ACIL ALLEN CONSULTING

REPORT TO
AUSTRALIAN ENERGY COUNCIL
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WHOLESALE ELECTRICITY COSTS

VICTORIAN DEFAULT OFFER 2020

REVIEW OF THE ESSENTIAL SERVICES COMMISSION'S CURRENT ESTIMATION APPROACH

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EXECUTIVE SUMMARY

ACIL Allen Consulting (ACIL Allen) has been engaged by the Australian Energy Council (AEC) to review the results of the wholesale electricity cost (WEC) estimates as provided by the Essential Services Commission's (ESC's) consultant, Frontier Economics (Frontier), for the draft determination of the 2020 Victorian Default Offer (VDO).

This review is to assess the application of Frontier's methodology to estimate the value of the WEC rather than to assess the methodology *per se*. We maintain the view that our current approach for estimating the WEC, as applied in the Queensland Competition Authority's determination process, which includes undertaking market modelling simulations for the given determination year, is the most appropriate approach to estimate the efficient WEC associated with providing retail electricity services.

To undertake this review, we first replicated Frontier's methodology for estimating the WEC. We then analysed the following:

- use of volatility allowance
- use of three historical years versus two historical years of data
- scaling of historical spot prices to Base futures prices
- use of contract premium
- take up of rooftop solar panels.

In making a VDO price determination, the ESC must have regard to:

… the efficient costs of providing retail electricity services, including wholesale electricity purchases.[1]

Our analysis concluded that the WEC would be more representative of the efficient cost of wholesale electricity purchases if:

1. the WEC is selected based on the distribution of simulated prices, rather than the simulation that gives the median load weighted price – there is a 95 per cent chance that the retailers' costs to purchase wholesale electricity will be higher than the WEC estimated under Frontier's approach
2. the wholesale electricity spot prices are scaled prior to undertaking the Monte Carlo analysis to more appropriately represent the uncertainty of wholesale electricity spot price outcomes
3. the appropriate level of contract premium is an outcome of the analysis rather than an input
4. for future VDO determinations, the shapes of the load profiles are monitored to assess whether they have changed with the increasing uptake of rooftop solar panels and thus have a material impact on the WEC estimate.

[1] Essential Services Commission, *Victorian Default Offer to apply from 1 January 2020: Draft Decision*, 20 September 2019, page 18

1 INTRODUCTION

ACIL Allen Consulting (ACIL Allen) has been engaged by the Australian Energy Council (AEC) to review the results of the wholesale electricity cost (WEC) estimates as provided by the Essential Services Commission's (ESC's) consultant, Frontier Economics (Frontier), for the draft determination of the 2020 Victorian Default Offer (VDO).

1.1 Background

On 20 September 2019 the ESC released its draft decision on the 2020 VDO. The ESC engaged Frontier to calculate the WEC separately for residential and business customers in each of the five distribution areas in Victoria.

We understand that the underlying methodology adopted by Frontier is the same as that used for the 2019 VDO. However, the underlying historical data used by the methodology has been extended by one year – making use of observed half-hourly spot prices and load profiles from the 2018-19 financial year (as well as data from 2016-17 and 2017-18 which were used in the 2019 VDO determination).

1.2 Scope of work

Our scope of work is to provide the AEC with an improved understanding of the methodology used by the ESC to estimate the WEC, and the implications of certain assumptions and aspects of the methodology on the estimated WEC value.

We are not required to provide or suggest an alternative approach to that currently used by the ESC although, where appropriate, the AEC would welcome credible suggestions to refine the current approach.

Our analysis focusses on the following areas:

— Use of volatility allowance – what impact would it have if the 95th percentile WEC from the 500 simulations was used rather than applying a volatility allowance to the WEC corresponding to the median simulated low weighted price?

— Use of three historical years versus two historical years of data – what are the impacts?

— Scaling of historical spot prices to Base futures prices – what are the implications of scaling the historical spot prices prior to undertaking the Monte Carlo simulation analysis, rather than scaling the spot prices within each simulation?

— Scaling of historical spot prices to Base futures prices – what are the implications of assuming no contract premium, rather than the currently assumed five per cent contract premium?

— Take up of rooftop PV – what are the implications of adjusting the load profiles for the assumed increase in rooftop PV from the historical years to 2020?

1.3 Structure of our report

In this report we:

- summarise our understanding of the ESC’s approach to estimating the WEC in chapter 2
- replicate the ESC’s WEC methodology for the residential load profile in the AusNet Services’ distribution area in chapter 3
- explore some of the key assumptions used in the methodology and their implications if altered in chapter 4
- summarise our findings in chapter 5.

2 DESCRIPTION OF THE ESC METHODOLOGY

In this chapter we provide our understanding of the ESC's approach to determining the WEC. We draw information from the following report on the ESC's website:

— *Wholesale electricity costs for 2020: A report for the Essential Services Commission*, Frontier Economics, 16 September 2019[2].

The ESC's approach to estimating the WEC includes four key steps:

— Step 1: Develop simulations of the annual half-hourly profiles of load and spot prices
— Step 2: Determine contract prices
— Step 3: Determine an appropriate contract position
— Step 4: Calculate settlement payments and difference payments based on data from steps 1 to 3.

Rather than using some form of market modelling and demand forecasting to project the future state of the National Electricity Market (NEM) for a given determination year in terms of demand and spot price outcomes, the ESC uses recent historical load and spot price data, coupled with forward contract prices from ASX Energy, and an efficient contracting strategy to estimate the WEC.

2.1 Step 1: Develop simulations of annual half-hourly profiles of load and spot prices

The methodology for the 2020 VDO uses the most recent three financial years of half-hourly load and Victorian spot price data (2016-17 to 2018-19). A Monte Carlo simulation analysis is performed using these three years of data as inputs to develop 500 annual simulations of half-hourly loads and corresponding spot prices.

The simulations are developed by using a stratified random sampling technique with the strata being defined by each quarter and day-type (working day / weekend). A chronological day structure for the 2020 calendar year is used – it may well be the actual day structure of 2020 or a synthetic day structure – and adopted for each of the 500 simulations. For each day in each of the 500 simulations a day of actual half-hourly load and corresponding spot price data is chosen randomly from the actual data of 2016-17 to 2018-19 with the same calendar quarter and day type. For example, if 1 July 2020 is a working day, then a working day between 1 July and 30 September is randomly chosen from the past three years of actual data, and this process is repeated 500 times (once for each simulation). The important outcome, as noted by Frontier, is a set of 500 annual half-hourly simulated load and spot prices which maintain the same degree of correlation as observed historically over the past three years.

[2] https://www.esc.vic.gov.au/sites/default/files/documents/OTH%20-%20VDO%202020%20-%20Frontier%20Economics%20Wholesale%20electricity%20and%20environmental%20costs%2020190916%20small.pdf

Spot prices

In an attempt to align the half-hourly historic spot prices with future expectations (as measured by ASX Energy prices), the spot prices within each simulation are scaled to the adopted base contract price (using the contract prices determined in Step 2) less an assumed contract premium. The scaling is done separately for each quarter.

