ACIL ALLEN

21 May 2024

Report to Australian Energy Regulator

Wholesale energy costs and rooftop PV exports

Interaction of DMO WEC estimation methodology with solar FiTs

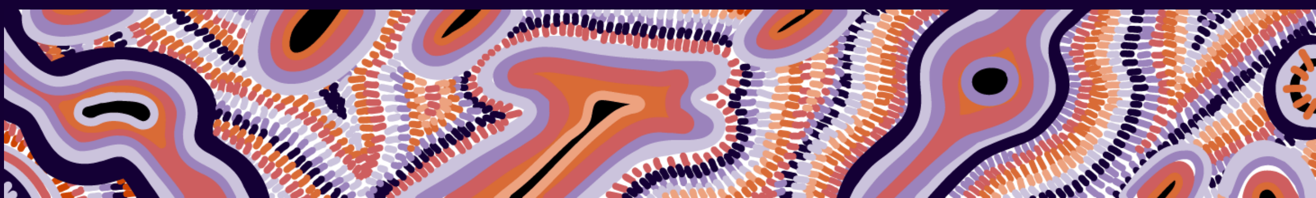
About ACIL Allen

ACIL Allen is a leading independent economics, policy and strategy advisory firm, dedicated to helping clients solve complex issues.

Our purpose is to help clients make informed decisions about complex economic and public policy issues.

Our vision is to be Australia's most trusted economics, policy and strategy advisory firm. We are committed and passionate about providing rigorous independent advice that contributes to a better world.

ACIL Allen acknowledges Aboriginal and Torres Strait Islander peoples as the Traditional Custodians of the land and its waters. We pay our respects to Elders, past and present, and to the youth, for the future. We extend this to all Aboriginal and Torres Strait Islander peoples reading this report.



Goomup, by Jarni McGuire

ACIL ALLEN

Contents

Figures

Tables

1 Introduction

ACIL Allen has been engaged by the Australian Energy Regulator (AER) to support the AER in estimating specific cost inputs required for the determination of Default Market Offer (DMO) prices.

An emerging issue is the interaction of rooftop PV exports with the estimate of the wholesale energy costs (WECs).

Consideration of the appropriateness of the WEC estimation methodology is timely given the continued uptake of solar rooftop PV by households and small businesses, coupled with rollout of interval meters replacing accumulation meters, as well as the change in the way the Australian Energy Market Operator (AEMO) reports data associated with residential and small business demand and solar exports with the commencement of five-minute settlement (5MS).

Taking into consideration the fact the AER does not set solar export feed in tariffs (FiTs), this report summarises ACIL Allen's position on the appropriate demand profile to use when estimating the WEC for the DMO.

ACIL Allen's position 2

A key component of the DMO price is the wholesale energy cost (WEC). The ACIL Allen methodology adopted to estimate the WEC for the determination, estimates costs from a retailing perspective. This involves estimating the energy costs an electricity retailer would be expected to incur from purchasing the energy in the NEM to supply its customers in a given determination year. The methodology includes estimating the aggregate amount of energy (and consumption profile) a retailer needs to procure from the NEM to supply its customers' consumption, undertaking wholesale energy market simulations to estimate expected spot market costs and volatility, and using a hedging strategy to manage the spot market price risk by entering into electricity contracts with prices represented by the observable futures market data. Details of the methodology can be found in our report for the Draft Determination of the 2024-25 determination year[1].

2.1 What is and isn't the DMO?

The DMO is a price cap for customer demand taken (imported) from the grid. Retailers charge customers on this basis, with or without a discount of some form (that is, DMO price with a discount multiplied by the demand taken from the grid).

The DMO regulations have no jurisdiction over PV export tariffs (FiTs), and hence retailers are free to set their own FiT for PV exports independent of the DMO process – presumably based on competitive forces in the market, each retailer's view on the market value of energy from PV exports, and each retailer's broader strategy for attracting and retaining customers.

In other words, the DMO is not a price cap for customer demand net of PV exports (net imports). Rather, it is a price cap for customer demand taken from the grid (imports).

2.2 What is the NSLP?

Prior to the 2024-25 determination, when estimating the WEC, the net system load profile (NSLP) has been used as the representative demand profile for residential and small business customers because the majority of residential and small business customers were on accumulation (or basic) meters. And those customers with interval meters were in the minority.

