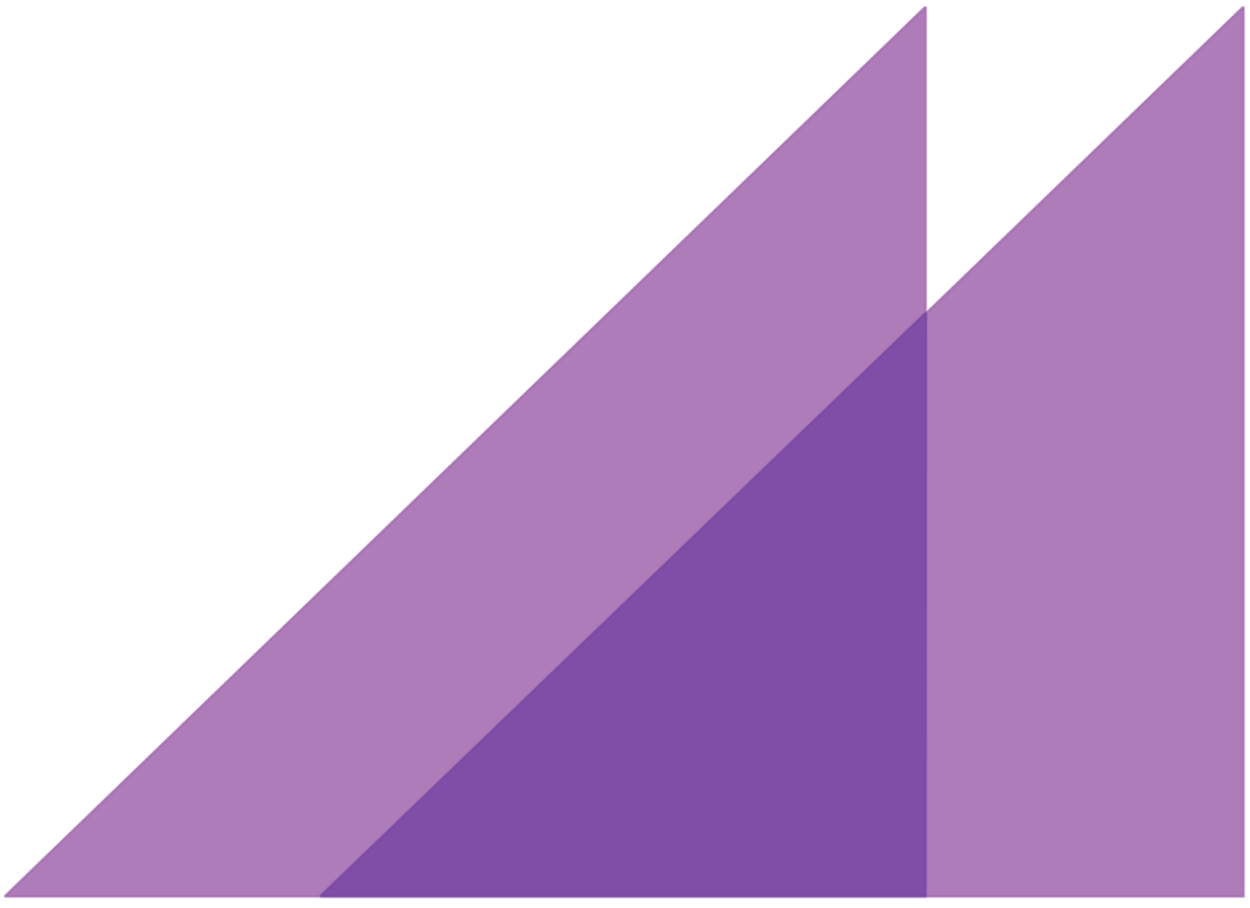
ACIL ALLEN CONSULTING

REPORT TO
ESSENTIAL SERVICES COMMISSION OF SOUTH AUSTRALIA

30 SEPTEMBER 2013

ESTIMATED VALUE OF PV EXPORTS

CALENDAR YEAR 2014 ESTIMATE FROM MARKET MODELLING



ACIL ALLEN CONSULTING PTY LTD
ABN 68 102 652 148

LEVEL FIFTEEN
127 CREEK STREET
BRISBANE QLD 4000
AUSTRALIA
T+61 7 3009 8700
F+61 7 3009 8799

LEVEL TWO
33 AINSLIE PLACE
CANBERRA ACT 2600
AUSTRALIA
T+61 2 6103 8200
F+61 2 6103 8233

LEVEL NINE
60 COLLINS STREET
MELBOURNE VIC 3000
AUSTRALIA
T+61 3 8650 6000
F+61 3 9654 6363

LEVEL ONE
50 PITT STREET
SYDNEY NSW 2000
AUSTRALIA
T+61 2 8272 5100
F+61 2 9247 2455

SUITE C2 CENTA BUILDING
118 RAILWAY STREET
WEST PERTH WA 6005
AUSTRALIA
T+61 8 9449 9600
F+61 8 9322 3955

ACILALLEN.COM.AU

1 Introduction

In January 2012, ACIL Allen Consulting (ACIL Allen - then ACIL Tasman) provided the Essential Services Commission of South Australia (the Commission) with an estimate of the value to a retailer of electricity generated by a domestic solar photovoltaic (PV) system and exported to the electricity grid (exported PV output).[1]

The Commission went on to determine, on 27 January 2012, the price that electricity retailers would pay for exported solar PV output pursuant to the *Electricity Act 1996* (SA).

ACIL Allen's estimate of the value of exported PV output 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 our methodology is provided in our report to the Commission of March 2013, available from the Commission's website (the methodology report).

The purpose of this briefing note is to provide an updated projection of the value of exported PV output using the above methodology with updated inputs. A new feature of the projection on this occasion is that we provide an estimate of the likely range of values. That range is based on a range of projected values of the wholesale (spot) price of electricity in South Australia in 2014, in turn based on a stochastic analysis of particular inputs to the projection.

We have also changed the source of data relating to the capacity of PV installed in South Australia. In the past we had relied on data from SA Power Networks[2], which were unpublished. On this occasion we used data from the Clean Energy Regulator, which are published.

On this occasion the estimate is for calendar year 2014.

[1] Report available from http://www.escosa.sa.gov.au/projects/167/2012-determination-of-solar-feed-in-tariff-premium.aspx

