Independent Pricing and Regulatory Tribunal
New South Wales

Solar feed-in tariffs

The value of electricity from small-scale solar panels in 2018-19

Final Report
Electricity

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The Independent Pricing and Regulatory Tribunal (IPART)

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1 Executive summary

In NSW more than 10% of households and small business premises have installed a solar photovoltaic (PV) system, or solar panels.[1] The major financial benefit of solar panels is that they can lead to lower electricity bills. When solar customers use the electricity generated by their solar panels rather than buying it from their retailer, they avoid paying the retail price for this electricity and so make significant savings on their bills.

A secondary benefit is that when solar customers don't use all the electricity generated by their panels, the excess amounts are exported to the grid and customers may be paid a 'solar feed-in tariff' for these solar exports. Retailers aren't obliged to pay this tariff. But during 2017-18, most retailers offeared a solar feed-in tariff of between 6 cents and 20 cents per kilowatt hour (c/kWh) in their market offers to solar customers.

To help solar customers in comparing market offers, the Independent Pricing and Regulatory Tribunal of NSW (IPART) has set a 'benchmark range' for solar feed-in tariffs for each year since 2012. Our benchmark range can help customers in deciding whether the tariff a retailer is offering is reasonable. However, we stress that customers need to consider all elements of a retailer's offer, particularly the retail price. Our analysis has found that offers that include a high feed-in tariff are not necessarily the best overall deal for customers.

This report outlines our 2018-19 solar feed-in tariff benchmarks, and explains why and how we reached these decisions, including our responses to stakeholder comments on our Issues Paper and Draft Report.

1.1 Our 2018-19 benchmark range is 6.9 to 8.4 c/kWh

To set our benchmarks for solar feed-in tariffs, we forecast what retailers would pay for customers' solar exports if this electricity were sold into the wholesale spot market in 2018-19 (the National Electricity Market or NEM) in the same way as other generators' output.[2]

In this market, wholesale prices are set for each half hour of the day to reflect the supply and demand for electricity at that time. Typically, these wholesale prices are:

- lower late at night (when demand is lowest), and through the middle of the day (when solar energy meets a proportion of demand), and
- highest in the late afternoon and evening (when demand is highest, and when solar energy meets little or none of this demand).

1 Department of Planning and Environment, *Solar Panels and Systems*, *https://www.resourcesandelectricity.nsw.gov.au/electricity-consumers/solar/solar-panels*, accessed 14 February 2018. AER, *NSW – Small Customers*, https://www.aer.gov.au/retail-markets/retail-statistics/nsw-small-customers, accessed 14 February 2018.

2 This is a hypothetical concept, as customers with small-scale solar PV cannot sell their exported energy into the wholesale spot market.

We set the benchmark range based on our forecast of the **average price** that retailers would pay for solar exports across the day (weighted by solar output) if they were buying this electricity on the wholesale spot market.

For 2018-19, our benchmark range for all-day solar feed-in tariffs is **6.9 to 8.4 c/kWh.** We consider that this is reasonable, and that a higher benchmark would lead to unacceptable outcomes. Specifically, if retailers were **required** to pay more than this for solar exports, they would be paying more than they pay for wholesale electricity on the NEM. As a result, retail prices for **all** customers would need to be higher to recover the difference. For example, we estimate that in 2018-19:

- If *all* retailers paid a solar feed-in tariff of 15 c/kWh rather than 8.4 c/kWh (the top our benchmark range), their total costs would be $52 million higher across NSW. To recover these additional costs from NSW households, the average annual household bill would need to increase by around $19.
- If *all* retailers paid a feed-in tariff of 25 c/kWh (equal to the current average retail price of electricity), their total costs would be $130 million higher, and the average annual household bill would need to increase by around $50.[3]

In effect, a higher feed-in tariff would result in households **without** solar panels paying higher electricity bills so that customers **with** solar panels could receive more for their solar exports. This would be contrary to the requirement in our Terms of Reference from the Government that our benchmark range not lead to higher retail prices (Appendix A). It would also disadvantage the households who are unable to install a solar system themselves (for example, because they rent or they cannot afford the upfront costs).

As at December 2017, the Australian Energy Market Commission (AEMC) found all electricity customers **already** pay an average of around $15 per year to customers with solar panels to subsidise the upfront installation costs under the Small-Scale Renewable Energy Scheme, as well as an average of $55 per year for other 'green costs' (including subsidies for the Renewable Energy Target, the climate change fund, and the Energy Saving Scheme).

In addition, on average, solar customers' annual electricity bills are $450 lower than those of customers without solar panels, **before** revenue earned from solar feed-in tariffs is taken into account (see Box 1.1). This represents an ongoing saving to customers after their payback period (which is currently approximately 6-8 years).

3 Based on total estimated solar exports, and forecast number of households in NSW, using data from networks on solar exports and number of solar customers, and data from ABS 2016 Census data and New South Wales Department of Environment and Planning for forecast of number of households (4% growth assumed since 2016 based on average annual growth 2016-2021). See ABS, '2016 New South Wales (STE) Community Profile', cat. No 2001.0, Table G32, http://www.abs.gov.au/websitedbs/D3310114.nsf/Home/2016%20Census%20Community%20Profiles; http://www.planning.nsw.gov.au/Research-and-Demography/Demography/Population-projections. Estimates may understate the total annual solar output, as no growth factor has been applied to latest available customer numbers for 2018-19. This would result in an underestimate of additional costs to retailers and customers.

Box 1.1 Bills for households with solar panels are significantly lower

The average electricity bill for a solar customer with a 2kW PV system is around $1,550 per annum, compared to $2,100 for households without panels. Solar customers can save around $450 a year by using the solar energy they generate themselves (rather than purchasing it from their retailer), in addition to receiving any solar feed-in tariff from their retailer (an average of around $100 a year).

As noted above, solar customers also receive an upfront subsidy for installing their panels under the Small-Scale Renewable Energy Scheme (SRES). For a 2kW solar system installed in Sydney, the subsidy is currently worth around $1,050 to $1,330. After this subsidy, the upfront costs of a solar system are around $3,400. The payback period for these upfront costs is around 6 years.

Following the payback period, the customer can make ongoing savings off their bills for the remaining life of the panels (around 19 years).

Even without any feed-in tariff, the customer would still pay off their panels in around 7.5 years. If the upfront subsidy were removed, the payback period would be 8 years, with a remaining life after payback of almost 17 years.

Note: The values for financial incentives under the SRES assume the solar unit is installed in Sydney on 24 April 2018. The dollar range is based on certificate prices of $30 and $38. Assumes a solar panel life of 25 years.

Source: Clean Energy Regulator, *Small generation unit STC calculator*, https://www.rec-registry.gov.au/rec-registry/app/calculators/sgu-stc-calculator, accessed 24 April 2018; Green Energy Markets, *STC Market Prices*, http://greenmarkets.com.au/resources/stc-market-prices, accessed 24 April 2018. Solar Choice, *Current Solar System Prices: Residential and Commercial*, *https://www.solarchoice.net.au/blog/solar-power-system-prices*, accessed 24 April 2018.

1.2 Our 2018-19 benchmark is lower than the current benchmark

To estimate the value of solar exports for the coming financial year, we forecast the average wholesale electricity spot price based on information from the Australian Stock Exchange (ASX) NSW future contracts markets, and then apply a 'solar multiplier'. This multiplier takes account of whether wholesale prices are likely to be higher or lower than average at the times when solar customers export to the grid (that is, weighting wholesale prices by solar output):

- If more solar exports occur during times when spot wholesale prices are higher than average, the solar multiplier will be greater than one.
- If more exports occur when spot wholesale prices are lower than average, then it will be less than one.

We calculate the solar multiplier using historical data on the prices when solar is exporting to the grid, compared to the average wholesale price across the day.

For 2018-19, our benchmark range of 6.9 to 8.4 c/kWh is lower than the current benchmark range of 11.9 to 15 c/kWh for 2017-18. This is mainly because our estimate of the average wholesale price is significantly lower than it was in 2017-18, but it is also due to a lower solar multiplier. However, it is higher than the solar feed-in tariffs for earlier years (Table 1.1).

Table 1.1 Solar feed-in tariff benchmarks over time

	2015-16	2016-17	2017-18	2018-19 (final)
Solar benchmark (c/kWh)	4.7 to 6.1	5.5 to 7.2	11.9 to 15	6.9 to 8.4

Since last year, the 40-day average of the ASX baseload electricity contract prices has fallen from 11.6 c/kWh (when we published our Final Report last year) to 7.5 c/kWh (as at 15 May 2018) (Table 1.2).

The reduction in the ASX forward contract prices for wholesale electricity is consistent with the forecasts in the AEMC's 2017 Residential electricity price trends report:

> The trend in wholesale costs in 2018/19 and 2019/20 is downwards and is driven by:
>
> - approximately 4,100 MW of new committed and expected (modelled) generation entering the NEM in 2018/19 and 2019/20
> - the return to service of the Swanbank E gas power station (385 MW) in early 2018
> - reduced short-run costs for South Australian gas plants in 2019/20 due to the pass through of certificate revenue related to the Energy Security Target.[4]

In addition, the most recent historical data suggests that wholesale prices are likely to be lower at the times of the day when solar is exported to the grid than they were in previous years. In our 2017-18 review, we estimated a solar multiplier of 1.14 (based on seven years of data from 2009-10 to 2015-16), which meant that the value of solar exports would be 14% higher than the average wholesale price across the day. This reflected historical spikes in wholesale prices in the middle of the day.