The appropriateness of using base contract prices for scaling depends on the nature of the change between historical price levels and the expected future price level. For example, if future contract prices are higher due to an expected increase in the underlying costs of generation (say, because of higher coal costs) then using the base contracts to scale historical spot prices is not unreasonable – although the additive scaling approach would be more appropriate. However, if future contract prices are higher due to an expected increase in price volatility (say, because of expected limitations in plant availability), then the proposed approach will not scale historical spot prices to reflect this expectation since the cap contract price level is ignored.

Further, using base contracts for scaling and ignoring peak and cap contracts risks understating the level of price volatility observed in the historical spot price data. For example, if the past five years of spot price data represent a historical sequence of relatively normal or low levels of price volatility (due to relatively normal or low levels of weather-related demand, and relatively normal and high levels of renewable energy resource levels), then clearly the scaling approach will understate the risk of future price volatility. It is the risk of price volatility that incentivises retailers to enter into hedging arrangements.

Further, because each set of simulated prices is scaled to the quarterly base contract prices, this means that, despite developing 500 simulations, each one has a quarterly time weighted average price equal to the base contract price. This ignores the quite reasonable future possibility of average quarterly spot prices being above or below the contract price, which influences the extent of the difference payments and hence the value of the WEC.

Retailers, when developing a hedge portfolio, are not just cognisant of their expectations or the market's expectations of future spot prices, they are also acutely aware of there being a skewed probability distribution of outcomes around the expectation. The ESC approach does not account for this. This could be addressed by scaling the half-hourly prices within a given quarter across all 500 simulations simultaneously – which would result in 500 quarterly average prices distributed around the contract price.

The contract price premium is set at five per cent. Although this is not unreasonable, the contract premium is likely to be different over time – reflecting the changing state of the NEM. Further, the premium is likely to not be the same for base, peak and cap contracts. Typically, peak and cap contracts attract a higher premium since it is usually during peak periods that the risk of price volatility is greatest, and of course, the premium will be more concentrated during periods when spot prices exceed $300/MWh.

The use of a contract premium is likely due to the approach making use of the simulation with the median spot price outcome. It is widely accepted that because spot prices are not normally distributed there is a premium between the expected average quarterly price and the median quarterly price.

Demand

The ESC approach takes the corresponding half-hourly demand data for the 500 simulations and uses this in determining the load weighted price for each simulation, as well as an input to determining the appropriate contracting strategy and WEC. Frontier, on page 16 of its report, states that:

Once we have completed this Monte Carlo simulation, we make no further adjustments to the consumption data.

However, this does not appear to be the case. The half hourly load data contained in the spreadsheets on the ESC website[3] for each distribution area have been normalised so that the energy of each simulation equals 1,000 MWh.

[3] https://www.esc.vic.gov.au/sites/default/files/documents/SS%20-%20VDO%202020%20-%20Draft%20determination%20-%2019-09-17-DJP%20settling%20contract%20positions%20-%20half%20hourly%20cash%20flows%20Ausnet.XLSX

Similar to scaling the half hourly prices, a choice can be made as to whether the demands are scaled within each simulation, or across all simulations. The current approach means that each simulation has the same amount of energy.

Although volatility in energy consumption is nowhere near the levels of price volatility, the current approach ensures there is no volatility in annual energy levels between each simulation.

2.2 Step 2: Determine contract prices

Two sets of average contract prices are determined:

5. The first set is based on the 12-month trade volume weighted average contract prices
6. The second set is based on the 40-day trade volume weighted average contract prices.

The first set is used as an input to the estimate of the contracting costs – assuming a portfolio of hedges is built up over a 12-month period.

The second set is intended to represent the most recent view of where participants expect spot prices to settle in 2020, and thus is used to scale the historical spot prices.

2.3 Step 3: Determine an appropriate contract position

An optimal contracting strategy is a function of load shape, spot prices and contract prices. Various contracting strategies need to be evaluated, and their evaluation requires the calculation of the WEC.

Our experience is that there are groups of multiple strategies that give the same (or very similar) WEC estimates. This is part of the reason why we do not change the strategy each year in our work is estimating the WEC for the Queensland Competition Authority (QCA). There needs to be a reasonable change in the load profile, or change in the relativities in contract prices (between base, peak and cap) and spot prices, to invoke a change in the optimal strategy.

The ESC approach to determining the efficient contract position is to calculate the WEC for different contract positions for a selection of simulations (*not* all 500 simulations). For a given contracting strategy, the WEC is calculated for seven simulations – which represent the 99th, 95th, 75th, 50th, 25th, 5th, and 1st percentiles of the 500 annual demand weighted prices. From these seven WECs the standard deviation appears to be calculated. The contracting strategy with the smallest standard deviation is then deemed to be the efficient strategy and is adopted for the final estimation of the WEC.

This is broadly analogous to us choosing the strategy with the lowest 95th percentile WEC. By choosing the strategy that gives the lowest 95th percentile WEC, we are reducing the potential for upward variation in the WEC.

Calculate settlement payments and difference payments

As part of determining the efficient contracting strategy and hence the final WEC, the ESC's approach takes the data from the previous steps to calculate the settlement and difference payments for each half-hour for a given simulation and contracting strategy. This is analogous to using a hedge model. These payments are then summed and divided by the total energy to estimate the WEC in \$/MWh terms.

3 REPLICATION OF THE ESC WEC ESTIMATION METHODOLOGY

In this chapter we replicate the ESC's WEC estimation approach. This is an important step as our ability to replicate the approach means we can then explore the results in more detail and test changes to the input assumptions.

We start by outlining the steps we took to replicate the process. We then show the outcomes of the analysis and how those outcomes closely match the results provided in Frontier's report. We then explore the results of the simulations and the relationship between the load weighted price and the WEC.

3.1 Process

3.1.1 Data

In replicating the analysis, we made use of the following data:

- half-hourly Victorian spot prices from 2016-17 to 2018-19 as published by AEMO (in $/MWh, nominal)
- half-hourly load profile data for residential customers in the AusNet Services distribution area for 2016-17 to 2018-19 (published on the ESC's website) (in kWh) (the loads)
- the 12-month average contract prices (in $/MWh, nominal) provided in the Frontier spreadsheet on the ESC's website for the AusNet Services distribution area[4], which are also published on page 24 of Frontier's report
- we inferred the 40-day average base contract price (in $/MWh, nominal) for each quarter by calculating the average quarterly spot price in the Frontier spreadsheet (which we assume were scaled to the 40-day average quarterly contract prices less five per cent) and adjusting for the assumed five per cent contract premium
- the quarterly contracting strategy (by contract type) (in normalised MW) provided in the Frontier spreadsheet on the ESC's website for residential customers in the AusNet Services distribution area
- the day structure (day type and period type) for the 2020 calendar year.