[2] At the time SA Power Networks was known as ETSA Utilities.

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. Previously our estimate of the value of exported PV output has been based on our 'base case' (also referred to as the P50) estimate of the wholesale spot price of electricity.

On this occasion the base case projection was supplemented with a Monte-Carlo analysis of key drivers of uncertainty in the wholesale (spot) price of electricity in South Australia.

2.1 Carbon price

Our previous projections of the estimated value of exported PV output were prepared on the basis that a carbon price would be applicable to the electricity generation sector in Australia, as is currently the case. The projected value of the carbon price was based on policy settings current when the estimates were prepared.

In this case the projection was prepared during the 2013 election campaign, in which the future of the carbon price was a key issue. Broadly:

- the incumbent Government, which was not returned, intended to retain the carbon price but proposed to introduce amending legislation to bring forward the transition from a fixed price to a floating price one year earlier than anticipated (July 2014 compared with July 2015 within existing legislation)
- the Opposition, which won Government, intended to repeal the carbon price legislation as soon as possible.

To produce a projection, an assumption needed to be made in relation to the carbon price. While the projection was prepared before the election outcome was known, the published polls that were available before the election, suggested that the Government would change. Nonetheless, the Commission asked us to assume that the fixed carbon price would continue throughout calendar 2014 in line with the existing Clean Energy Future legislation.

This reflects the uncertainty about the incoming Government's ability to remove or modify the Clean Energy Future legislation before the end of 2014. In particular, we note that the Senate will not change until 1 July 2014 and the final make-up and attitudes of the Senate in relation to the carbon price are uncertain.

Therefore, our projection of the wholesale spot price of electricity is based on the assumption that the carbon price will continue to operate in accordance with the fixed price settings of \$24.15/tonne CO_2-e until 30 June 2014 and \$25.40/tonne CO_2-e from then until 30 June 2015.

2.2 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.