The NSLP represents the aggregated half-hourly net demand profile of consumers on accumulation meters.[2]

[1] https://www.aer.gov.au/documents/acil-allen-draft-determination-default-market-offer-prices-2024-25-wholesale-and-environmental-costs

[2] Historically the NSLP has captured the demand profiles of residential and small business customers in aggregate – since it is these consumers who have had accumulation meters installed at their premises. Large energy consumers (large business and industrial) have historically utilised interval meters.

Given it is not possible to obtain half-hourly demand data from an accumulation meter, AEMO estimates the NSLP by aggregating the measured half hourly bulk supply point demands for a region (this can be thought of as the total half hourly system demand for the region) and deducting from this, the half-hourly demands from all interval meters[3]. In other words, the half hourly demand profile that remains is *net* of the interval meter demand profiles.

2.3 The shape of the NSLP and the influence of roof PV installations

There has been a strong uptake of rooftop PV by households (and to some extent small businesses) over the past decade.

Prior to the commencement of the rollout of interval meters for small customers in NEM regions (excluding Victoria) from 2017[4], an installation of rooftop PV at a consumer's premises was coupled with an accumulation meter. An accumulation meter records the accumulated volume (between quarterly or monthly readings) – not the half hourly data. This means that for premises with rooftop PV and accumulation meters there is no way of directly measuring the half hourly demand taken from the grid or solar exported to the grid, only the cumulative volume.

For this reason, the NSLP includes the effects of aggregated imports and PV exports from all premises on accumulation meters – imports and PV exports cannot be disentangled into separate half hourly profiles.

This is why the 'carve out' of demand during daylight hours has become so apparent in the NSLP over time with the uptake of rooftop PV.

Figure 2.1 summarises the average time of day demand for the SAPN NSLP over the past decade or so. Starting with 2009-10 it can be seen that demand is at its lowest between 11 pm and 5 am, it then increases to a morning peak at about 8 am, remains at this level until about 5 pm, before reaching the evening peak at about 7-8 pm (which is higher than the morning peak).

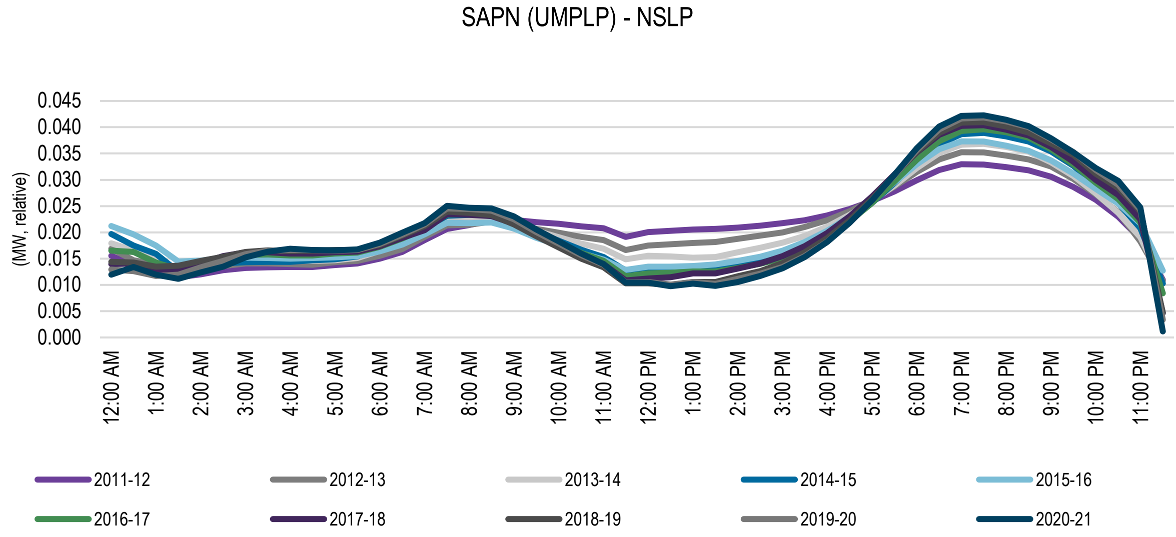
Outside of daylight hours, the shape of the NSLP has not changed much over the past decade or so. However, during daylight hours the demand has reduced with uptake of rooftop PV (coupled accumulation meters) until about 2017-18. This carve out includes all rooftop PV production – both the production used internally in the premises and the production exported from the premises to the distribution network (and subsequently used by other nearby premises on the distribution network and thus reducing demand to be drawn from the transmission network).

