

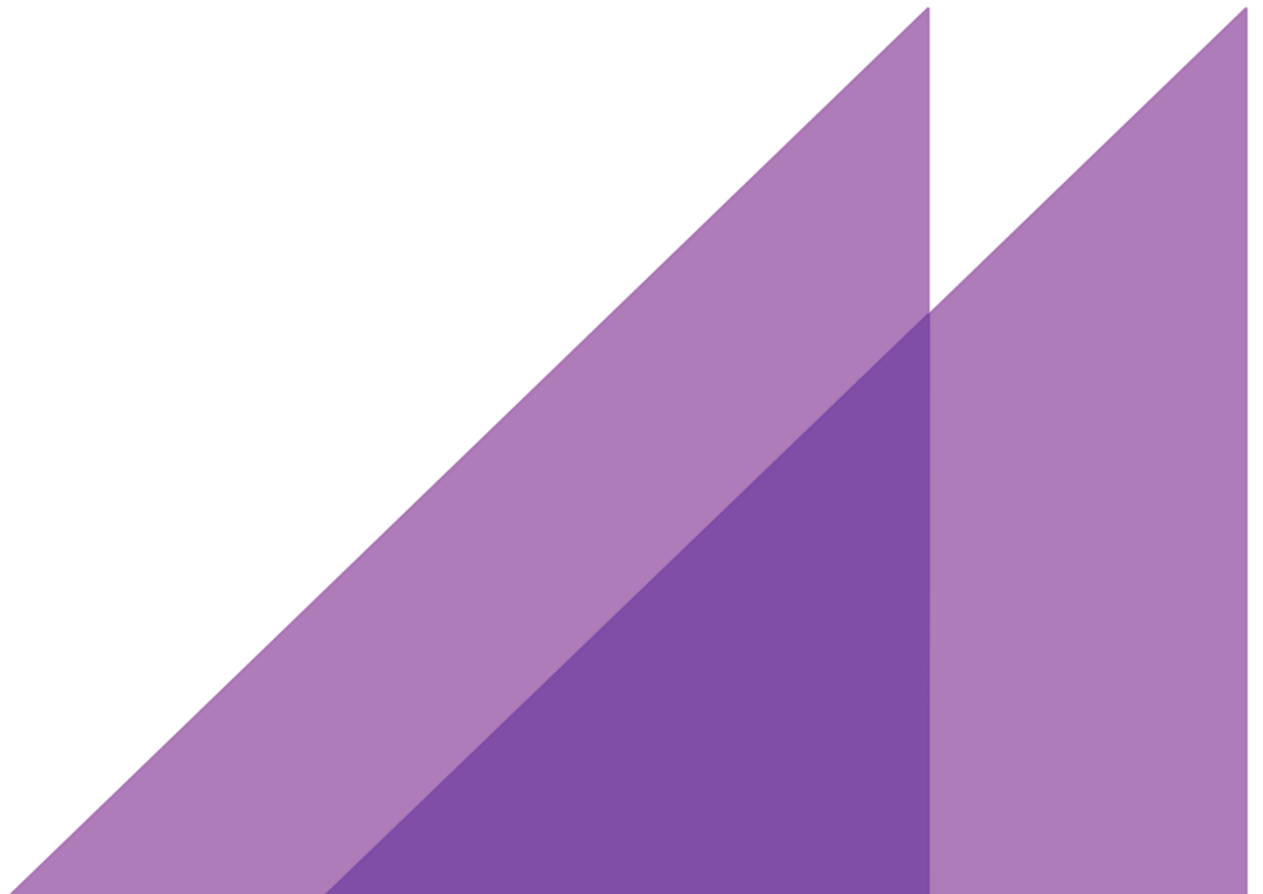
REPORT TO
ESSENTIAL SERVICES COMMISSION OF SOUTH
AUSTRALIA

7 NOVEMBER 2013

ESTIMATED VALUE OF PV EXPORTS



CALENDAR YEAR 2014 –
UPDATE TO INCLUDE
CARBON PRICE SCENARIOS





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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).