Table 1 shows the load weighted average wholesale spot price of electricity as it was projected in:

- September 2013 (base case – calendar 2014)
- December 2012 (base case – financial 2013/14)
- December 2011 (base case – financial 2013/14).

Table 1 **Wholesale price projections load weighted average wholesale price of electricity in 2013/14 (nominal)**

	Projected price
	$ per MWh
September 2013 (calendar 2014)	$73.44
December 2012 projection (financial 2013/14)	$64.29
December 2011 projection (carbon scenario, financial 2013/14)	$87.05

Source: ACIL Allen Consulting

The wholesale (spot) market for electricity is inherently uncertain. Prices can, and do, vary widely. The annual average price of electricity is typically at the levels shown in Table 1, but the (half hourly) spot price ranges from negative amounts to prices of several thousand dollars per MWh. The price is constrained by legal limits at -$1000 per MWh and $13,100 per MWh (in 2013/14).

The current projection of the wholesale spot price has increased since that prepared in September 2012 due to:

- changes in generation plant availability (including the mothballing of existing coal-fired capacity in response to market conditions)
- increases in gas price and expiry of pre-existing gas supply contracts.

There are many factors that contribute to this variability. Key among them are the inherent uncertainty of:

- generator unavailability due to planned (maintenance) and unplanned outages
- Peak demand variability driven by extreme weather factors (consecutive hot days in summer and cold days in winter)
- Intermittent generator output (particularly local wind farms in South Australia).

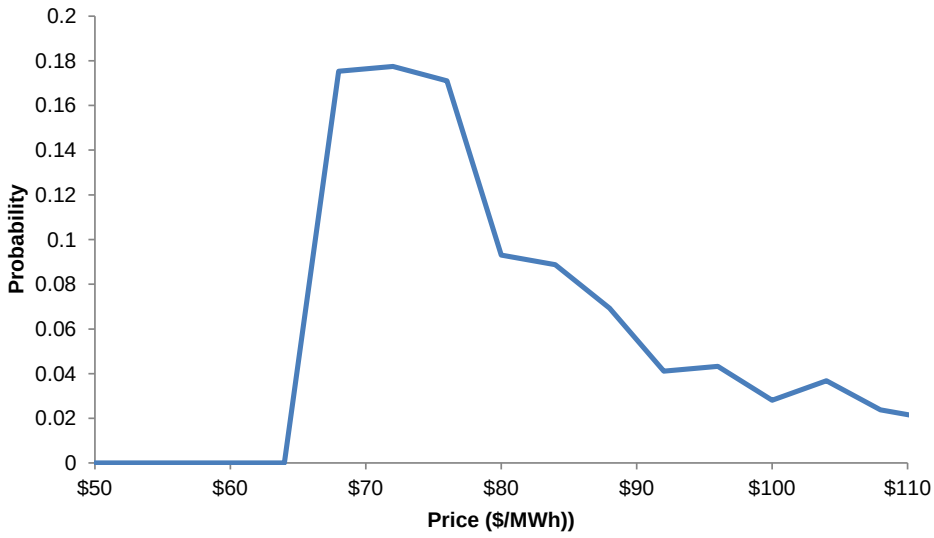
ACIL Allen applied Monte Carlo techniques to the projection of the wholesale (spot) price of electricity. The projected wholesale price was simulated 462 times to capture the uncertainty associated with these stochastic factors (giving 463 simulations including the model base case). The results are summarised in Figure 1 and Table 2.

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.

ACIL Allen designs its base case projection to sit close to the median (P50) of annual price outcomes for all regions simultaneously, though it will not necessarily align to the median in any given region or any given year. The Base case represents our single best projection of price outcomes in South Australia in 2014.