From 2018-19 the rate of the carve out of demand during daylight hours slowed substantially, despite the continued uptake of rooftop PV. This is because, since the Power of Choice reforms were implemented in 2017, new rooftop solar PV installations require the replacement of an existing accumulation meter with a new interval meter.

[3] https://aemo.com.au/-/media/files/electricity/nem/data/metering/load-profiles/understanding-load-profiles-published-from-msats.pdf

[4] Interval meter penetration has increased from very low levels in 2017 (>5% of small customers) to more than a third of small customers in 2023, encouraged by the implementation of the Competition in Metering Rule in 2017, which is available at Expanding competition in metering and related services | AEMC

Figure 2.1 Average time of day demand (MW) of the SAPN NSLP – 2011-12 to 2020-21



Source: ACIL Allen analysis of AEMO data

2.4 Prior to 2024-25, the estimation of the WEC included the carve of demand due to rooftop solar PV exports

Prior to the rollout of interval meters, the NSLP represented the entire residential and small business demand.

Given the WECs for determinations prior to 2024-25, are estimated based on the shape of the NSLP, and that the shape of the NSLP includes the carve out of demand satisfied by rooftop PV production used internally on premises, as well as PV production that is exported to the distribution network and consumed by other premises on the distribution network, the WEC accounted for the change in shape and volume of the NSLP due to rooftop PV production (including the export carve out).

As noted in our reports for the various price determinations, the carve out of the NSLP makes it more expensive to hedge on a per MWh basis.

Ideally, for the previous DMO determinations, the PV export carve out would be removed from the net demand profile when estimating the WEC, thus giving a profile of demand imported from the grid, given the DMO is a price for imports, not imports net of PV exports. However, this was not possible for reasons mentioned earlier. The nature of the estimation process was limited by the detail of the demand data which was limited by the meter technology collecting the demand data.

2.5 Penetration of interval meters

According to the AER's various State of the Energy Market reports, penetration of interval meters in residential premises was about:

— 5 per cent in June 2018

— 10-15 per cent in February 2020

— 23 per cent in June 2021

— 30 per cent in June 2023.

Prior to 2018, the State of the Energy Market reports do not report on interval meter penetration rates - presumably because the penetration rates were close to 0 per cent. In other words, prior to

2018 the NSLP represents almost 100 per cent of residential and small business customers, and in 2021, represents about 80 per cent of small customers.

Since the Power of Choice reforms in 2017, new rooftop solar PV installations require the replacement of an existing accumulation meter with a new interval meter. In previous DMOs the NSLP has been used as the representative load profile for residential and small business customers because the majority (about 90 per cent in 2020, and 80 per cent in 2021) of residential and small business customers were on accumulation (or basic) meters. And those customers with interval (or smart) meters were in the minority. However, ACIL Allen estimates the penetration of interval meters in 2022 increased to about 30 per cent, and to about 40 per cent in 2023.

With the likely continued roll out of interval meters due to, in part by retailers responding to various market incentives, the end-of-life replacement of older accumulation meters, and due to the AEMC's recommendation of a target of 100 per cent uptake of smart meters by 2030, it is likely that small customers on interval meters will be the majority in the next few years.

2.6 For the 2024-25 determination new data is available

Post 5MS, for each consumer on an interval meter there is now data available of half hourly demand imported from the distribution network and half hourly PV exported to the distribution network. This allows for the separation of PV exports from imports, and represents a fundamental change in the detail of small customer demand data now available.

However, it is still the case that PV exports cannot be separated from the NSLP for those customers on accumulation meters.

Further, given the degree of penetration of interval meters, it can no longer be claimed that the NSLP on its own is representative of the consumption profile of all small customers.

Therefore, it is appropriate to combine the NSLP and interval meter demand data to encapsulate the demand of all small customers when estimating the WEC.

2.7 The DMO is a price for imports, not exports

As noted earlier, the DMO represents the reference price for customers on notified prices, and for retailers to use when constructing market offers for those customers engaged in the market.

Therefore, the demand profile used to estimate the WEC needs to be fit for purpose and should reflect as close as possible the profile used by retailers to bill small customers for their consumption imported from the grid.