[4] https://www.esc.vic.gov.au/sites/default/files/documents/SS%20-%20VDO%202020%20-%20Draft%20determination%20-%2019-09-17-DJP%20settling%20contract%20positions%20-%20half%20hourly%20cash%20flows%20Ausnet.XLSX

3.1.2 Generating simulations

We generated 500 simulations of 17,520 half hourly spot prices and loads by undertaking the following steps:

1. Classify each day from 1 July 2016 to 30 June 2019 by quarter and day type.
2. For each day of each simulation, randomly draw a day from 2016-17 to 2018-19 with the same quarter and day-type, and take the 48 half-hourly prices and loads from the drawn day and allocate to the simulation day. Each historical day of data has an equal probability of being chosen (for a given quarter and day type).
3. For each simulation, scale the half-hourly prices in each quarter to the 40-day average base contract price.
4. For each simulation, calculate the normalised half-hourly loads across the year by dividing each drawn load by the sum of the drawn loads, multiplying by 1,000 (to get to MW) – such that the set of normalised half-hourly loads for each simulation has an annual energy equal to 1,000 MWh – as per the Frontier spreadsheet.
5. For each simulation, for each half-hour, calculate the payment to AEMO, the contract difference payments and cap premium payment.
6. For each simulation, calculate the annual average load weighted spot price, and WEC.

3.2 Results

Figure 3.1 shows the distribution of 500 simulated annual load weighted prices (LWP) and wholesale energy costs (WEC) for the AusNet Services residential load derived from the application of the ESC methodology. This compares favourably with the distribution of results provided in the Frontier report (a shown in Figure 3.2). The key observations are:

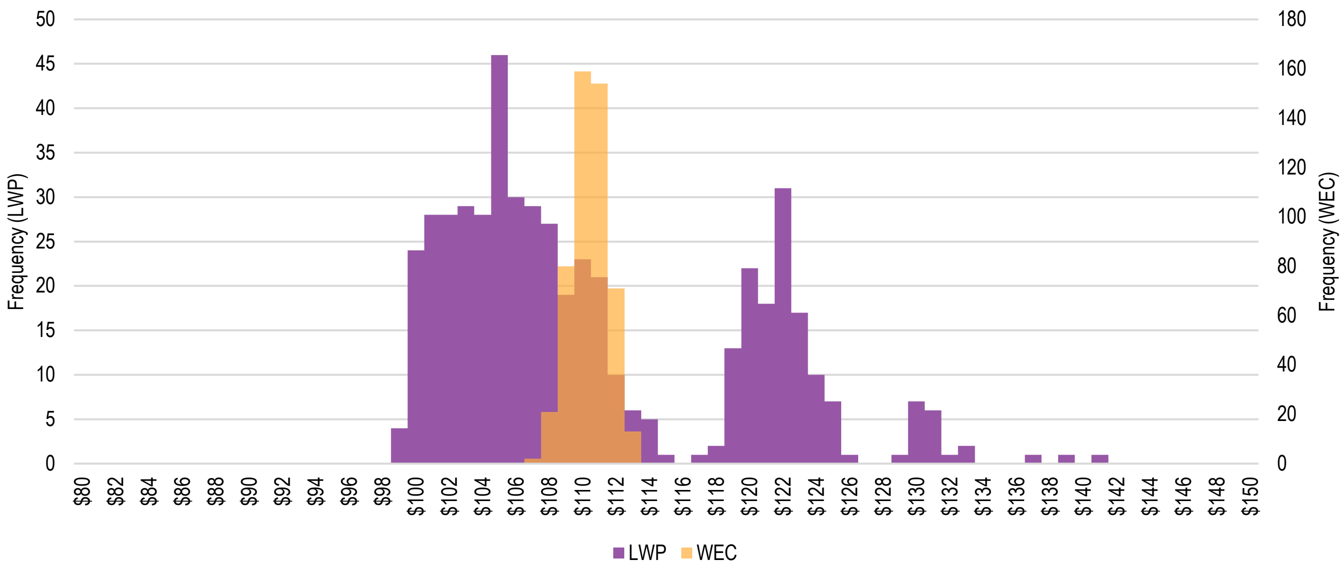
— The distribution of LWPs are tri-modal – reflecting the different price outcomes, and relationship between prices and load, from 2016-17 to 2018-19.

— The distribution of WECs has a single mode – as a result of the hedging strategy.

— As expected, the distribution of WECs is much tighter than that of the LWPs.

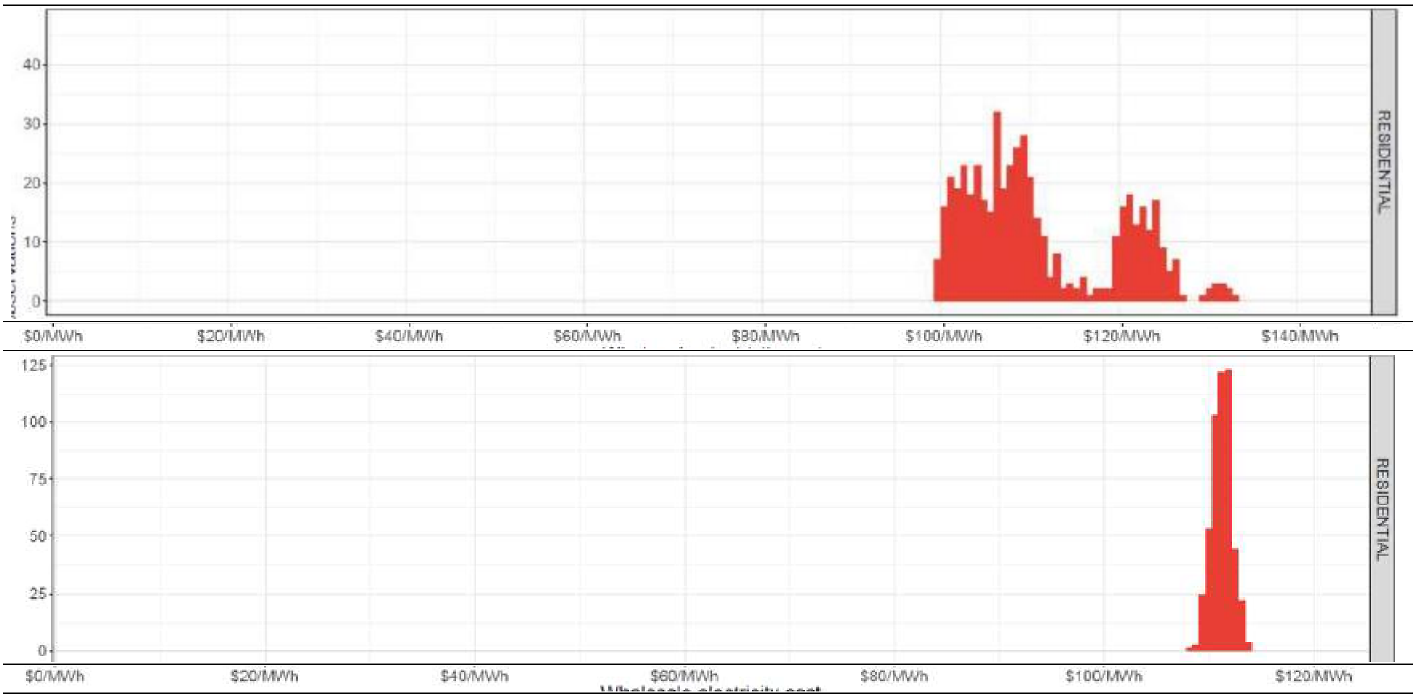
— There is very strong agreement between the ESC distribution and the distribution based on our replication of the methodology (in terms of shape and location) for both the LWP and WEC. We do not expect to perfectly re-create the distribution of ESC LWPs and WECs since the Monte Carlo process relies on random sampling.