In September 2013 ACIL Allen provided a projection of the value of exported PV output using the above methodology with updated inputs. A new feature of the projection on that occasion was that we provide an estimate of the likely range of values. That range was 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 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 In the past we had relied on data from SA Power Networks², which were unpublished. On this occasion we used data from the Clean Energy Regulator, which are published.

On that occasion the estimate was for calendar year 2014. A report on that projection was published with the Commission's Draft Determination

One of the assumptions that the Commission asked ACIL Allen to make in preparing that projection was that the carbon price would apply for all of 2014. More recently the Commission asked us to replicate our earlier projection with an assumption that the carbon price would be repealed from 1 July 2014. This report includes a projection based on that assumption and repeats the earlier projection for completeness.

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 report to the Commission of September 2013 was prepared during the 2013 election campaign, in which the future of the carbon price was a key issue. One of the assumptions that the Commission asked ACIL Allen to make in preparing that projection was that the carbon price would apply for all of 2014.

Now, the newly elected Government has introduced bills to Federal Parliament to remove the carbon price from 1 July 2014. While there is still some uncertainty about whether those bills will pass, the Commission now considers the potential for the carbon price to be removed from 1 July 2014 to have increased significantly. Therefore, the Commission asked ACIL Allen to produce a second estimate of the value of exported PV output in calendar 2014 in addition to that which was published with the draft determination. The two projections use the same assumptions as each other with the exception of the way the carbon price is treated, which is discussed below.

2.1.1 Carbon price scenario

In the carbon price scenario the wholesale spot price of electricity was projected on the assumption that the carbon price will continue to operate in accordance with the fixed price settings of \$24.15/tonne CO₂-e until 30 June 2014 and \$25.40/tonne CO₂-e from then until 30 June 2015.

2.1.2 Repeal scenario

In the repeal scenario the wholesale spot price of electricity was projected based on the assumption that the carbon price will continue to operate in accordance with the fixed price settings of \$24.15/tonne CO₂-e until 30 June 2014 and then fall immediately to zero.

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 (carbon and repeal cases – 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_repeal scenario)	\$61.60
September 2013 (calendar 2014_carbon scenario)	\$73.44
December 2012 projection (financial 2013/14_carbon price included)	\$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).