2.8 Using SAPN as an example

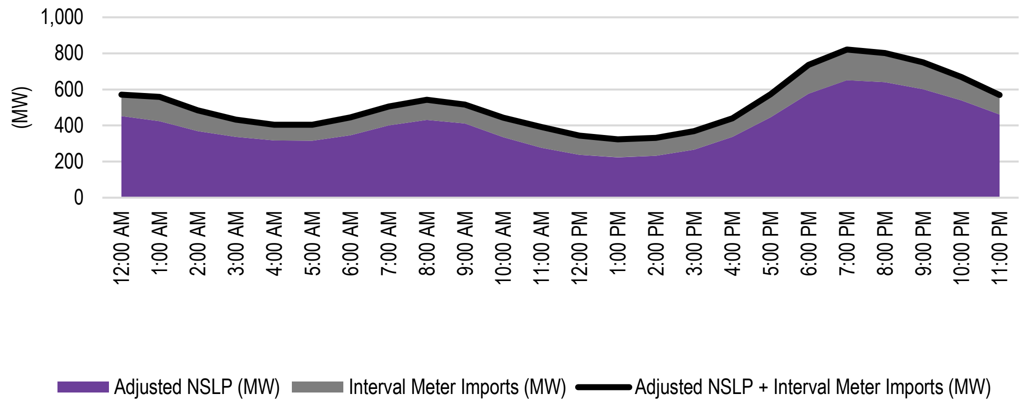
Provided in this section is an example of the impact of including the PV export carve out in the demand profile when estimating the WEC for small customers in the SAPN network.

For simplicity, in this example we assume that retailers do not offer a discount on the WEC, and offer FiTs reflecting the true market value of the PV at the time it is exporting. This means the revenue retailers earn from small customers equals the cost incurred.

Figure 2.2 shows the average time of day profile of the demand sets used to estimate the WEC for the Draft and Final Determination – it equals the aggregate of the NSLP (which includes the PV export carveout) and interval meter import data - shown as the black solid line.

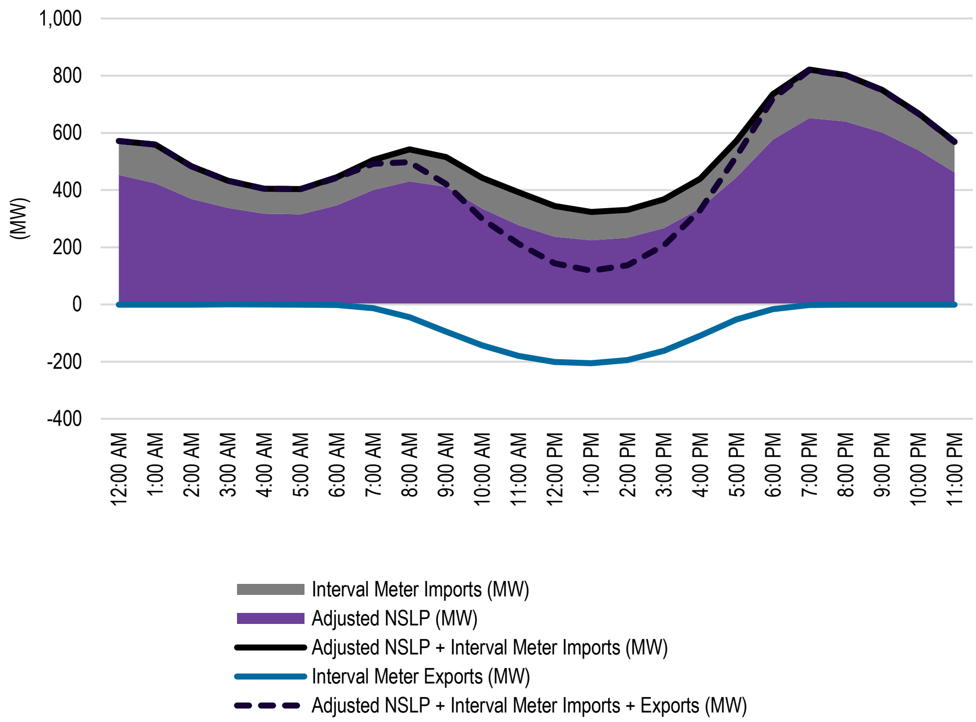
Figure 2.3 shows the impact on the shape of the demand profile if the PV export carve out from interval meters is included (the dashed black line). Inclusion of the PV export carve out from the interval meter data results in a far peakier load profile (in relative terms) by reducing demand during daylight hours – for example, on average by 200 MW around 1pm. But it also reduces the overall quantity energy by about 15 per cent.