FIGURE 3.1 DISTRIBUTION OF 500 SIMULATED ANNUAL LOAD-WEIGHTED PRICES AND WECs ($/MWH, NOMINAL) FOR AUSNET SERVICES RESIDENTIAL LOAD – 2020 – ACIL ALLEN APPLICATION OF ESC METHODOLOGY



SOURCE: ACIL ALLEN ANALYSIS OF AEMO DATA, AND ESC / FRONTIER ECONOMICS REPORTS

FIGURE 3.2 DISTRIBUTION OF 500 SIMULATED ANNUAL LOAD-WEIGHTED PRICES AND WECs ($/MWH, NOMINAL) FOR AUSNET SERVICES RESIDENTIAL LOAD – 2020 – ESC/FRONTIER



Note: The two graphs have a different scale on x-axis.

SOURCE: FRONTIER ECONOMICS REPORT

As mentioned earlier, the ESC adopts, as its final estimate, the WEC corresponding to the simulation which gives the median LWP across the 500 simulations. In the case of the residential load in the

AusNet Services distribution area, our replication analysis produces a WEC of $109.11/MWh, which is within one per cent of the ESC estimate of $108.95/MWh. Given the high degree of agreement of these two estimates, and the strong similarity in distributions, we are comfortable that we have accurately replicated the approach adopted by Frontier for the ESC.

4

IMPLICATIONS OF KEY ASSUMPTIONS OF ESC WEC METHODOLOGY

In this chapter we test some key variations to the ESC's current methodology to assist the AEC in understanding the sensitivity of the current approach to different assumptions.

4.1 Use of the median and volatility allowance

Use of volatility allowance – what impact would it have if the 95th percentile WEC from the 500 simulations was used rather than applying a volatility allowance to the WEC corresponding to the median simulated low weighted price?

Currently, the ESC adopts the annual WEC corresponding to the simulation that gives the median annual LWP, and then applies a volatility allowance.

Although the distributions of LWPs and WECs are provided separately in the Frontier report, no description is provided about the correlation between the WEC and LWP.

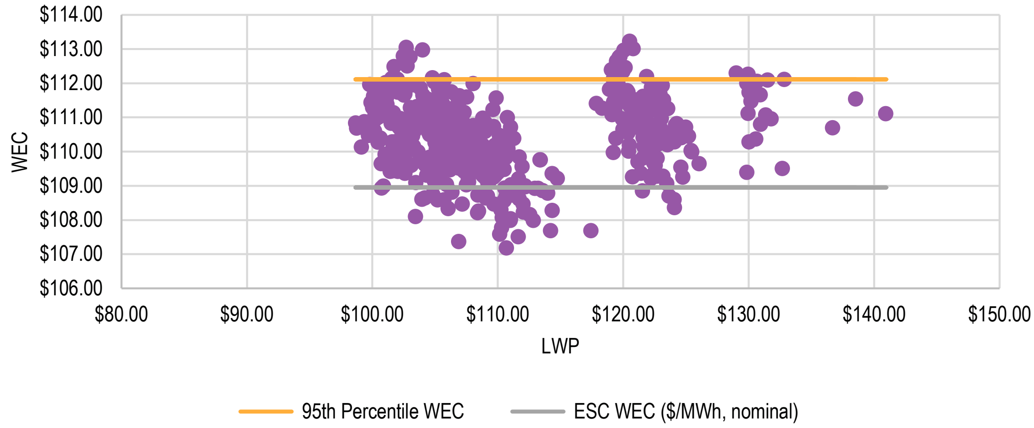
Figure 4.1 plots the 500 pairs of LWPs and WECs from our replication of the ESC methodology (and Figure 4.2 shows the same graph – but zoomed in around the median LWP). The median LWP from our replication of the approach is $107.66/MWh (compared with $108.70/MWh in the Frontier spreadsheet) – this further demonstrates the reasonableness of our replication of the approach.

The key features of Figure 4.1 and Figure 4.2 are:

— There is little correlation between the WEC and LWP. In other words, the contracting strategy results in a WEC outcome that is largely immune to the LWP.
— Although the spread in WEC is much less than that of the LWP, it is about $6/MWh.
— The WEC of the simulation with the median annual LWP sits at the lower end of the distribution of WECs. This is true for both our replication of the process, and that of the ESC and Frontier (as shown previously in Figure 3.2):
— Even when zooming in to within $1/MWh of the median LWP, it can be seen that the simulations giving a LWP close to the median LWP have a range of WECs covering the entire distribution of WECs.

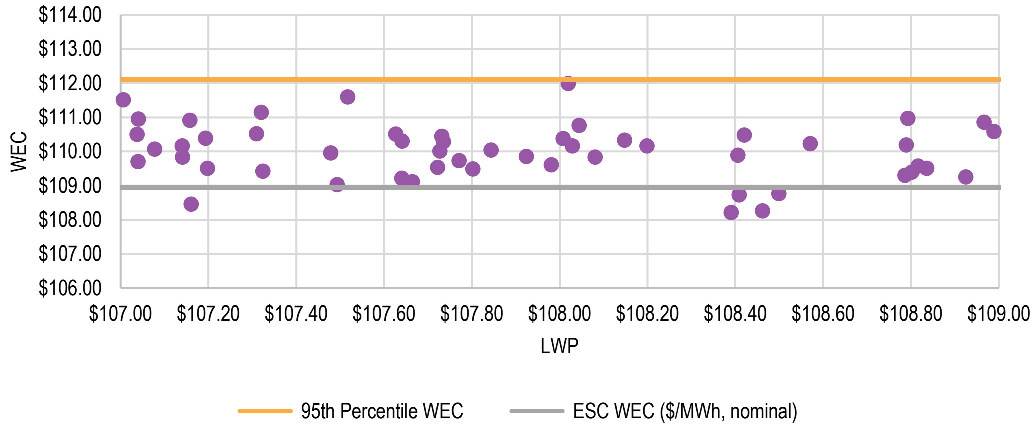
Choosing the WEC of the simulation that gives the median LWP means there is no consideration of where the associated WEC sits in the distribution of WECs. In this instance, the WEC is in the lower 5th percentile of the distribution – for both our replication of the approach and Frontier's application of the approach. Or put another way, based on the given contracting strategy and underlying historical data, there is a 95 per cent chance that the WEC will be greater than the final estimate adopted by the ESC in its draft determination.