However, since 2011-12, wholesale prices have trended lower in the middle of the day as solar generation has increased and met a greater proportion of demand at this time. Therefore, we have calculated the solar multiplier for our 2018-19 benchmarks focusing on the most recent three years of data (to 2016-17) to best reflect supply and demand conditions for the forecast year. Using this data, we have calculated a solar multiplier of 0.99, which means we expect the value of solar exports will be slightly lower than the average wholesale price of energy across the day (a solar multiplier of 1 would indicate that the value of solar exports is equal to the average wholesale price of energy).

As part of our methodology to calculate the value of solar exports, we also:

- multiply the value of the solar energy by a loss factor, to gross up solar generation to account for the avoided losses that usually arise as electricity flows through the transmission and distribution networks because solar exports tend to be consumed close to where the electricity is produced, and
- add the value of the NEM fees and charges that are avoided because these charges are levied on retailers' net purchases.

The inputs to the solar benchmark have also been updated since releasing our Draft Report in May. Since the Draft Report, the wholesale prices on the ASX forward contract market have fallen from 7.8 cents to 7.5 cents. We have also received new information from AEMO for the 2018-19 state-wide marginal loss factor, increasing the weighted average loss factor from 1.01 to 1.07.[5]

4 AEMC, *2017 Residential electricity price trends Final Report*, December 2017, p 19.

5 We use a weighted average loss factor across the three distribution network areas in NSW, accounting for both transmission and distribution line losses. Our Draft Report used 2018-19 estimates based on loss factors supplied by AEMO for 2017-18.

Table 1.2 Benchmark components for all-day solar feed-in tariffs in 2018-19 compared to 2017-18

	2017-18 (final)	2018-19 (draft)	2018-19 (final)
Estimated average wholesale spot price	11.0 c/kWh	7.4 c/kWh	6.8 to 8.3 c/kWh
ASX baseload forward contract for the 12 month period 2018-19 using the 40-day average price	11.6	7.8	7.5[a]
% range for uncertainty	-	-	+/-10%
Adjustment to removed contract premium	5%	5%	5%
Solar multiplier	1.14	0.99	0.99
Network loss factor	1.01	1.01	1.07[b]
NEM fees and charges	0.08 c/kWh	0.08 c/kWh	0.08 c/kWh

a As at 15 May 2018.

b As supplied by AEMO in May 2018 for 2018-19.

Note: The all-day feed-in tariff is calculated according to the following formula:

(Upper and lower end of estimated average spot price range x solar multiplier x network loss factor) + NEM fees and charges.

1.2.1 We will continue to average ASX forward contract prices over 40 days

As in previous years, a key issue for the review was the length of the period that we use to average the ASX baseload electricity forward contract prices. We forecast wholesale electricity prices using the ASX baseload electricity contract prices for the 12 month period 2018-19 using the 40-day average of these prices to 15 May 2018 (and adjusted downwards by 5% to subtract the premium paid on hedging contracts to manage risk compared to the spot price[6]). This data reflects the prices currently paid to purchase baseload electricity contracts in 2018-19 based on expectations of what this electricity will be worth for the next financial year.

Stakeholders submitted that our decision to average the forward contract prices over the most recent 40 days drives substantial volatility in the wholesale price estimates between years, leading to fluctuating solar feed-in benchmarks. They considered that averaging contract prices over six months or a year would reduce this volatility. They also submitted that averaging the contract prices over a longer period would better reflect how retailers purchase their electricity.

After considering this feedback, we have decided to maintain the approach that we have taken in previous reviews, which is to take a forward looking approach to valuing electricity in 2018-19, based on expectations of spot prices.

We acknowledge that in practice retailers might contract for future years in advance. But those contracts are worth only what the market would pay for them now. A retailer might have entered into forward contracts for energy in 2018-19 over the past two years. However, if the retailer wanted to unwind that position today, it wouldn't get what it paid for the contracts – it would get what the market thought that they were worth today. This is also the price that a new entrant would pay.

6 The contract premium of 5% based on expert advice provided by Frontier Economics.

We average the forward contract prices over the most recent 40 days because this information captures the most up to date expectations of the value of electricity for the forward period. Averaging it over a longer period would include expectations of the market based on out of date information that may no longer be relevant, and would still lead to some fluctuations between years.

1.2.2 Our benchmark range recognises the forecasting uncertainty around wholesale prices

While we have maintained the 40-day averaging period for ASX baseload electricity contracts for the 2018-19 12 month period, we have decided to include a range of +/-10% around this average to recognise the forecasting uncertainty around wholesale prices. Even though these are the expected prices currently paid in the market, there is likely to be some variation between the prices paid on the forward market and actual spot prices.

As a result, our final decision is to set a solar feed-in benchmark range (6.9 to 8.4 c/kWh), rather than the point estimate we set in our Draft Report (7.5 c/kWh).

This is different to how we have set a benchmark range in previous reviews. Rather than recognising the forecasting uncertainty of wholesale prices, in previous years we set a range for our solar feed-in benchmark based on the value of solar at different times of the day:

- the top of the range based on the two-hour window when the value of solar exports was forecast to be highest (this was between 2 pm and 4 pm in 2017-18), and
- the bottom of the range based on the value of exports at all other times.

We decided not to use this same approach for setting a benchmark range for 2018-19, because we expect that the wholesale value of solar will be highest after 5:30 pm when less than 1% of solar exports occur. Because such a small amount of solar generation occurs in this time window, we do not think that setting the top of the range in line with the value of solar at this time would provide a realistic guide to customers about the value of solar for the overwhelming majority of their exports.

Our forecasts for 2018-19 indicate that the value of solar exports will hardly vary across the times of the day when most solar exports occur. In particular between 6 am and 3 pm, when almost 90% of all solar exports occur, there is very little variation. As a result, we have decided to set an 'all-day' benchmark range for this review. This all-day benchmark also provides a more useful comparator for the offers that are currently available in the market, which are not dependent on the time that solar is exported to the grid.

1.2.3 A longer term solar feed-in benchmark would not be reliable

As Table 1.1 indicates, our solar feed-in benchmark has fluctuated substantially over the past three to four years. Several stakeholders suggested that we should provide a longer term view of the value of solar exports, as solar panels are a longer term investment.

However, wholesale prices are volatile, reflecting changes in supply and demand driven by changing weather, fuel costs and investment conditions. Due to this volatility, most retailers review their retail prices at least once a year, rather than lock them in over the longer term.

Similarly, it would not be possible for IPART to establish a longer term benchmark that is reliable.

Our Terms of Reference require us to continue setting benchmarks for solar feed-in tariffs annually until 2020-21. This allows us to update our benchmarks to reflect the most up to date market conditions. For our next reviews of the benchmark feed-in tariffs (2019-20 and 2020-21) we will undertake our consultation and analysis, and complete the reviews in April for the next financial year.

1.3 We have also set time-dependent solar feed-in tariff benchmark ranges

Although retailers currently offer their customers a single feed-in tariff that applies at all times, they could choose to offer a tariff that varies depending on the time of day the solar customer exports to the grid. For this review, the Government specifically asked us to also set a benchmark range for time-dependent solar feed-in tariffs.

Our time-dependent benchmark ranges are shown in Table 1.3. We have set these ranges based on when the most price variation occurs during the day. It shows that our time-dependent benchmark ranges have been updated between our draft and final reports to reflect stakeholder feedback that the time intervals for each benchmark should start on the **hour** instead of the half hour to better align with time-of-use consumption tariff blocks. In addition, in response to feedback that our benchmark ranges were too wide to be useful, we have used a solar multiplier for each time block based on the midpoint of the minimum and maximum solar multipliers for three modelling runs (the three years 2014-15 to 2016-17, the two years of 2015-16 to 2016-17, and the most recent year of 2016-17) (rather than the highest and lowest values), which has narrowed these time-dependent ranges.[7]

Table 1.3 Benchmark ranges for time-dependent solar feed-in tariffs

Draft decision		Final decision		
Time window	(c/kWh)	Time window	(c/kWh)	% of solar exports
6:30 am to 3:30 pm	6.9 to 7.2	6 am to 3 pm	6.5 to 7.9	86.2
3:30 to 4:30 pm	8.9 to 11.7	3 to 4 pm	7.4 to 9.1	8.0
4:30 to 5:30 pm	11.3 to 13.3	4 to 5 pm	11.2 to 13.7	4.0
5:30 to 6:30 pm	12.8 to 20.9	5 to 6 pm	14.1 to 17.2	1.5
6:30 to 7:30pm	8.7 to 9.6	6 to 7 pm	10.7 to 13.0	0.271
7:30 to 8:30 pm	8.4 to 8.5	7 to 8 pm	7.8 to 9.5	0.012

Table 1.3 shows that the average value of solar is higher in the afternoon. This means it would be more cost-reflective if retailers offered a higher feed-in tariff in the afternoon, compared to the morning.