In this instance the Base case is around 0.9% 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 1 **Projected load weighted wholesale spot price of electricity in South Australia (463 scenarios)**



Source: ACIL Allen Consulting

Table 2 **Projected load weighted wholesale spot price of electricity in South Australia (463 scenarios)**

Value	Projected price ($ per MWh)
	$ per MWh
Minimum	$60.84
90 percentile	$62.78
50 percentile	$68.09
ACIL Allen base case	$67.50
Mean	$70.02
10 percentile	$81.10
Maximum	$99.49

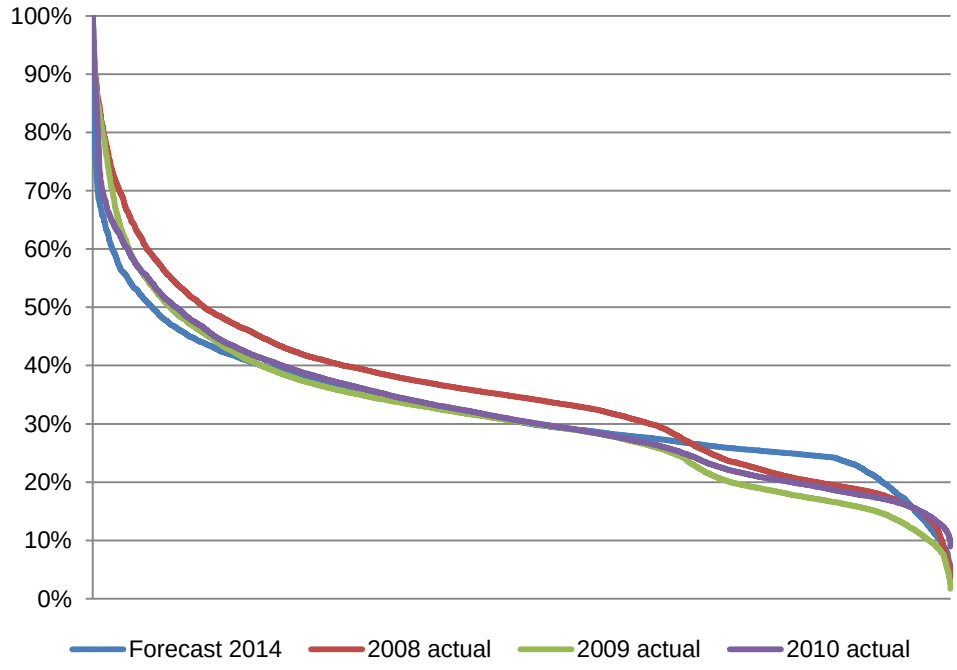
Source: ACIL Allen Consulting

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 2014 as well as information about peak periods and calendar quarters.

As is shown in Figure 2, the shape of this forecast NSLP is consistent with the shape of historic NSLPs for calendar years 2008 to 2010.

Figure 2 **Comparison of projected NSLP shape and historic NSLP shapes**



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:

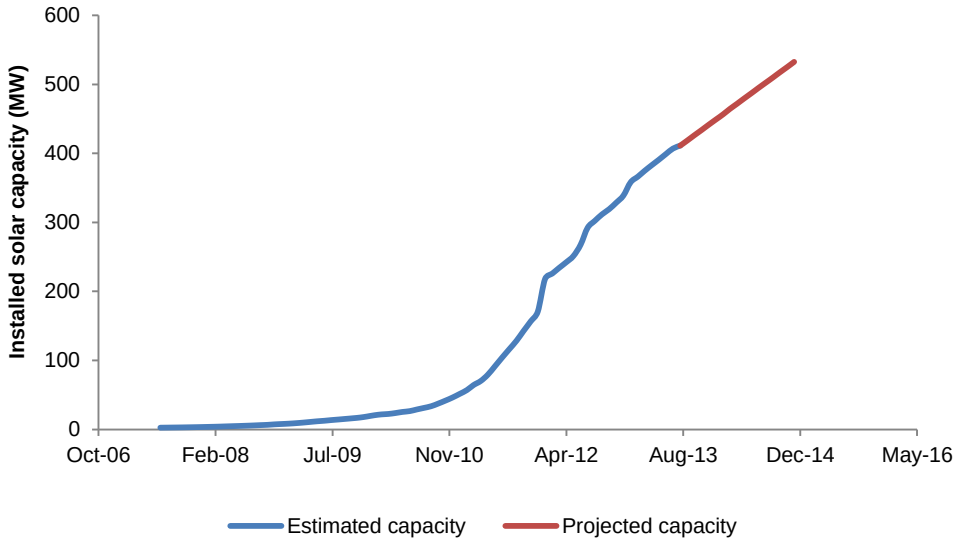
1. solar insolation data for North West Bend developed by 3TIER for Renewables SA.[3]
2. solar PV uptake data imputed from data published by the Clean Energy Regulator relating to the number of small scale technology certificates created in South Australia.