FIGURE 4.1 500 SIMULATED ANNUAL LWPs VERSUS WECs ($/MWH, NOMINAL) FOR AUSNET SERVICES RESIDENTIAL LOAD – 2020 – ACIL ALLEN APPLICATION OF ESC METHODOLOGY



SOURCE: ACIL ALLEN ANALYSIS

FIGURE 4.2 500 SIMULATED ANNUAL LWPs VERSUS WECs ($/MWH, NOMINAL) FOR AUSNET SERVICES RESIDENTIAL LOAD – 2020 – ACIL ALLEN APPLICATION OF ESC METHODOLOGY



SOURCE: ACIL ALLEN ANALYSIS

As mentioned earlier, our approach when undertaking similar work for the QCA (setting aside other differences in the two approaches) is to take the 95th percentile WEC as the final estimate. The 95th percentile is shown in Figure 4.1. We take this approach as we wish to be 95 per cent confident that we do not underestimate the WEC for retailers and hence minimise the risk of there being no opportunity for retail competition (and noting that retailers can compete by offering contracts with a WEC below this value).

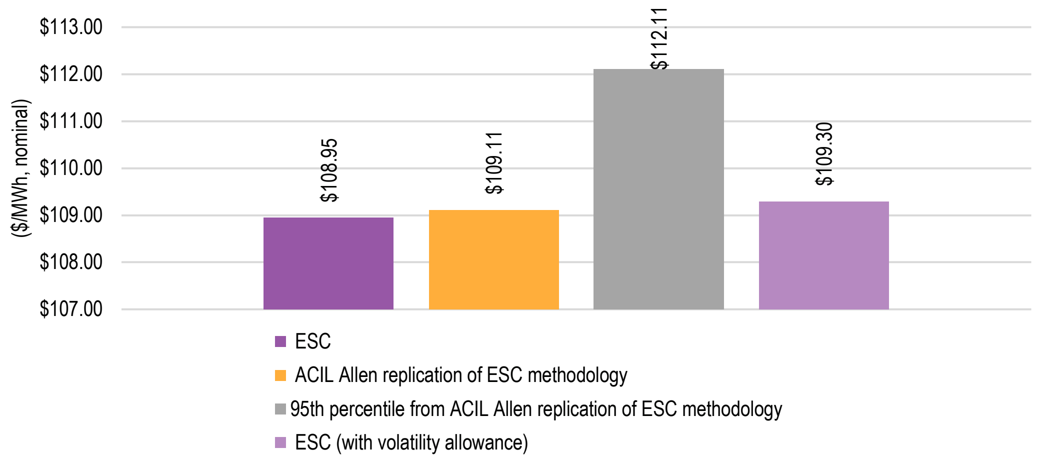
It is unclear as to why the ESC takes this approach. It could be the case that there is an expectation that the simulation giving the median LWP also gives the median WEC – but this is not the case in this instance. It could be the case that the ESC and Frontier view the simulation that gives the median WEC as the most likely outcome (since there is a 50:50 chance of the LWP being above or below this value). However, the hedging strategy does not result in a transformation of the LWP to a WEC which preserves the ranking of the simulations.

At the very least, it would seem reasonable to choose the WEC from the midpoint of the distribution of WEC outcomes – but even this means there is a 50 per cent chance is underestimating the value of the WEC.

The ESC methodology takes the estimated WEC and increases it by a volatility allowance. Frontier notes that the volatility allowance is intended to compensate retailers for the residual risk to which they are exposed since they are adopting the WEC from the simulation with gives the median LWP to fund cashflow shortfalls. However, application of the volatility allowance does not cover the cost of an underestimate of the WEC – only the cashflow shortfalls.

In the case of the residential load in the AusNet Services distribution area, the volatility allowance is estimated as \$0.35/MWh in the ESC's draft determination. This still results in a WEC that is \$3/MWh below the 95th percentile WEC, as shown in Figure 4.3.

FIGURE 4.3 COMPARISON OF ESTIMATED WEC (\$/MWH, NOMINAL) – FOR AUSNET SERVICES RESIDENTIAL LOAD – 2020



Note: Scale on y-axis has been enlarged to show differences in WEC values.

SOURCE: ACIL ALLEN ANALYSIS

4.2 Use of three historical years versus two historical years of data

Use of three historical years versus two historical years of data – what are the impacts?

AEC notes that the 2020 VDO makes use of the 2018-19 historical data in addition to the 2016-17 and 2017-18 data (which were used in the 2019 VDO). Frontier in its report states that, based on its analysis of the three years of historical data, rather than rolling forward 12 months for the 2020 VDO and using the 2017-18 and 2018-19 data only, all three years should be used.

We generally share this view, since using two years only of historical data increases the risk of understating or overstating the volatility of price outcomes in the NEM. However, we add the caveat that consideration be given to any structural changes in the market during the period the historical data spans – as does Frontier.

Regardless, we have undertaken a sensitivity in which we repeat the Monte Carlo simulation process by using the 2017-18 and 2018-19 data only. This sensitivity also reruns the contracting strategy search algorithm to find the efficient strategy given the change in data.

The results of the sensitivity are shown in Figure 4.4. The key features are:

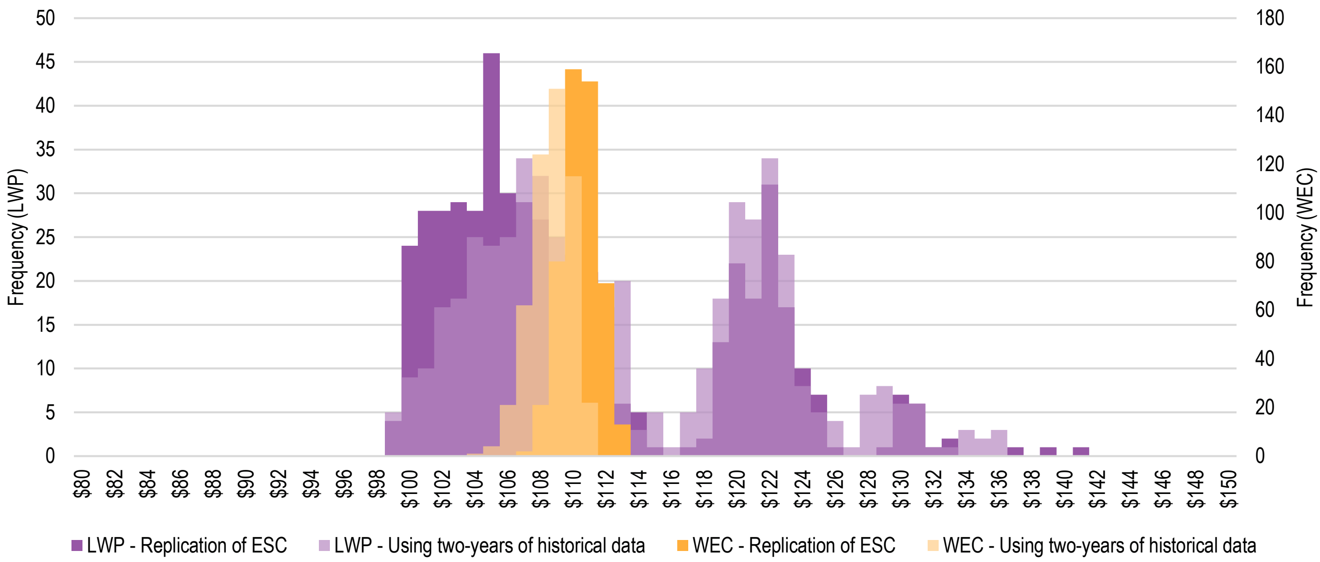
— The distribution of simulated LWPs is not dissimilar to that when using the three years of data – although it is not as skewed towards lower prices.

