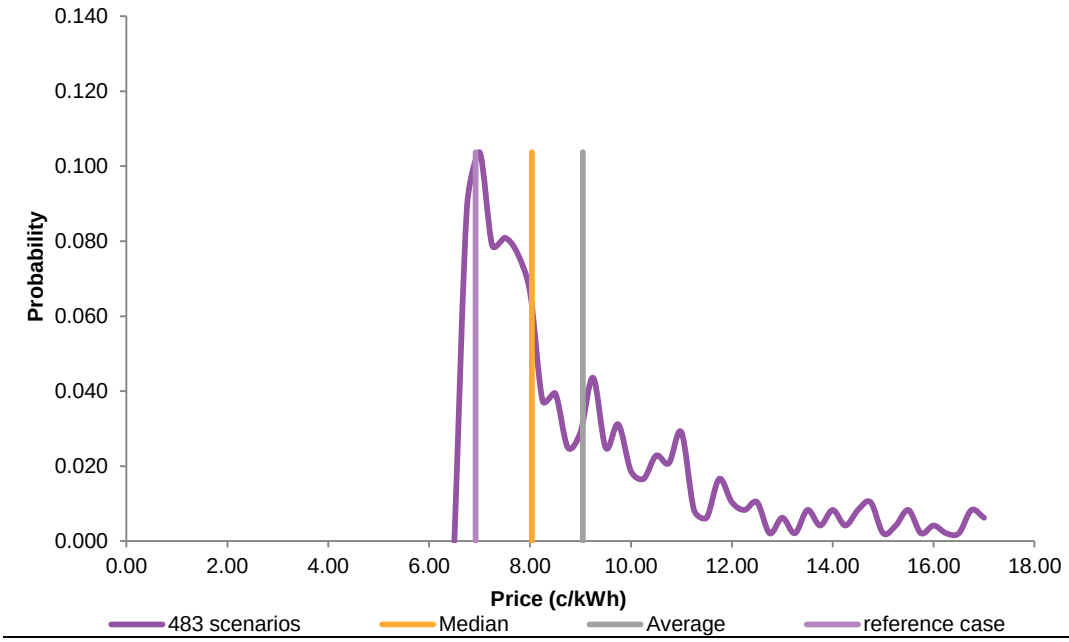
TABLE 6.1 – **UPDATED ESTIMATE OF THE VALUE OF EXPORTED PV OUTPUT (NOMINAL CENTS PER KWH, GST EXCLUSIVE**

	October 2015 Reference case (2016)	July 2014 reference case (2015)	September 2013 reference case (2014)	December 2012 reference case (2013/14)
Units	c per kWh	c per kWh	c per kWh	c per kWh
Net system load profile weighted wholesale spot price	6.34	5.03	7.83	8.53
Avoided losses	0.51	0.40	0.61	0.68
Market fees	0.07	0.07	0.09	0.10
Value of exported PV output	**6.92**	**5.50**	**8.53**	**9.31**

SOURCE: ACIL ALLEN CONSULTING

We also calculated the NSLP-weighted South Australian price from each of the 483 scenarios to determine the possible distribution of these prices. The range resulting from the stochastic analysis is summarised in Table 6.2 and Figure 6.1.

FIGURE 6.1 – **PROJECTED VALUE OF EXPORTED PV OUTPUT IN SOUTH AUSTRALIA (483 SIMULATIONS)**



SOURCE: ACIL ALLENCONSULTING

TABLE 6.2 – **PROJECTED VALUE OF EXPORTED PV OUTPUT IN SOUTH AUSTRALIA (483 SIMULATIONS)**

Value	Projection (c/kWh)
Minimum	6.53
90 percentile	6.78
50 percentile	8.04
Mean	9.05
10 percentile	12.99
Maximum	18.10

SOURCE: ACIL ALLEN CONSULTING

Figure 6.1 and Table 6.2 indicate that the fair and reasonable value of exported PV output is most likely to fall between 6.78 and 12.99 c/kWh. Within that range the median value is 8.04c/kWh. There is a small likelihood that the fair value would fall outside this range.

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