Figure 2.2 Average time of day profile of aggregate NSLP and interval meter imports (MW) for SAPN small customers – used in the 2024-25 Draft Determination



Source: ACIL Allen analysis of AEMO data

Figure 2.3 Impact of including interval meter PV exports on average time of day profile (MW) for SAPN small customers



Source: ACIL Allen analysis of AEMO data

We have calculated the WEC for both profiles across the 583 simulations, using the same simulated spot price sets, hedging strategy, and contract prices adopted for the Final Determination. These are presented in **Figure 2.4**. The first chart in **Figure 2.4** shows the WEC (and its components) in the usual $/MWh terms, while the second chart takes the WEC in $/MWh terms and multiplies this by the corresponding energy to arrive at the cost incurred by retailers in $’M terms. The charts also include the value of PV exports from the corresponding simulation.

The WEC increases in $/MWh terms from $163.30/MWh to $189.75/MWh, when the PV export carve out is included, driven largely by the increase in spot market costs (the demand weighted spot price or DWP). This is not surprising, including the PV carve out increases the relative weighting of the demand profile during the evening peak when prices tend to be at their highest.

There are some smaller changes in contract costs, but keep in mind the energy volumes of the two profiles are different, and hence any contract difference payments are recovered over the different volumes of customer energy.

The value of PV exports is $15.37/MWh – reflecting the low spot prices during daylight hours (including negative prices on occasions during periods of exports)

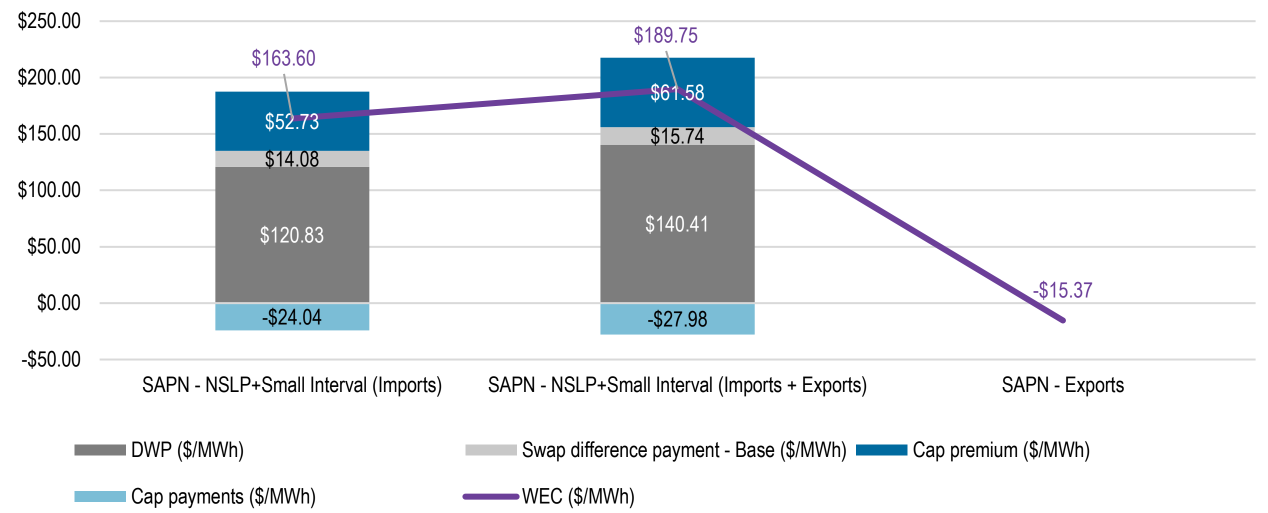
The total annual volume of the aggregated NSLP and interval meter import profile is about 4,346 GWh, compared with the lower volume of 3,694 GWh when the PV export carve out is included.

Although the WEC is higher in $/MWh terms when including the PV export carve out, the cost in $ terms when taking into account the reduced volume is slightly lower ($711’M versus $701’M). This difference is equal to the value of the PV exports ($10’M).