7 The value of the solar multiplier for each time window depends on the historical price and export data that we use. For our **Draft Report**, we modelled the solar multiplier for three historical periods (2014-15 to 2016-17, 2015-16 to 2016-17 and 2016-17 only), and set the range based on the highest and lowest multipliers from these modelling runs. For example, for the 5:30 to 6:30 pm time window, the bottom of the range (12.8 c/kWh) is based on solar multiplier (1.75) from the three years of historical data, and the top of the range (20.9 c/kWh) is based on the solar multiplier for the 2016-17 period only (2.76). For our final benchmarks, we have used the midpoint of the range.

Evghen though solar exports are very low after 5 pm, we set benchmarks in the later afternoon and evening because wholesale prices are highest at this time. Currently, customers have a limited ability to respond to a high feed-in tariff in the very late afternoon because there is limited sunlight at this time. However, these benchmarks provide a price signal to customers with batteries, or considering purchasing batteries, about when they should export their energy to the grid. Only around 1,600 households in NSW currently have batteries, representing less than 0.1% of households.[8] But over time this signal will become more important as battery prices fall and their uptake increases.

The peak prices in the late afternoon and evening are being driven by high levels of electricity demand at the same time of the day as solar output is falling. Higher wholesale prices in the evening also reflect increasing 'peakiness' of wholesale prices in recent years, as the demand-supply balance has tightened, particularly following the closure of the Hazelwood power station in Victoria in March 2017. This means that prices are often driven by higher cost generation (such as gas generators) when demand is highest.

In setting the benchmarks, we:

- Set one benchmark between 6 am and 3 pm, because there is very little variation in wholesale prices across these times.
- Set benchmarks for each one-hour period after 3 pm, when there is much more price variation.
- Set benchmarks after 6 pm that are not weighted by solar output. Solar exports are negligible during these times, so the main reason for setting these benchmarks is to provide a price signal for the value of battery exports (which could occur at any time).
- Did not set a benchmark between 8 pm and 6 am because exports are immaterial, and wholesale prices are relatively low.

We note that while the time-dependent feed-in tariffs are likely to be more cost-reflective, retailers may continue to prefer to set an all-day rate, reflecting the small amount of variation in the value of the vast majority of solar exports. Retailers submitted that a single all-day solar feed-in tariff is simple to understand and does not create complexity and additional costs to retail operations.[9]

1.4 We considered stakeholder comments and do not agree that solar feed-in tariffs should be higher

Around 410 stakeholders made a submission in response to our Issues Paper, and 16 stakeholders made a submission to our Draft Report. Many of these stakeholders submitted that our benchmarks should be higher.

Most of the issues raised have also been raised in previous reviews. The most common themes in submissions were:

- feed-in tariffs should include a subsidy to reflect the value of the environmental and health benefits that solar electricity provides to the broader community

8 Australian Energy Council, Solar Report – January 2018, p 6.
9 AGL submission to IPART Issues Paper, April 2018, p 2.

- feed-in tariffs should also reflect the financial benefit to electricity network suppliers, particularly the potential to defer network investment
- reducing the solar feed-in tariff benchmark in line with wholesale costs would be effectively punishing solar panel owners for their contribution in helping to reduce the wholesale power price for all consumers, and
- feed-in tariffs should be the same as retail prices or retailers will profit unfairly from solar customers.

In general, if we were to set the benchmark for solar feed-in tariffs higher than the financial value of customers' solar exports to retailers (ie, the cost they avoid when they supply this electricity to other customers rather than purchasing an equivalent amount on the NEM), retailers would likely set the feed-in tariffs they offer below this benchmark.

Even if retailers were **required** to offer a minimum feed-in tariff equal to our benchmark, we consider this benchmark should not exceed the financial value of solar exports to retailers because this would result in:

- higher costs to retailers, which they would then need to recover from all customers, or
- retailers choosing not to supply solar customers, which would reduce competition for solar customers.

As outlined in section 1.1, our view is that households without solar panels should not have to pay higher retail prices to reduce the bills of customers with solar panels. This would disadvantage the households who are unable to install a solar system themselves (for example, because they rent or they cannot afford the upfront costs). In addition:

- Customers already receive a subsidy through the Commonwealth Government's Small-scale Renewable Energy Scheme (SRES) when they install a system to reflect the environmental and health benefits that solar electricity provides to the broader community.
- Solar panels do have the potential to create network benefits by deferring network expenditure where it reduces demand on the network at peak times, but this is likely to be the case only in limited parts of the network. In many parts of the network, solar exports are unlikely to contribute to meeting peak demand on the distribution and transmission networks because the peak occurs in the late afternoon when the proportion of exports is very low. In these areas, solar exports are unlikely to defer network costs. In other areas, large volumes of solar exports are driving higher network costs due to additional investment required to support the bi-directional flows of electricity to handle the volume of solar exports. In summary, the benefits of solar depend on the particular location in the network, and as a result recent reviews by the AEMC and the Victorian Essential Services Commission (ESC) both concluded that potential network benefits are too variable between location, across times, and between years to be well suited for remuneration via a broad-based tariff.
- We consider that solar customers should be treated like any other generator in the competitive electricity market, which means that they take or pay the market price – and are not otherwise compensated or penalised for their impact on these prices. For example, a new generator that contributes to a reduction in wholesale spot prices does not receive any additional payment to reflect the lower wholesale price. It takes the same market price as all other generators, and so all customers benefit from the price reduction. Likewise, a customer who consumes electricity by switching on an appliance

and thereby increasing the market demand for electricity and electricity prices for all customers is not required to compensate the other customers for these higher prices. These are normal outcomes of a competitive market.

- Our feed-in tariff benchmark reflects the saving to retailers because they do not have to buy this electricity from the wholesale market, which accounts for around a third of their total costs of supplying electricity. They still incur network and green scheme costs when they supply these solar exports to other customers, which means that the savings to retailers are less than the value of retail prices.

1.5 We have found there is no strong correlation between customers' total electricity bills and solar feed-in tariffs

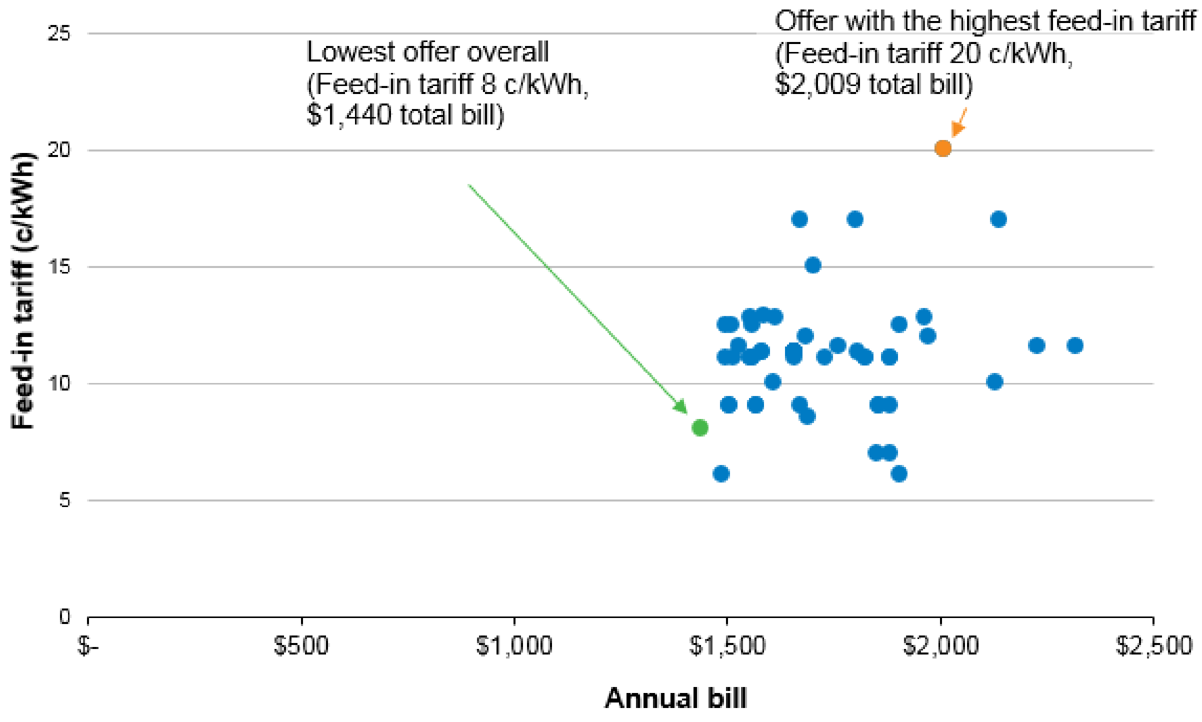
Our analysis shows that market offers with higher feed-in tariffs do not necessarily result in lower bills. As most solar customers import much more electricity than they export, the most important thing they should consider when comparing market offers is the retail electricity price. This price typically includes per kilowatt hour (kWh) usage charges, and a fixed daily supply charge ranging from 80 cents to $1.50 per day. Other important factors are the terms and conditions associated with the offer, such as any contract period and fees such as exit fees and late payment fees.