— The shape of the distribution of simulated WECs is not dissimilar to that when using the three years of data. Importantly however, the location of the distribution is about \$2/MWh lower.

— The WEC associated with the simulation having the median LWP is about $1.50/MWh higher than the WEC based on the current approach.

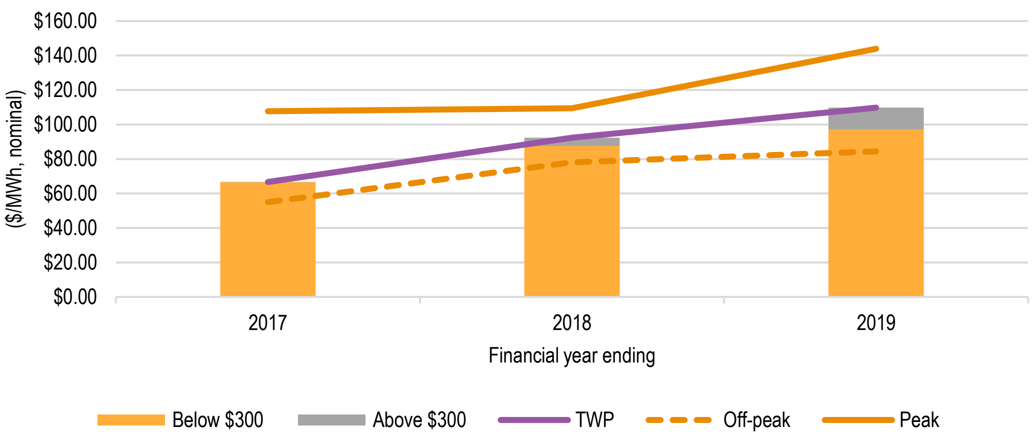
The lower WEC estimates are not surprising when considering the nature of the historical data (as shown in Figure 4.5). Price outcomes in 2016-17 were lower than the other two years – both in terms of overall price level and price volatility. At face value, by including the lower priced year of 2016-17 one could expect a set of lower simulated WEC estimates. However, it is not so much the level of spot price outcomes but rather the diversity in outcomes. By including 2016-17, the diversity in spot price outcomes is increased. It is the diversity, or larger spread of outcomes, that increases the risk to retailers, and hence the cost of hedging that risk. For this reason, we are comfortable with using all three years of data.

FIGURE 4.4 DISTRIBUTION OF 500 SIMULATED ANNUAL LOAD-WEIGHTED PRICES AND WECS ($/MWH, NOMINAL) FOR AUSNET RESIDENTIAL LOAD – 2020 – ACIL ALLEN APPLICATION OF ESC METHODOLOGY WITH TWO YEARS OF DATA



SOURCE: ACIL ALLEN ANALYSIS OF AEMO DATA, AND ESC / FRONTIER ECONOMICS REPORTS

FIGURE 4.5 HISTORICAL ANNUAL VICTORIAN SPOT PRICE ($/MWH, NOMINAL)



SOURCE: ACIL ALLEN ANALYSIS OF AEMO DATA

4.3 Scaling of historical spot prices to Base futures prices

Scaling of historical spot prices to Base futures prices – what are the implications of scaling the historical spot prices prior to undertaking the Monte Carlo simulation analysis, rather than scaling the spot prices within each simulation?

The ESC's current approach scales the half-hourly prices in each of the 500 simulations to the same quarterly average spot price. In effect this means that each simulation is differentiated only by the correlation between half-hourly price and load.

Uncertainty in future price levels is a key risk faced by retailers, and not just the correlation between price and load). Since the NEM's inception, annual average spot prices in Victoria have ranged between about $35/MWh and $100/MWh in real terms. Some of this variation is due to structural changes in the market (in terms of demand, supply, type of supply, and cost of supply), but just as importantly, this variation is also due to stochastic influences of different weather driven demand outcomes, weather driven renewable energy resource availability, and thermal power station availability.

Scaling the half-hourly prices within each simulation essentially assumes away these stochastic influences on overall price levels (but maintains intra-year variations). This runs the risk of understating the cost of wholesale electricity.

To test this, we have undertaken a sensitivity, by repeating the ESC approach, but scaling the spot prices across 2016-17 to 2018-19 to the corresponding base contract prices prior to running the Monte Carlo simulations. This means that the average price outcome in each simulation is not forced to be the same. Although this approach does not consider weather driven demand outcomes, renewable plant resource availability and thermal power station availability over a longer period of time, it at least allows an assessment without limiting the price outcomes in each simulation on average to the same value.

The results of the sensitivity are shown in Figure 4.6. The key features are:

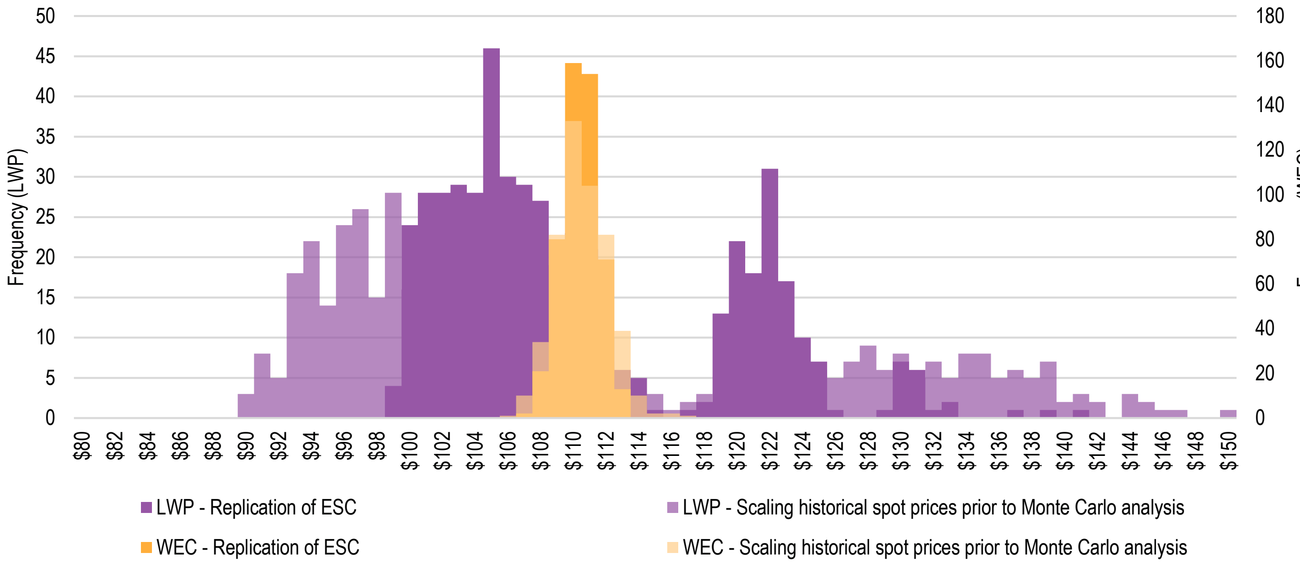
— The distribution of simulated LWPs are far more diverse when scaling the spot prices prior to the Monte Carlo analysis – which is not surprising. However, overall the average price outcome is not dissimilar to the average outcome of the current approach – since we are drawing from a price series that on average equals the base contract prices.