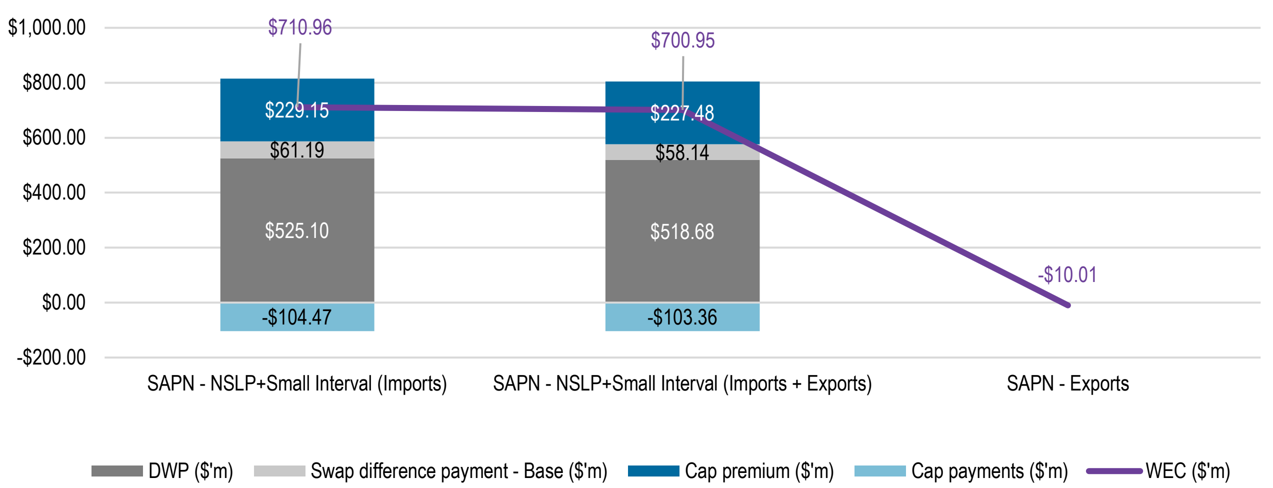
In other words, the revenue retailers earn by supplying the demand without the exports at the lower import price plus the cost incurred by paying out the FiT for the exports equals the revenue earned by supplying the net profile at the higher net import price and not paying a FiT. This represents a zero sum game.

Figure 2.4 Components of the 75th percentile WEC ($/MWh, and $'M) for SAPN

WEC in $/MWh terms



WEC in $'M terms



Source: ACIL Allen analysis

Table 2.1 75th percentile WEC ($/MWh, and $'M) for SAPN

Profile	Element	Value
NSLP + Small Interval (Imports)	Import Volume (GWh)	4,346
	WEC ($/MWh)	$164
	WEC revenue ($'M)	$711
NSLP+Small Interval (Imports+PV Exports)	Net Import Volume (GWh)	3,694
	WEC ($/MWh)	$190
	WEC revenue ($'M)	$701
PV Exports	Export Volume (GWh)	652
	Export price ($/MWh)	-$15
	Export cost ($'M)	-$10

Note: Values rounded
Source: ACIL Allen analysis

Some retailers in their submissions to the Draft Determination are advocating that the PV export carve out should be included in the demand profile when calculating the WEC for the DMO. The zero sum game would be preserved if the DMO was charged by retailers to small customers for their imports net of PV exports, but this is not the case, the DMO applies to imports only. We continue with the SAPN example to explore what would be the impact if the WEC was estimated based on the profile that includes the PV exports?

Table 2.2 shows that:

1. If the WEC is estimated based on net import profile, then the value of the WEC is $190/MWh
2. Under the DMO, this price is then applied by retailers to the imports of small customers (4,346 GWh)
3. Which gives a total revenue/cost of $825 M
4. This is $114 M higher than what the revenue would be if the WEC was estimated based on the import profile
5. After deducting the cost of the exports ($10 M), retailers would still be ahead by $124 M.

Table 2.2 Mixing and matching: Impact of estimating the WEC based on net imports, but charging customers based on import volumes

Element	Value
Import Volume (GWh)	4,346
Net Import WEC ($/MWh)	$190
WEC revenue ($'m)	$825
Delta ($) (benefit)	$114
FiT cost ($'m) (paid to consumers for exports)	-$10
Delta ($) (benefit, after accounting for FiT cost)	$124

Source:

A zero-sum game is preserved only if:

- The WEC is estimated based on the import profile and charged by retailers for imports, and the retailer then pays a FiT for exports, or
- The WEC is estimated based on net import profile and charged by retailers for the net imports, and there is no payment for exports.