Figure 1.1 compares the annual bills for all solar offers that are currently available in the Ausgrid network area. We calculated the bills for a solar customer with a 2kW system (around 8 panels), assuming they used the average amount of electricity (6,500 kWh), and used two-thirds of the electricity generated by the solar panels in their home.

It shows that there is not a strong correlation between customers' total bills and the feed-in tariff offered. For many offers, a customer is better off overall with a lower-feed-in tariff, because the retail tariffs offered by retailers are also lower. Of the offers in the market that resulted in the highest bills, some had relatively high feed-in tariffs, and others had relatively low feed-in tariffs.

Customers need to look at all elements of a retailer's offer in deciding whether to accept an offer, rather than focusing solely on the feed-in tariff. We encourage all customers, including solar customers, to regularly shop around for a better deal. The Australian Government's Energy Made Easy website (www.energymadeeasy.gov.au) provides information about the offers that are available. Customers can also use the tool provided on the IPART website (www.ipart.nsw.gov.au) to help compare these offers based on how much solar energy they are likely to consume and export.

Figure 1.1 Annual bills and feed-in tariffs (April 2018, Ausgrid network area)



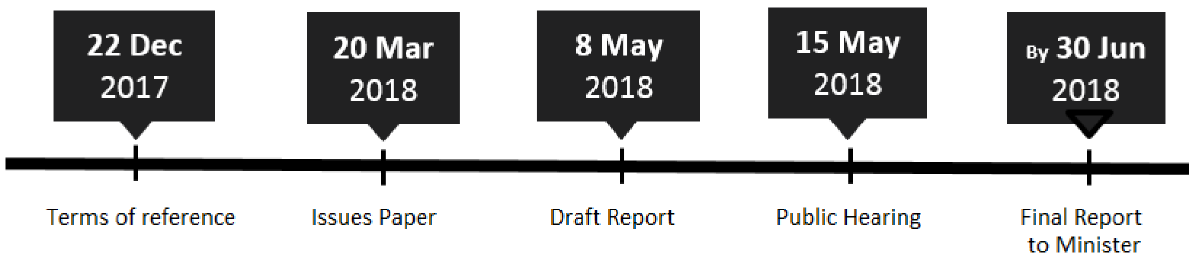
Note: in this example, the 2 kW solar system generates 2,546 kWh per year.
Data source: IPART

1.6 Process for this review

Our review process has involved detailed analysis and public consultation:

- In March 2018 we released an Issues Paper that set out our proposed approach for the review. We received 410 submissions.
- In May 2018, we release a Draft Report which set out our draft benchmarks, and received 16 submissions.
- We held a public hearing on 15 May 2018 at the IPART offices in Sydney.
- We appointed Frontier Economics to provide expert advice on our proposed approach to estimating feed-in tariffs.

The submissions, the transcript of the public hearing, and the Frontier Economics Report are available on our website. We have considered all the issues raised in submissions and at the public hearing in making our final decisions on the feed-in tariff benchmarks.



1.7 List of decisions

1.8 What the rest of this report covers

The rest of this report explains our review and our decisions in more detail:

- Chapter 2 outlines the context for this review
- Chapter 3 explains our decisions on the benchmark for all-day solar feed-in tariffs and the benchmark ranges for time-dependent solar feed-in tariffs for 2018-19
- Chapter 4 explains our methodology for calculating these benchmarks
- Chapter 5 explains how we forecast the average wholesale price of 2018-19, which is the key component of our benchmark range
- Chapter 6 explains how we calculated the solar multiplier.

2 Context for this review

To help retailers in setting solar feed-in tariffs, and solar customers in deciding whether these tariffs are reasonable, IPART sets benchmark solar feed-in tariffs each year. However, the revenue customers receive from solar feed-in tariffs is a relatively minor benefit of having solar panels. The main benefit is that customers can save money when they use electricity generated by their solar panels, rather than buying it from their retailer.

As context for our review, the sections below:

- explain IPART's role in reviewing solar feed-in tariffs
- provide more information on the financial benefits of having solar panels, and how this varies under different metering arrangements
- report on the feed-in tariffs currently on offer, and
- analyse whether higher solar feed-in tariffs lead to lower electricity bills.

2.1 IPART's role in reviewing solar feed-in tariffs

We have been reviewing the solar industry since 2011, following the introduction of the Solar Bonus Scheme in 2010. Initially, our role was to set 'retailer contributions' towards the costs of the Solar Bonus Scheme, and to set a benchmark range for solar feed-in tariffs for solar customers who were not part of this scheme[10] (see Box 2.1).

This year, we have received a Terms of Reference under Section 9 of the *Independent Pricing and Regulatory Tribunal Act 1992* (IPART Act) which asks us to review solar feed-in tariffs annually for the next three financial years.

Consistent with our reviews for previous years, we are required to set a benchmark range that:

- should not lead to solar feed-in tariffs that contribute to higher retail electricity prices, and
- should operate in a way that supports a competitive electricity market in NSW.

Essentially, these two conditions mean that we cannot set the benchmark range higher than the financial value of the electricity exported by solar customers to a retailer – that is, the price it would pay to purchase that electricity from the NEM.

We are also required to set time-dependent benchmark ranges for solar feed-in tariffs – that is, ranges for electricity supplied to the grid at different times of day.

10 IPART, Solar feed-in tariffs – 2011-2012, https://www.ipart.nsw.gov.au/Home/Industries/Energy/Reviews/Electricity/Solar feed-in-tariffs-2011-to-2012?qDh=0, accessed 1 May 2018.

Box 2.1 IPART's role in reviewing feed-in tariffs over time

Setting Solar Bonus Scheme 'retailer contributions'

IPART was first asked to review solar exports in 2011. At that time, the NSW Government had introduced the Solar Bonus Scheme, which provided a subsidised feed-in tariff to solar customers from 2010. Initially, the feed-in tariff was set at 60c/kWh. This was reduced to 20 c/kWh for participants that entered the scheme between 28 October 2010 and 1 July 2011, when it was closed to new participants. Participants in the scheme received these payments until the scheme ended on 31 December 2016.

Over the life of the scheme, the total amount paid in feed-in tariffs was around $1.25 billion. Most of the subsidy to customers was funded through a levy on electricity distribution networks, which was passed on to all electricity customers in NSW. However, retailers were also benefiting from the scheme: when customers exported solar energy to the grid, retailers could save on the amount of wholesale electricity they had to purchase from the NEM (National Electricity Market) to supply their customers. Therefore the NSW Government passed legislation that allowed the Minister to ask IPART to determine the 'retailer contribution' to the Solar Bonus Scheme each year based on the value of these savings. We published our first determination in June 2012 for the 2012-13 financial year.

Setting the benchmark range for customers outside the Solar Bonus Scheme

Customers who installed solar panels after 1 July 2011 were not eligible for the Solar Bonus Scheme. As part of our first review in 2011, the Government asked us to advise whether retailers should be obliged to provide a feed-in tariff for these solar customers, and if so, how it should be set.

We recommended that the best way to implement a feed-in tariff was to set a benchmark range to help guide retailers and customers, based on the savings to retailers. We considered that this would provide the best balance between the risk that regulatory intervention would deter competition for solar customers, against the risk that solar customers may not receive a payment for the value of the electricity they export to the grid without regulatory intervention. We considered that the benchmark range should be set annually because the significant volatility in wholesale prices would make it difficult to set a reasonably accurate range for a period longer than one year.

As part of our 2011 review, we set a benchmark range for 2011-12, and in each year following this review, the NSW Government has asked us to continue to set an unsubsidised benchmark range.

Our legislative role in determining the retailer contribution and benchmark range ended with the conclusion of the Solar Bonus Scheme in December 2016. However, the NSW Government has asked us to continue reviewing solar feed-in tariffs.

Source: IPART, Solar feed-in tariffs, Final Report, March 2012, pp 145-148, Section 43ECA of the *Electricity Supply Act 1995* (repealed); IPART, *Solar Feed-in tariffs,* Final Report, March 2012, pp 115-116, 101-102, Statutory Review, Report to the Minister for Resources and Energy, August 2014, p ii.

2.2 Solar customers make substantial savings off their bills

Most solar customers in NSW have net meters. Under a net metering arrangement customers:

- Use the electricity they generate to power their home, and they save money because they don't need to buy this electricity from their retailer.
- Export solar energy to the grid when they generate more electricity than they need to power their home. They may receive a solar feed-in tariff for this amount (if such a tariff is included in their market offer).
- Import the shortfall from the grid when their solar panels generate less electricity than required to power their home (such as at night). They pay the retail price for this amount.

The savings that customers make off their bills are typically the largest financial benefit from having solar panels. They are typically much larger than the revenue they make from receiving a solar feed-in tariff for the energy that they export. This means that customers are better off consuming the energy that they generate, which saves them from buying this electricity from their retailer, rather than exporting it to the grid.