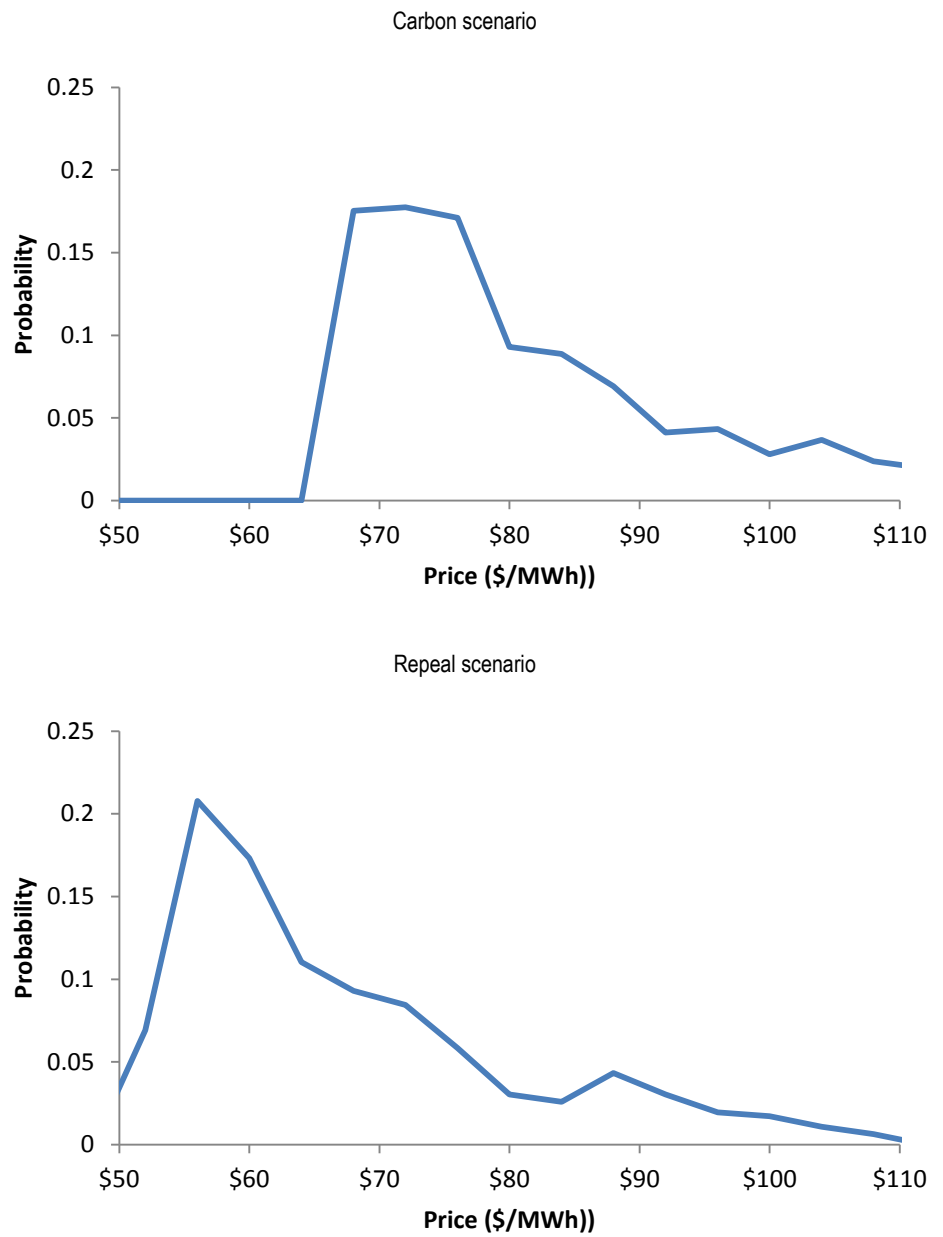
ACIL Allen applied Monte Carlo techniques to the projection of the wholesale (spot) price of electricity. The projected wholesale price was simulated 462 times to capture the uncertainty associated with these stochastic factors (giving 463 simulations including the model base case). The results are summarised in Figure 1, Table 2 and Table 3.

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 average wholesale spot price of electricity in South Australia (463 scenarios) – carbon price scenario

Value	Time weighted	Load weighted
	\$/MWh	\$/MWh
Minimum	\$60.84	\$64.18
90 percentile	\$62.78	\$66.99
50 percentile	\$68.09	\$75.57
ACIL Allen base case	\$67.50	\$73.44
Mean	\$70.02	\$80.21
10 percentile	\$81.10	\$101.43
Maximum	\$99.49	\$138.06

Note: In an earlier draft of this report the time weighted average prices from the carbon price scenario were incorrectly labelled load weighted average prices. Both series are provided here to avoid confusion.

Source: ACIL Allen Consulting

Table 3 Projected average wholesale spot price of electricity in South Australia (463 scenarios) – repeal scenario

Value	Time weighted	Load weighted
	\$/MWh	\$/MWh
Minimum	\$47.54	\$50.33
90 percentile	\$49.39	\$52.74
50 percentile	\$54.59	\$61.87
ACIL Allen base case	\$55.04	\$61.60
Mean	\$56.76	\$66.67
10 percentile	\$67.41	\$88.40
Maximum	\$85.02	\$122.72