— The shape of the distribution of simulated WECs is not dissimilar to that when using the current approach – although it displays a slightly larger spread. The location of the distribution is about $1/MWh higher than under the current approach.

— The WEC associated with the simulation having the median LWP is about $2/MWh higher than the WEC based on the current approach.

We are of the opinion that the historical spot prices should be scaled in aggregate prior to undertaking the Monte Carlo analysis.

FIGURE 4.6 DISTRIBUTION OF 500 SIMULATED ANNUAL LOAD-WEIGHTED PRICES AND WECs ($/MWH, NOMINAL) FOR AUSNET SERVICES RESIDENTIAL LOAD – 2020 – ACIL ALLEN APPLICATION OF ESC METHODOLOGY WITH DIFFERENT SPOT PRICE SCALING



SOURCE: ACIL ALLEN ANALYSIS OF AEMO DATA, AND ESC / FRONTIER ECONOMICS REPORTS

4.4 Use of a contract premium

Scaling of historical spot prices to Base futures prices – what are the implications of assuming no contract premium, rather than the currently assumed five per cent contract premium?

The ESC's current approach assumes a five per cent contract premium when scaling the spot prices within each simulation to the base contract price. Presumably this is because the current approach makes use of the simulation which gives the median LWP, and it is assumed, reasonably, that contract price is the market's risked weighted view of future price which, due to the skewed nature of spot prices, will be at a premium to the median outcome.

Although it is reasonable to expect that the median outcome should be at a discount to the contract price, scaling each simulation to the contract price less five cent assumes that each simulation is a median outcome.

To test the materiality of assuming a five per cent contract premium, we have undertaken a sensitivity, by repeating the ESC approach, but scaling the spot prices without a discount to the contract prices.

The results of the sensitivity are shown in Figure 4.7. The key features are:

— The distribution of simulated LWPs are simply five per cent higher than those of the current approach.

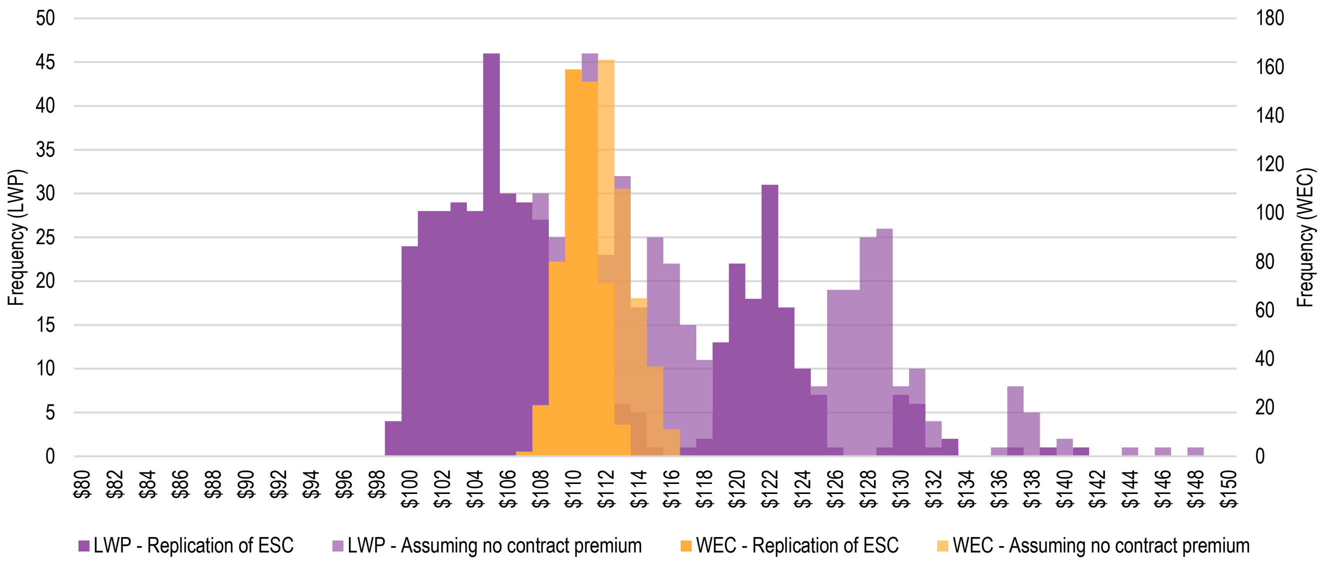
— The shape of the distribution of simulated WECs is not dissimilar to that when using the current approach. The location of the distribution is about $2/MWh higher than under the current approach. This is because of AEMO payments during high spot price events when the load is not fully hedged.

— The WEC associated with the simulation having the median LWP is about $1.80/MWh higher than the WEC based on the current approach.

We are of the opinion that the adoption of a contract premium could be removed if the approach is modified by scaling the spot prices to the contract price prior to undertaking the Monte Carlo simulations. Interestingly, in the sensitivity in section 4.3, which scaled the spot prices prior to undertaking the Monte Carlo analysis, the simulation with the average of the annual LWPs is about six per cent higher than the simulation with the median LWP.

In other words, it may be possible to not force an assumed contract premium and instead let the data guide the analysis as to what the contact premium should be. This is the philosophy that we use when undertaking its work for the QCA – it lets the market modelling simulations determine the extent of the skewness in the distribution of annual outcomes.

FIGURE 4.7 DISTRIBUTION OF 500 SIMULATED ANNUAL LOAD-WEIGHTED PRICES AND WECs ($/MWH, NOMINAL) FOR AUSNET SERVICES RESIDENTIAL LOAD – 2020 – ACIL ALLEN APPLICATION OF ESC METHODOLOGY WITH NO CONTRACT PREMIUM



SOURCE: ACIL ALLEN ANALYSIS OF AEMO DATA, AND ESC / FRONTIER ECONOMICS REPORTS

4.5 Up-take of rooftop PV

Take up of rooftop PV – what are the implications of adjusting the load profiles for the assumed incremental increase in rooftop PV from the historical years to 2020?