For example, Figure 2.1 shows an example of two customers on a **typical offer** (based on the offer **currently** in the market that results in the median bill) who consume the same amount of energy (6,500 kWh per year), and generate the same amount of energy with panels (around 2,546 kWh with a 2 kW panel). Inclusive of GST, the offer has:

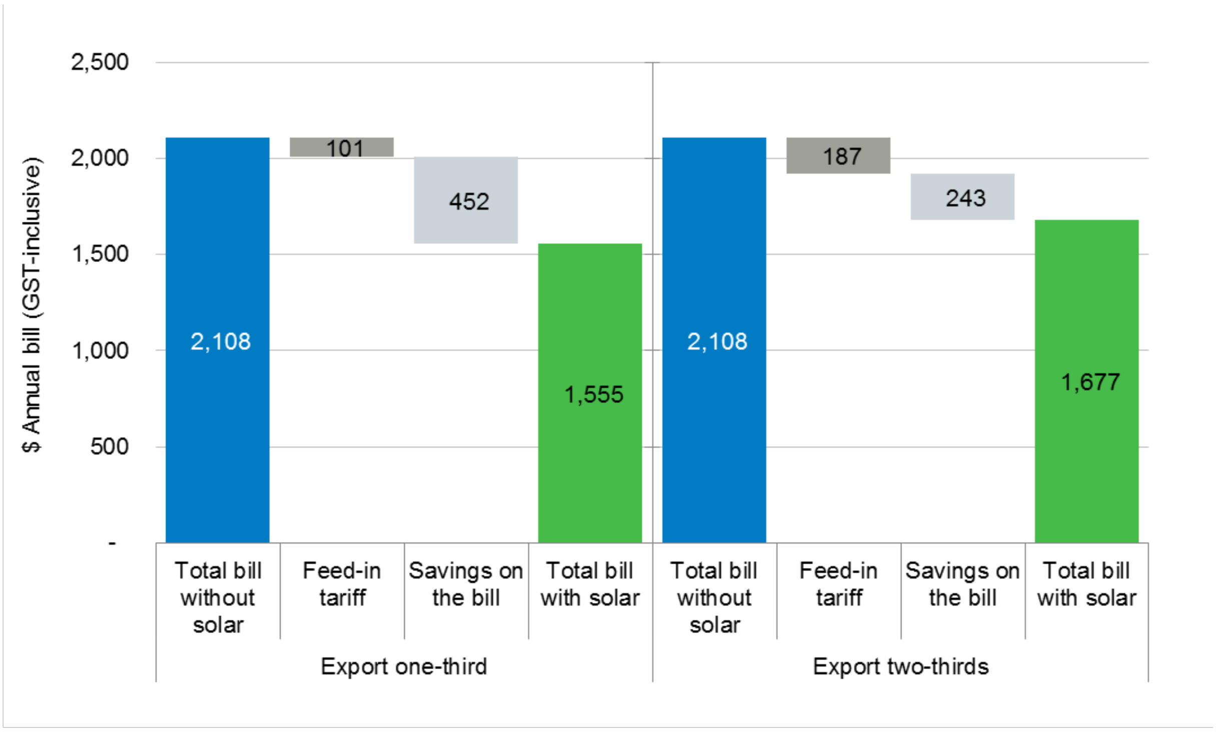
- a fixed charge of 87.07 c/day,
- a consumption charge of 27.5 c/kWh, and
- a feed-in tariff of 11.3 c/kWh[11].

The first customer only exports **one-third** of the electricity that they generate (and uses two-thirds to power their home). With a feed-in tariff of 11.3 c/kWh exported, they earn $101 on the energy they export over the year. The second customer exports **two-thirds** of their solar electricity, and earns a higher amount of $187 per year.

However, the first customer has a significantly lower bill ($1,555 compared to $1,677), because by consuming their energy in the home, they have saved $452 in retail charges, compared to only $243 saved by the second customer.

[11] Based on the offer currently in the market that results in the median bill for 2017-18.

Figure 2.1 Annual bills for typical solar customers with a net meter



Note: In this example, the 2 kW solar system generates 2,546 kWh per year. Numbers may not add due to rounding.

Source: IPART analysis using data from energymadeeasy.com.au.

In addition to the savings from their bills and the revenue from feed-in tariffs, solar customers are eligible for a one-off subsidy when they install solar panels under the Commonwealth Small-Scale Renewable Energy Scheme (SRES). The size of the subsidy varies with the size of the system installed, as it is based on the expected generation from the system until the Small-Scale Renewable Energy Scheme ends in 2030. Currently, the subsidy ranges from around $1,050 to $1,330 for a 2 kW system to around $3,000 for a 5 kW system. This covers around 25-35% of the total system costs.[12] The costs of the Small-Scale Renewable Energy Scheme subsidy are paid for by retailers, and passed onto customers through electricity retail prices.

2.2.1 Customers are currently better off with net meters than gross meters

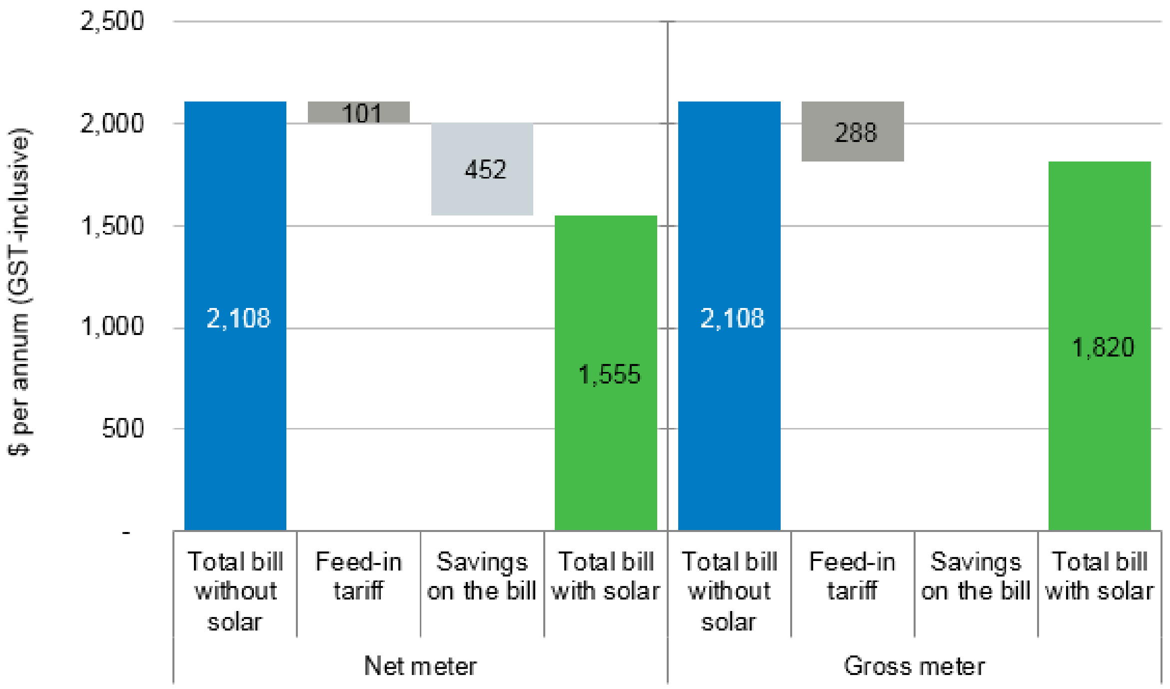
Unlike customers with net meters, customers with **gross meters** do not make savings off their bill when they generate solar electricity. All the energy that they generate is exported to the grid, and they earn a feed-in tariff on this energy. They then have to buy all the energy that they use from their retailer. Customers with gross meters will only be better off than customers with net meters if their feed-in tariff is higher than the retail price of electricity. This was the case under the Solar Bonus Scheme, when the initial feed-in tariff was 60 c/kWh, outlined in Box 2.1 above.

12 The values for financial incentives under the Small-Scale Renewable Energy Scheme assume the solar unit is installed in Sydney on 24 April 2018. The dollar range is based on certificate prices of $30 and $38. Clean Energy Regulator, *Small generation unit STC calculator*, https://www.rec-registry.gov.au/rec-registry/app/calculators/sgu-stc-calculator, accessed 24 April 2018; Green Electricity Markets, *STC Market Prices*, http://greenmarkets.com.au/resources/stc-market-prices, accessed 24 April 2018. Solar Choice, *Current Solar System Prices: Residential and Commercial*, *https://www.solarchoice.net.au/blog/solar-power-system-prices*, accessed 24 April 2018.

Figure 2.2 shows the difference in the annual bill for the same offer as in Figure 2.1, however, in this example one customer has a net meter, and one customer has a gross meter.