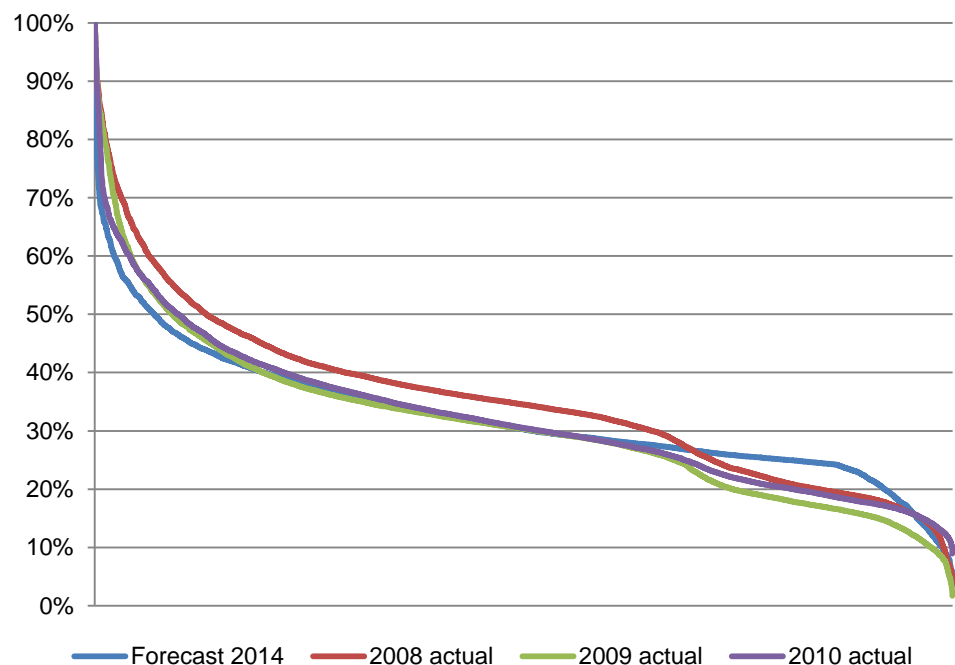
Source: ACIL Allen Consulting

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 (both scenarios)**



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:

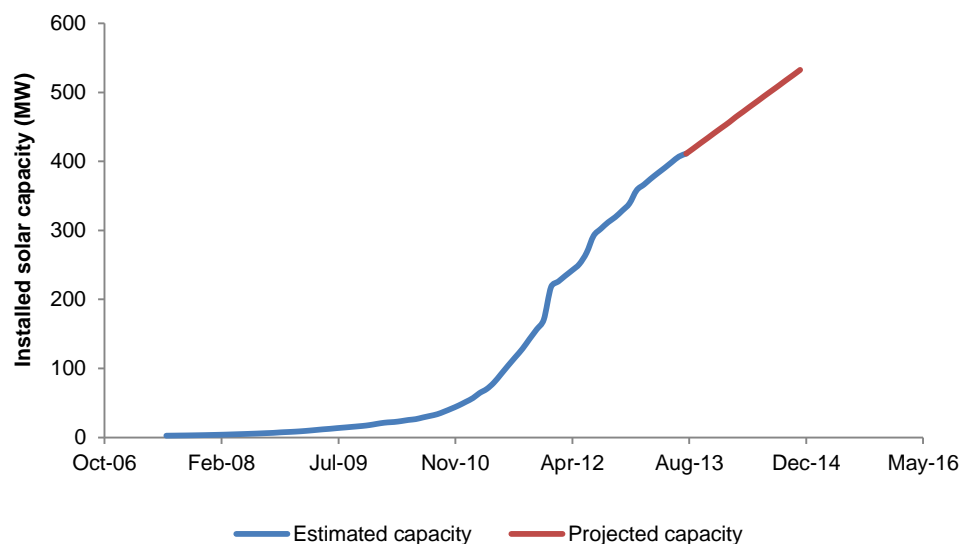
1. solar insolation data for North West Bend developed by 3TIER for Renewables SA.³
2. solar PV uptake data imputed from data published by the Clean Energy Regulator relating to the number of small scale technology certificates created in South Australia.