We projected the solar PV uptake on a straight line basis into the future by assuming that the quarterly rate of uptake of PV systems in future will be the same (on average) as it was through 2013 to date where data was available (that is, from January to July 2013 inclusive). The projection is shown in Figure 3.

We note that the Feed-in payment received in South Australia will drop for systems that are not in the process of being installed by 30 September. It would be reasonable to expect that this will cause the rate of uptake to decline after that date. Offsetting this, though, is the fact that the average system size has increased recently. It is the capacity installed, not the number of systems that is relevant.

If the uptake of PV systems was to slow dramatically and all else remained constant, the estimates presented here would err on the high side. However, the impact would be very small. Our estimates indicate that a halving of the projected rate of PV uptake would reduce the value of exported PV output by around one-hundredth of a cent per kWh.

Figure 3 **Domestic solar PV in South Australia, installed capacity**



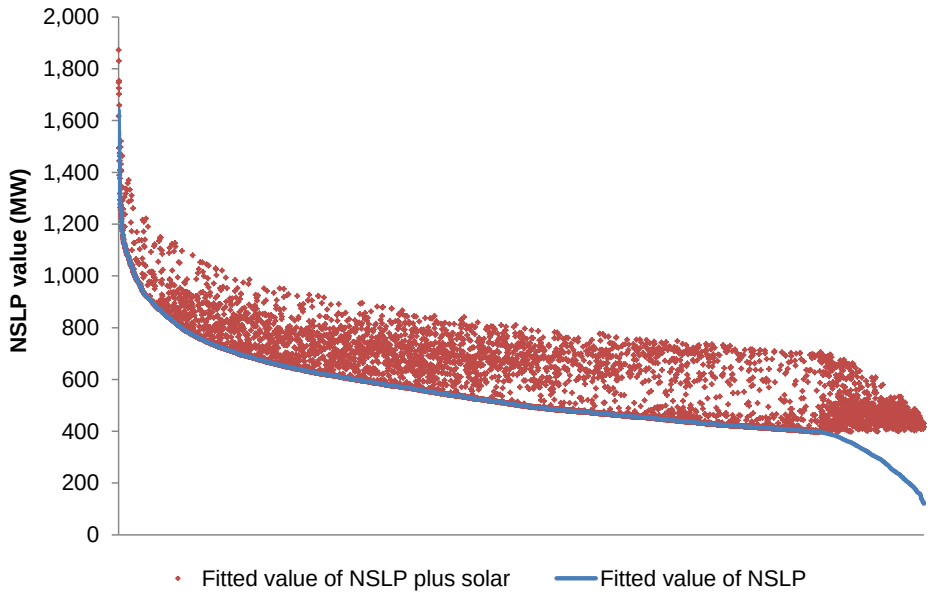
Source: History – Clean Energy Regulator, Projection, ACIL Allen Consulting

The impact of adjusting the NSLP to account for the output of PV systems in the projection period is illustrated in Figure 4. 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.[4]

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

[4] 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 4 **NSLP projection with and without solar output**



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 3 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. [5]

Table 3 **Historic loss factors in South Australia**

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

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

[5] 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).[6]

Market fees are published annually in advance and are generally levied on market customers (including retailers) on a per megawatt-hour basis.[7] AEMO's published 2013-14 fees are shown in Table 4. 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) 2014.

Table 4 **AEMO 2013-14 market fees**

Fee class	Rate	Paying participants
	$ per MWh	
General fees	$0.1121	Market customers
Allocated fees - market customers	$0.1412	Market customers
Full Retail Contestability – operations	$0.0600	Market customers with a retail licence
National Transmission Planner	$0.0192	Market customers
Electricity Consumer Advocacy Panel	$0.0140	Market customers
Total	**$0.3464**	

Data 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 8 September 2013 87 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, inclusing one week when the charge was more than $17.00 per MWh.