For the customer with the gross meter, for each kilowatt hour they use at the same time their panels are exporting electricity, they pay the full 27.5 cents for the usage tariff, to their retailer, and receive a 11.3 cent feed-in tariff for the electricity they generate. This means that they pay a net amount of 16.2 cents for this electricity that they consume. By contrast, with a net meter, for each kilowatt hour a customer generates and consumes themselves, they receive no feed-in tariff, but they save the full 27.5 cents on the retail price of electricity because they can avoid purchasing this electricity from their retailer. Figure 2.2 shows that in this example, for the same consumption and solar exports, the customer with the net meter is $265 better off.

Figure 2.2 Annual bills for customer with net meter versus gross meter



Note: In this example, the 2 kW solar system generates 2,546 kWh per year. Numbers may not add due to rounding.
Source: IPART analysis using data from energymadeeasy.com.au.

Solar customers who still have a gross meter can ask their retailer to install a net meter. Retailers may charge customers for the costs of the meter and installation.

We note that throughout 2017, it sometimes took several months for retailers to install a net meter after receiving a customer request. The Energy and Water Ombudsman (EWON) received a large number of complaints about installation delays. These delays were due to a range of factors – including installations taking more time than expected; a lack of qualified installers, aged/damaged house/meter wiring, the presence of asbestos or other meter board/box quality issues, and problems with access to meters.[13]

13 EWON, *Consumer Issues*, 16 March 2018, https://www.ewon.com.au/page/publications-and-submissions/annual-reports/2016-17/consumer-issues

As a result of these delays, the Minister for Energy and Utilities wrote to IPART in May to ask us to report on whether retailers are delivering acceptable levels of customer service in relation to their metering services.

2.3 During 2017-18 retailers offered a feed-in tariffs of around 6 to 20 cents

As at April 2018, 20 of the 25 retailers operating in NSW offered a solar feed-in tariff as part of their generally available market offers.[14] These tariffs varied from 6.1 cents to 20 c/kWh (Figure 2.3). Retailers offered the same feed-in tariff across each network area where they were selling electricity.

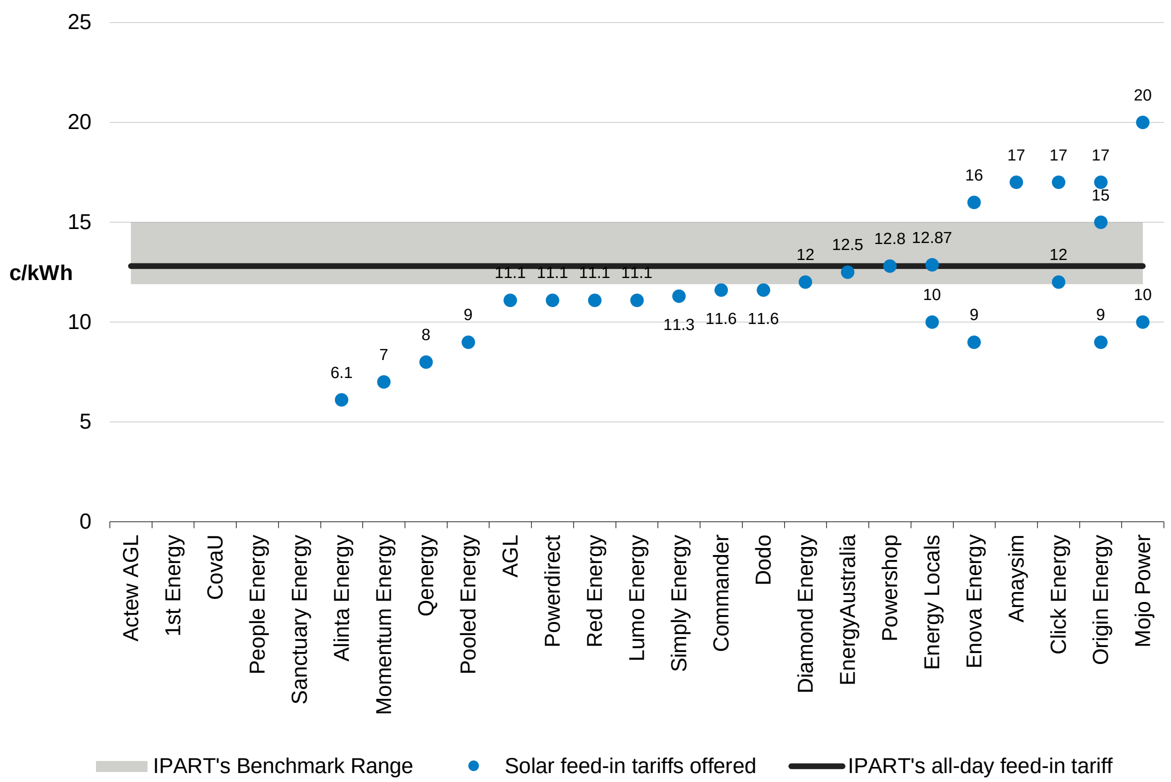
Our recommended benchmark range for 2017-18 is 11.9 c/kWh (for off-peak times) to 15.0 c/kWh (at peak times).[15] We note that for their generally available offers, all retailers are offering a flat all-day rate across the whole day, rather than different feed-in tariffs for peak and off-peak times. IPART's equivalent all-day benchmark is 12.8 c/kWh. However, some retailers are partnering with technology companies and offering pricing plans that intermittently pay customers more than $1 per kWh, or around 10 times the usual rate to provide an incentive for customers to export electricity during extreme high price events (for more details see Box 3.4 in Chapter 3).

When comparing retailers' all-day feed-in tariffs to our benchmark feed-in tariff range for 2017-18, we found that of the retailers offering tariffs:

- Eighteen offered a solar feed-in tariff that was below our all-day benchmark feed-in tariff of 12.8 c/kWh, and 15 of these were below the lower end of the benchmark range. The lowest of these was 6.1 c/kWh.
- Six offered a feed-in tariff equal or greater than our all-day benchmark, with five retailers offering more than 15.0 c/kWh (the upper end of the benchmark range). The highest of these was 20 c/kWh.
- Five retailers had more than one solar feed-in tariff option.

14 Data from www.energymadeeasy.com.au.
15 IPART, *Solar feed-in tariffs – benchmark range 2017-18*, Final Report, June 2017, p 1.

Figure 2.3 Solar feed-in tariffs available in NSW, based on retailers' market offers in April 2018

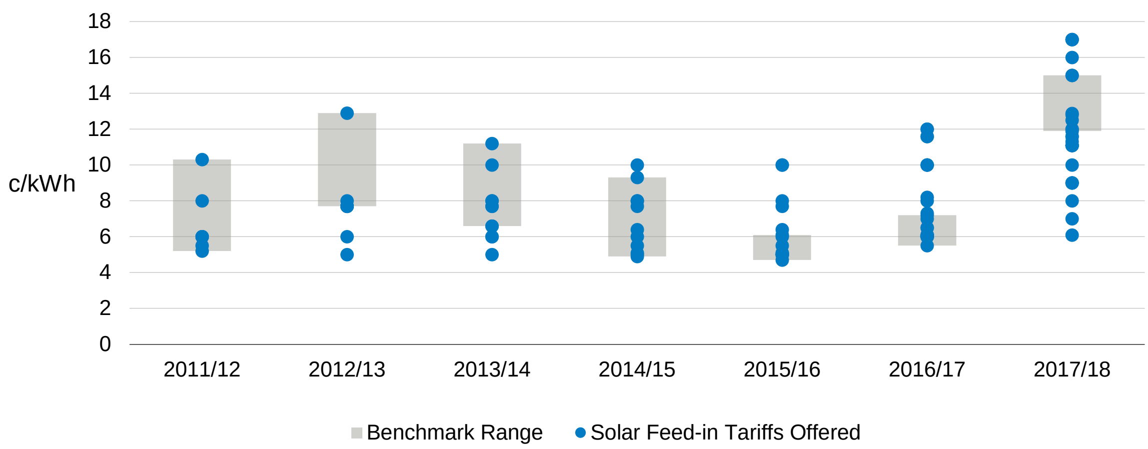


Note: Enova Energy was only retailing in the Essential Energy network area and Pooled Electricity was only supplying electricity in the Ausgrid and Endeavour Energy network areas.

Data source: IPART analysis, using data from www.energymadeeasy.com.au.

Figure 2.4 shows that feed-in tariffs offered in the market have changed from year to year, mainly reflecting the fluctuation in the forecast average wholesale prices.

Figure 2.4 IPART's solar benchmarks over time (2011-12 to 2017-18, nominal $)



Source: IPART reports, and IPART analysis using data from energymadeeasy.com.au.