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 (both scenarios)**

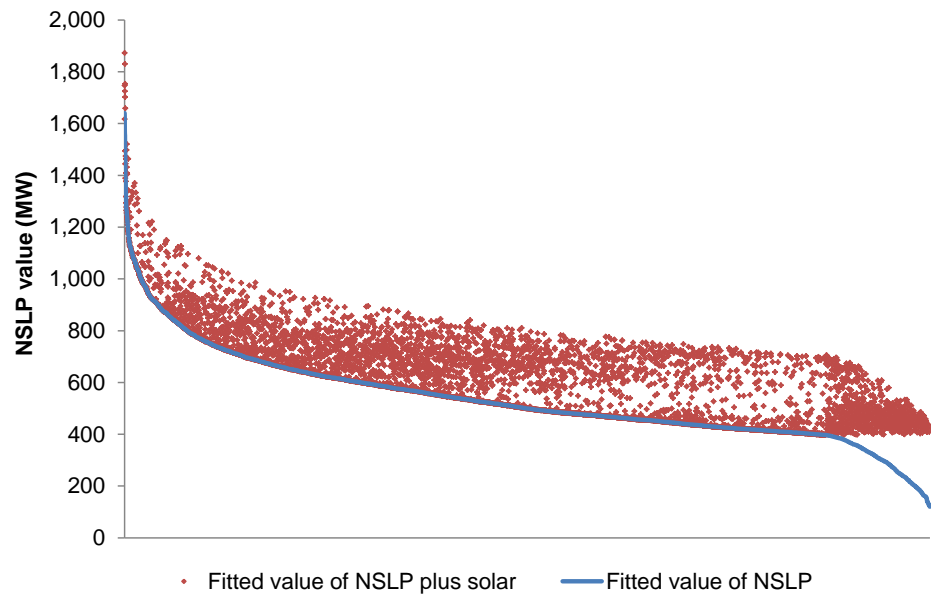


Source: History – Clean Energy Regulator, Projection, ACIL Allen Consulting

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.renewablesa.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 (both scenarios)**

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 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 4 **Historic loss factors in South Australia (both scenarios)**

	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 x 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 5. They indicate costs for market customers with a retail licence of around \$0.40 per MWh. We assumed for this exercise that these charges would be unchanged in the second half of (calendar) 2014.

Table 5 **AEMO 2013-14 market fees (both scenarios)**

Fee class	Rate	Paying participants
	\$/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, including 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 6 Ancillary Services charges to 8 September 2013 (both scenarios)

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 7 for the impact of market and ancillary services fees.

Table 7 Market fees and ancillary service fees (both scenarios)

Fee category	Fee rate	
	\$/MWh	c/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 8 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.