The ESC's current approach does not adjust the historical load profiles for further uptake of rooftop PV. Given the determination is looking forward one year only this is not an unreasonable simplification. However, if over time the ESC intends to extend the historical data set it uses to simulate the WEC, then consideration might be given to accounting for the incremental uptake of rooftop PV. The difficulty of course is that the historical spot prices do not reflect the incremental uptake. Regardless, we have undertaken a sensitivity by repeating the ESC approach but adjusting the historical load profiles by accounting for the incremental uptake of rooftop PV.

We have used the latest AEMO forecast of rooftop PV uptake in Victoria for 2020 and compared this with the actual uptake for 2016-17 to 2018-19. For each year we have calculated the incremental uptake, which is then converted into a half-hourly solar PV output profile which is then applied as an adjustment to the load profile of each of the three historical years.

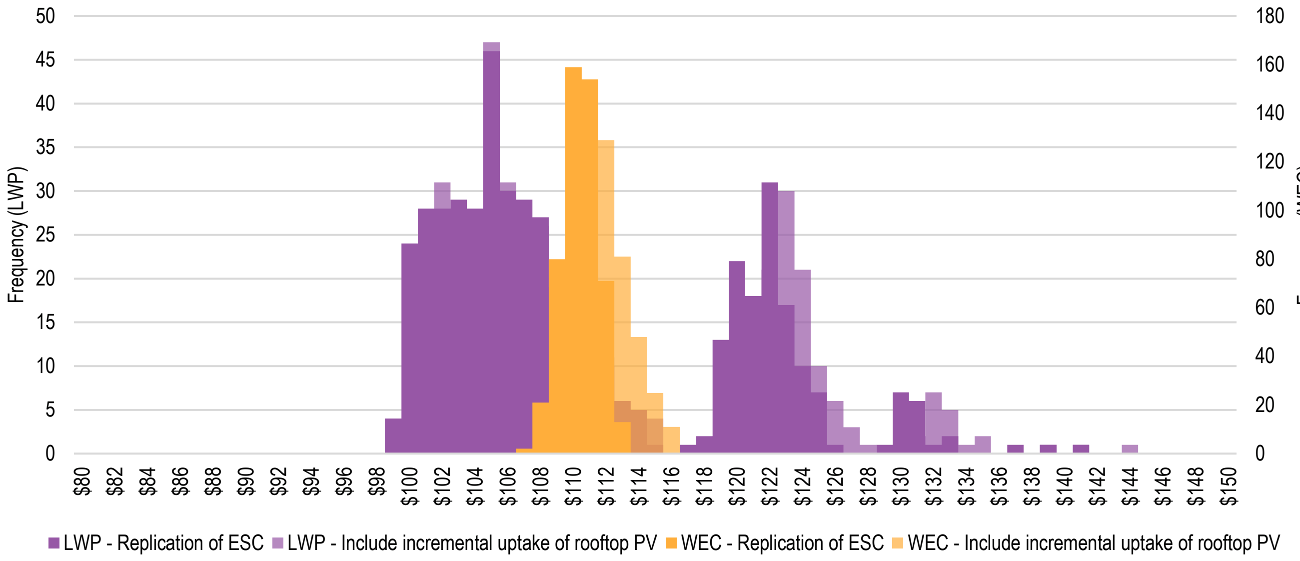
The results of the sensitivity are shown in Figure 4.8. The key features are:

— The distribution of simulated LWPs are about $2/MWh higher when compared with the current approach. This is because demand has been reduced slightly during daylight hours and historical spot prices are already starting to show the effects of rooftop PV

— The shape of the distribution of simulated WECs is not dissimilar to that when using the current approach. The location of the distribution is about $2/MWh higher than under the current approach.

— The WEC associated with the simulation having the median LWP is about $2/MWh higher than the WEC based on the current approach.

FIGURE 4.8 DISTRIBUTION OF 500 SIMULATED ANNUAL LOAD-WEIGHTED PRICES AND WECs ($/MWH, NOMINAL) FOR AUSNET SERVICES RESIDENTIAL LOAD – 2020 – ACIL ALLEN APPLICATION OF ESC METHODOLOGY WITH INCREMENTAL UPTAKE OF ROOFTOP SOLAR PV



SOURCE: ACIL ALLEN ANALYSIS OF AEMO DATA, AND ESC / FRONTIER ECONOMICS REPORTS

5 CONCLUSIONS

We have replicated the ESC's current methodology for estimating the WEC, and this has been applied to the residential load for the AusNet Services distribution area. We have then tested a number of sensitivities – the key results of which are shown in Figure 5.1. The key findings of our analysis are:

— Adopting the WEC of the simulation that gives the median LWP, rather than assessing the distribution of WECs and making an appropriate selection, risks underestimating the WEC. There is a risk that the WEC based on this approach sits in the lower five per cent of the distribution of simulated WECs. This in effect means there is a 95 per cent chance that the estimate is less than the actual WEC.

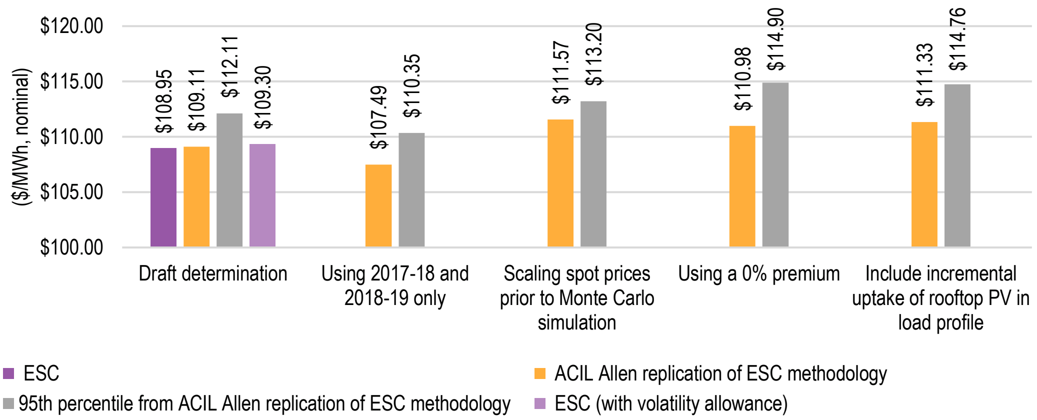
— Limiting the initial data to the most recent two years runs the risk of either understating or overstating the volatility and diversity in outcomes.

— Scaling the spot prices prior to undertaking the Monte Carlo analysis is likely to more appropriately represent the uncertainty in spot price outcomes that retailers face, rather than forcing each simulation to have the same average spot price.

— Scaling the spot prices prior to undertaking the Monte Carlo analysis also allows the data to provide guidance for the appropriate level of the contract premium.

— Care will need to be taken, if over time, the historical data set is extended, since the shape of the load profiles will change with the continued uptake of rooftop PV.

FIGURE 5.1 SUMMARY OF ESTIMATED WECS ($/MWH, NOMINAL) FOR AUSNET SERVICES RESIDENTIAL LOAD – 2020 – ACIL ALLEN APPLICATION OF ESC METHODOLOGY



SOURCE: ACIL ALLEN ANALYSIS

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