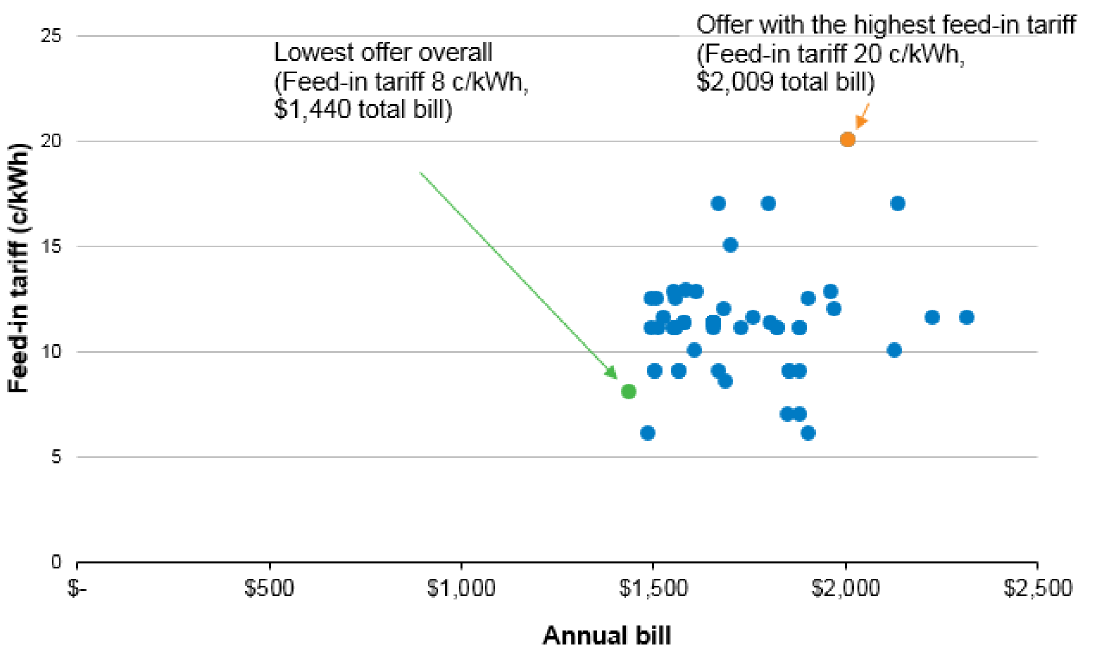
2.4 We have found there is no strong correlation between customers' total electricity bills and solar feed-in tariffs

When solar customers are comparing retailers' market offers, the level of the feed-in tariff included in the offer is not the only factor they should consider. Most solar customers import much more electricity than they export, and so the most important driver of their bills is the retail price they pay to buy electricity when their solar panels are not generating (such as at night or on cloudy days when the sun is not shining). Customers also pay a fixed retail charge of around 80 cents to $1.50 per day. Other important factors are the terms and conditions associated with the offer, such as any contract period, early termination fees etc. This means that offers with higher feed-in tariffs will not necessarily result in lower bills.

We analysed the offers that are currently available to consider whether customers are likely to be better off on offers with higher solar feed-in tariffs. Figure 2.5 compares the annual bills for all solar offers that are currently available in the Ausgrid network area. We calculated the bills for a solar customer with a 2 kW system (around 8 panels), assuming they used the average amount of electricity (6,500 kWh), and used two-thirds of the electricity generated by the solar panels in their home.

It shows that there is not a strong correlation between customers' total bills and the feed-in tariff offered. For many offers, a customer is better off overall with a lower-feed-in tariff (because the retail tariffs offered by retailers are also lower). Of the offers in the market that resulted in the highest bills, some had high feed-in tariffs, and others had lower feed-in tariffs.

Figure 2.5 Annual bills and feed-in tariffs (April 2018, Ausgrid network area)



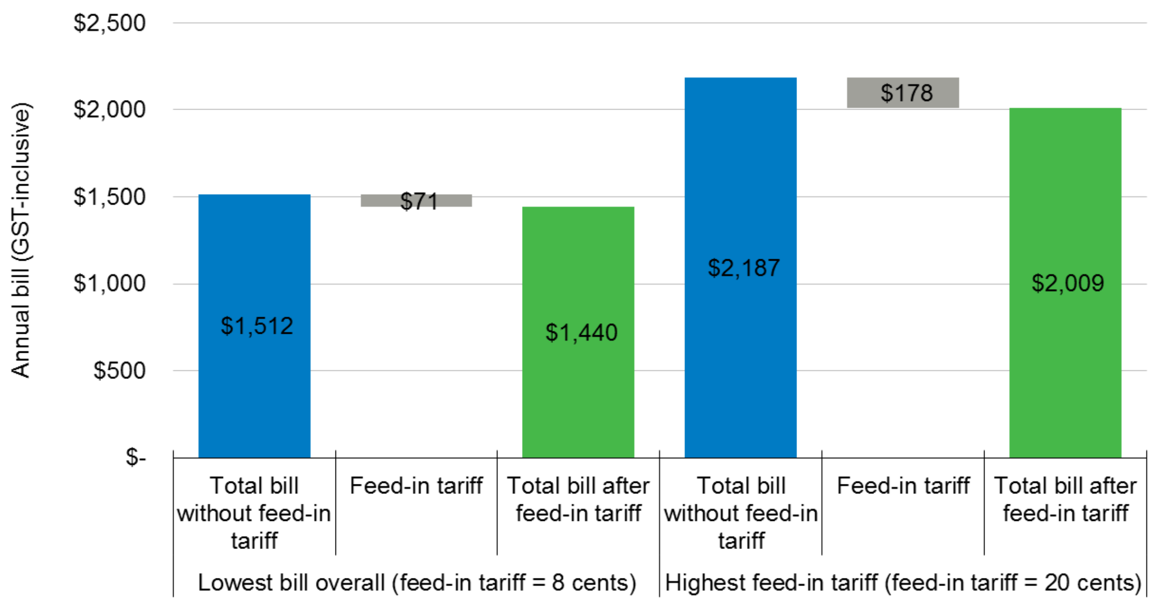
Note: In this example, the 2 kW solar system generates 2,546 kWh per year.
Data source: IPART analysis using data from energymadeeasy.com.au.

Figure 2.6 compares the annual bills for two of the offers shown in Figure 2.5 for a customer with a 2 kW system, who consumes 6,500 kWh per year and exports one-third of the electricity they use to the grid (and uses the rest to supply their home):

- The highest feed-in tariff offer pays a feed-in tariff of 20 c/kWh, has a consumption tariff of 27.9 c/kWh, plus a daily supply charge of $1.80 per day.
- The best offer overall pays a feed-in tariff of 8 c/kWh feed-in tariff, has a consumption tariff of 23.10 c/kWh, plus a daily supply charge of 88 cents.

The annual bill for a customer on the highest feed-in tariff offer is $2,009, which is $569 higher than the bill for an identical customer on the best offer ($1,440). This reflects the lower retailer charges of the best offer overall.

Figure 2.6 Comparison of two offers with different solar feed-in tariffs (exporting one-third of generation)



Note: In this example, the 2 kW solar system generates 2,546 kWh per year. Numbers may not add due to rounding.

Data source: IPART analysis using data from energymadeeasy.com.au

3 Solar feed-in benchmarks for 2018-19

As Chapter 2 discussed, this year we have been asked to set a benchmark range for all-day solar feed-in tariffs as well as benchmark ranges for time-dependent solar feed-in tariffs. The sections below provide an overview of our solar feed-in benchmarks for 2018-19, and then explain in broad terms how and why we set them. Chapters 4 to 6 discuss our approach in more detail.

3.1 Overview of the feed-in tariff benchmarks for 2018-19

Our benchmark range for 2018-19 is 6.9 to 8.4 c/kWh. This benchmark reflects our forecast of what solar exports would be worth if they could be sold on the wholesale spot market (the National Electricity Market or NEM) in the same way as energy produced by other generators.[16]

We have also set time-dependent solar feed-in tariffs benchmark ranges:

- 6.5 to 7.9 c/kWh between 6 am and 3 pm (when 86.2% of solar exports occur)
- 7.4 to 9.1 c/kWh between 3 pm and 4 pm (when 8% of solar exports occur)
- 11.2 to 13.7 c/kWh between 4 pm and 5 pm (when 4% of solar exports occur)
- 14.1 to 17.2 c/kWh between 5 pm and 6 pm (when 1.5% of solar exports occur)
- 10.7 to 13 c/kWh between 6 pm and 7 pm (when less than 1% of solar exports currently occur)
- 7.8 to 9.5 c/kWh between 7 pm and 8 pm (when less than 0.1% of solar exports currently occur).

Retailers to date have not offered time-dependent solar feed-in tariffs as customers have limited ability to respond to a high feed-in tariff in the very late afternoon. However, our benchmark ranges illustrate the potential for such tariffs to provide a price signal to solar customers with battery storage systems or who are considering purchasing such systems about when they should export to the grid.

In line with the requirements under our Terms of Reference, we have set the solar feed-in benchmarks for one year, rather than multiple years as some stakeholders suggested. This aligns with the frequency that retailers change their tariffs, which tend to be at least once a year, reflecting the substantial fluctuations in wholesale prices between years (as well as changes in other cost components).

16 This is a hypothetical concept, as customers with small-scale solar PV cannot sell their exported energy into the wholesale spot market.

3.2 Our 2018-19 benchmark range is 6.9 to 8.4 c/kWh

As indicated above, our benchmark for all-day solar feed-in tariffs for 2018-19 is 6.9 to 8.4 c/kWh. This benchmark reflects our forecast of what a solar customer's exported energy would be worth if it could be sold on the NEM like other generation. It is also around the same as the average price of wholesale for the whole day (ie, not weighted by solar output).