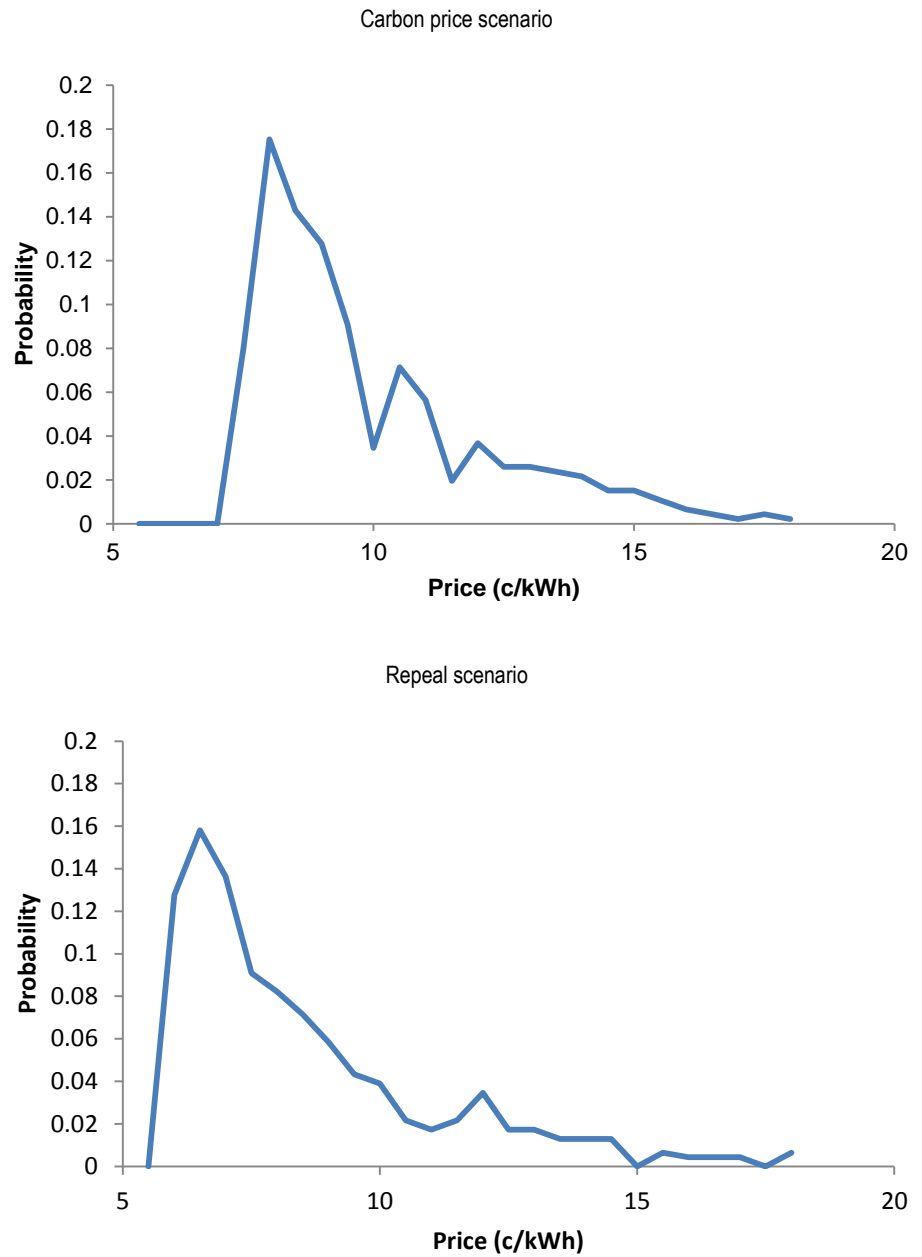
Table 8 **Updated estimate of the value of exported PV output (nominal cents per kWh, GST exclusive)**

	September 2013_repeal base case	September 2013_carbon base case	December 2012 base case (carbon price - 2013/14)
Units	c/kWh	c/kWh	c/kWh
Net system load profile weighted wholesale spot price	6.72	7.83	8.53
Avoided losses	0.52	0.61	0.68
Market fees	0.09	0.09	0.10
Value of exported PV output	7.34	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 9.

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



Source: ACIL Allen Consulting

Table 9 Projected value of exported PV output in South Australia (463 simulations)

Value	Repeal scenario	Carbon price scenario
	c/kWh	c/kWh
Minimum	5.65	7.20
90 percentile	5.97	7.58
50 percentile	7.39	8.90
Mean	8.25	9.73
10 percentile	11.96	13.38
Maximum	17.72	19.50

Source ACIL Allen Consulting

Table 9 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 in the carbon price scenario and between 5.97 and 11.96 c/kWh in the repeal scenario. Within those ranges the median value is 8.90 c/kWh in the carbon price scenario and 7.39 c/kWh in the repeal scenario. There is a small likelihood that the fair value would fall outside these ranges.