6 These deal with issues such as frequency control.

7 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 **Ancillary Services charges to 8 September 2013**

Price (upper)	Occurrences	Percentage
$0.05	0	0%
$0.10	22	21%
$0.15	47	45%
$0.20	22	21%
$0.25	3	3%
$1.00	4	4%
$2.00	2	2%
$3.00	1	1%
$4.00	1	1%
$5.00	0	0%
$10.00	2	2%
$15.00	0	0%
$20.00	1	1%

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 $0.51 per MWh, reflects the likely future level of these costs.

Therefore, we make the adjustment shown in Table 6 for the impact of market and ancillary services fees.

Table 6 **Market fees and ancillary service fees**

Fee category	Fee rate	
	$ per MWh	c per kWh
Market fees	$0.35	$0.03
Ancillary service fees	$0.51	$0.05
Market fees and ancillary service fees (at RRN)	$0.86	$0.09
Market fees and ancillary service fees (after adjustment for losses)	**$0.93**	**$0.09**

Note: All prices are presented in nominal terms

Data source: ACIL Allen Consulting

6 Value of exported PV output

Table 7 summarises our current base case projection of the value of exported PV output in 2014 based on the above inputs and compares them with the estimates produced in December 2012.

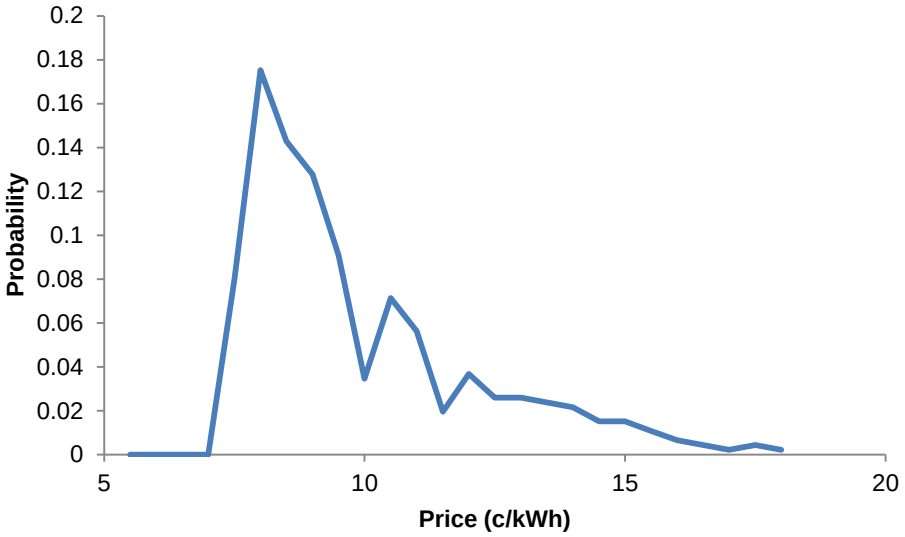
Table 7 **Updated estimate of the value of exported PV output (nominal cents per kWh, GST exclusive**

	September 2013 base case	December 2012 base case (2013/14)
Units	c per kWh	c per kWh
Net system load profile weighted wholesale spot price	7.83	8.53
Avoided losses	0.61	0.68
Market fees	0.09	0.10
Value of exported PV output	**8.53**	**9.31**

Data source: ACIL Allen modelling

We also calculated the NSLP-weighted South Australian price from each of the 463 scenarios to determine the possible distribution of these prices. The range resulting from the stochastic analysis is summarised in Figure 5 and Table 8.

Figure 5 **Projected value of exported PV output in South Australia (463 simulations)**



Source: ACIL Allen Consulting

Table 8 **Projected value of exported PV output in South Australia (463 simulations)**

Value	Projection (c/kWh)
Minimum	7.20
90 percentile	7.58
50 percentile	8.90
Mean	9.73
10 percentile	13.38
Maximum	19.50

Source ACIL Allen Consulting

Table 8 and Figure 5 indicate that the fair and reasonable value of exported PV output is most likely to fall between 7.58 and 13.38 c/kWh. Within that range the median value is 8.90 c/kWh. There is a small likelihood that the fair value would fall outside this range.