To put it colloquially, it needs to be apples with apples (import WEC with import volume, and a separate FiT for exports), or oranges with oranges (net import WEC with net import volume, and no FiT for exports). Estimating the WEC based on the net import profile and then charging this WEC against a different profile (the import profile) does not preserve the zero sum game.

2.9 What about the argument PV exports can occur when spot prices are negative and this represents a cost to retailers?

It is sometimes argued that when there is a coincidence of PV exports and negative spot prices, then this represents a cost to retailers that ought to be taken into account in the WEC estimation.

We agree that this represents a cost to retailers. But this ought to be taken into account by retailers when they determine (for themselves) what they're willing to pay for PV exports (the FiT). It is not a cost associated with imports.

A retailer will estimate the export volume weighted average value of spot prices when PV is exporting – this will include their view on the extent/magnitude of positive and negative half hourly prices

In other words, the greater the expectation that negative spot prices occur and correspond with exports, the more the FiT ought to be reduced/discounted by retailers - reflecting the lower value of this energy.

2.10 What about the increased cost of hedging the peakier load profile due to PV exports?

It is sometimes argued that when the PV export carve out is included in the demand profile, it increases the peakiness of the demand profile and therefore the cost of hedging.

We agree that the inclusion of the PV export carveout increases the mix of hedges slightly – shifting the weighting more towards caps. This represents an additional cost but this ought to be recovered by retailers accounting for this cost when determining the FiT. That is, retailers ought to reduce the FiT to cover this additional cost.

2.11 PV exports represent a cost that retailers have no option but to absorb when supplying a solar customer, so shouldn't they be factored into the WEC?

We agree that when a retailer takes on a solar customer, they are required to take on both the customer's imports and exports as a bundled package – a retailer cannot not take on only the imports, and leave the exports to another retailer.

However, retailers are able to offer, as part of the bundled package, a tariff for imports and a separate tariff for exports. Hence the costs associated with PV exports ought to be reflected in the export tariff.

2.12 Won't excluding the PV export carve out when estimating the WEC dissuade customers from installing rooftop PV?

It is sometimes argued that estimating a lower WEC (in $/MWh terms) by excluding the PV export carve out means that retailers will need to lower their FiT offering to cover the cost, thereby reducing the incentive for consumers to install rooftop PV. And that this is a bad thing since it contributes to a delay in the energy transition.

ACIL Allen's view is that it is not the role of the DMO to explicitly persuade or dissuade consumers to install rooftop PV. In fact, excluding the PV export carve out from the demand profile when estimating the import WEC sends the more appropriate price signal to consumers about the relative merits of installing rooftop PV at this point in time.

2.13 Summary

This report and analysis highlights that the approaches used to estimate the WEC and solar FiT cannot be considered in isolation from one another – to do so runs the risk of the retailer paying too much or too little (and vice versa for consumers).

Section 2.8 summarises the case for small customers in the SAPN network, and highlights the importance of internal consistency in preserving the zero-sum game.

The DMO is a price for consumption drawn from the grid (imports), not for exports and not for net imports.

Costs associated with exports (exports at times of negative prices, and changes in contracting mix) should be recovered via the export FiT (by reducing the FiT). There is no good reason to include them in the import WEC. Why recover a cost associated with exports via the import price?

If these export costs are included in the WEC, and then retailers charge this WEC for imports only, and then include these costs in the FiT (which they are free to do) then plainly they are being recovered twice from solar consumers (and once from consumers who do not have solar).

Melbourne
Suite 4, Level 19; North Tower
80 Collins Street
Melbourne VIC 3000 Australia
+61 3 8650 6000

Sydney
Suite 603, Level 6
309 Kent Street
Sydney NSW 2000 Australia
+61 2 8272 5100

Brisbane
Level 15, 127 Creek Street
Brisbane QLD 4000 Australia
+61 7 3009 8700

Canberra
Level 6, 54 Marcus Clarke Street
Canberra ACT 2601 Australia
+61 2 6103 8200

Perth
Level 12, 28 The Esplanade
Perth WA 6000 Australia
+61 8 9449 9600

Adelaide
167 Flinders Street
Adelaide SA 5000 Australia
+61 8 8122 4965

ACIL Allen Pty Ltd
ABN 68 102 652 148

acilallen.com.au