To reach this decision, we:

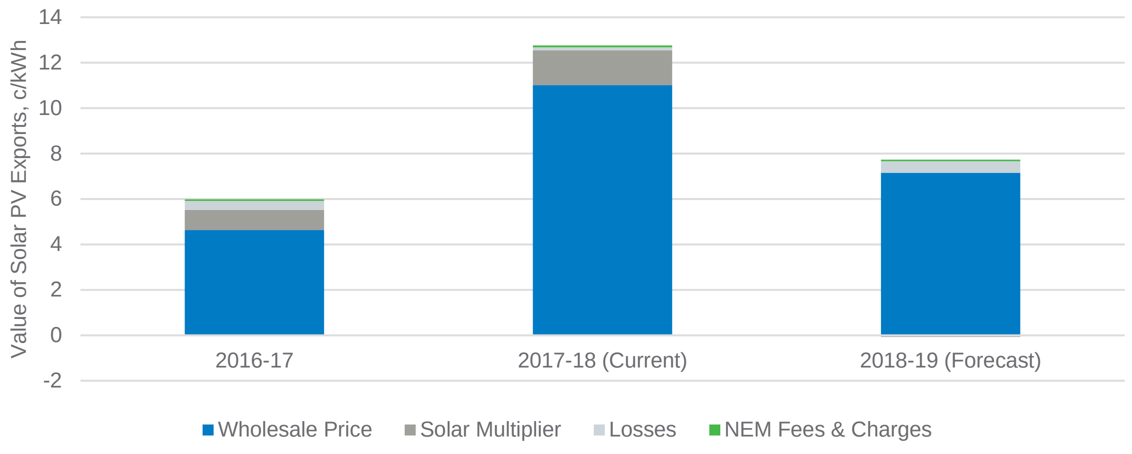
- Forecast the average wholesale electricity price on the NEM in 2018-19 using NSW baseload electricity futures contracts traded on the Australian Stock Exchange (ASX), averaging the daily close price over 40 days, including a range of +/-10% around this average to recognise the forecasting uncertainty around wholesale prices, and then adjusting each end of the range down to subtract a 5% premium to reflect that contracts typically trade at a premium to spot prices. Chapter 5 provides information on how we estimate the average wholesale price.
- Applied a 'solar multiplier' which reflects whether wholesale prices are likely to be higher or lower than this average price at the times when solar exports occur. This is necessary because, in the NEM, wholesale electricity prices are set for each half hour across the day, based on supply and demand at that time. Typically, they are lowest at night (when demand is lowest) and through the middle of the day (when solar energy meets a proportion of demand). We estimate the multiplier using the most recent three years of historical data on wholesale prices and the timing of solar exports. Chapter 6 discusses our methodology for calculating the solar multiplier.
- Grossed up solar generation to the NSW node using estimated loss factors. Supplying customers with solar exports also means that retailers require slightly less energy than they otherwise would if they were purchasing this energy from the NEM. This is because solar exports tend to be consumed close to where the electricity is produced, and so the electricity losses that usually arise as electricity flows through the transmission and distribution network are avoided.
- Added the value of the NEM fees and charges that a retailer would have paid if they purchased the wholesale energy in the NEM. Retailers do not have to pay NEM fees and charges on solar exports because they are accounted for in the NEM through a lower demand profile. However, retailers do have to pay network fees and the costs of environmental policies on all electricity that they supply.

The contribution of each of these components to our benchmark range for the all-day solar feed-in tariff for 2018-19 (using the midpoint of range of wholesale prices) and our all-day benchmarks for the previous two years are shown in Figure 3.1. As this figure indicates, our benchmark range for 2018-19 is lower than the benchmark for 2017-18, mainly because the forecast average wholesale price is lower in 2018-19.

Figure 3.1 also shows that unlike previous years, the solar multiplier has not resulted in a 'premium' over and above the average wholesale price for 2018-19. This is because we forecast that the value of solar exports will be around the same as the average price of energy across the day – and so we have calculated a solar-multiplier of 0.99. In contrast, in previous years we forecast that the value of solar exports would be slightly higher than the average price across the day. For example, in 2017-18, a solar multiplier of 1.14 added an extra 1.5 cents to the wholesale value of solar exports.

Finally, Figure 3.1 shows that electricity losses and estimated NEM fees and charges are relatively small components of the benchmark feed-in tariff, similar to previous years.

Figure 3.1 Change in the value of solar exports over time (all-day tariff)



Note: Estimates of the wholesale price are based on the 40-day average of wholesale prices (using the midpoint of the range of wholesale prices).

Data source: IPART, AEMO.

3.3 Our benchmark range recognises the forecasting uncertainty around wholesale prices

Our final decision is to set the benchmark using a range to recognise the forecasting uncertainty around wholesale prices. This is different to our Draft Report, where we set an all-day benchmark using a point estimate.

As outlined above, we forecast wholesale electricity prices using the ASX baseload electricity contract prices for the 12 month period 2018-19 using the 40-day average of these prices to 15 May 2018 (and adjusted downwards by 5% to subtract the premium paid on hedging contracts to manage risk compared to the spot price[17]). This data reflects the prices actually paid to purchase baseload electricity contracts, based on expectations of what this electricity will be worth using the latest available information.

However, as discussed earlier wholesale prices fluctuate and while we consider using the 40-day average of the ASX prices is the best estimate of prices in 2018-19, this is a forecast. There is likely to be some variation between the prices paid on the forward market, and actual spot prices. To recognise this uncertainty, we have decided to use a range for our estimate of the average spot prices, based on the 40-day average ASX contract price +/- 10%. This approach produces a benchmark range of 6.9 to 8.4 c/kWh. Our draft benchmark of 7.5 c/kWh falls within this range.

[17] The contract premium of 5% based on expert advice provided by Frontier Economics.

Our approach to setting our benchmark range is different to how we have set a benchmark range in previous reviews. Rather than recognising the forecasting uncertainty of wholesale prices, last year we set a range for our solar feed-in benchmark based on the value of solar at different times of the day:

- the top of the range based on the two-hour window when the value of solar exports was forecast to be highest (this was between 2 pm and 4 pm in 2017-18), and
- the bottom of the range based on the value of exports at all other times.

However, for 2018-19, our forecast indicates that the value of solar exports will hardly vary across the times of the day when most of these exports occur.

For example, Table 3.1 compares our forecasts of the value of solar between 2 and 4 pm (when around 20% of export occur) for 2018-19 with the forecasts for 2017-18. It shows that last year, we forecast the value of solar exports in this peak window to be 15 c/kWh, compared to an all-day average value of 12.8 c/kWh. In contrast, for 2018-19, we forecast that the average value of solar between 2 and 4 pm will be 7.1 to 8.7 c/kWh, which is only slightly above the all-day average value of 6.9 to 8.4 c/kWh.

Table 3.1 Forecast value of solar exports in 2018-19 compared to 2017-18

	2017-18 c/kWh	2018-19 c/kWh
2 pm to 4 pm (2017-18 peak)	15	7.1 to 8.7
All other times	11.9	6.1 to 8.3
All-day	12.8	**6.9 to 8.4**

Note: Last year we set a benchmark range based on the value of solar exports in the peak-time as the top of the range, and the value at all other times as the bottom of the range.

For 2018-19, we forecast that the two-hour window with the highest value of solar exports is likely to occur after 5:30 pm. However, less than 1% of all solar exports occur after this time. Because such a small amount of generation occurs in this time window, we considered that setting the top of the range in line with the value of solar during this time in the same way as we have done in previous years would not provide a realistic guide to customers about the value of solar for the majority of their exports, and could result in inaccurate price expectations for consumers.

Final decision

1 The all-day solar feed-in tariff benchmark range in NSW in 2018-19 is 6.9 to 8.4 c/kWh.

3.4 We have also set time-dependent benchmark ranges

As noted in Chapter 2, we have also been asked to set benchmarks for time-dependent feed-in tariffs. Retailers could offer different feed-in tariffs across the day as an alternative to an all-day rate (however, currently retailers are choosing to offer their customers a single feed-in tariff that applies at all times).

Stakeholders considered that our time-dependent feed-in tariffs should promote the efficient deployment and use of batteries.[18] An individual submitted that:

> Technology now enables small scale PV generators to move from self-consumption including battery storage, hot water, pool heating or pool filtering. The FiT model needs to be open to available technology rather than technology from the 20th century.[19]

Only around 1,600 households in NSW currently have batteries, representing less than 0.1% of households.[20] However, over time as battery prices fall and their uptake increases, a price signal for battery exports will become more important. Therefore, we have not limited our solar benchmarks to daylight hours. We set evening benchmarks to provide a price signal to customers with batteries, or considering purchasing batteries, about when they should export their energy to the grid.

Our time-dependent benchmark range are shown in Table 3.2.

Table 3.2 Benchmark ranges for time-dependent solar feed-in tariffs

Draft decision		Final decision		
Time window	(c/kWh)	Time window	(c/kWh)	% of solar exports
6:30 am to 3:30 pm	6.9 to 7.2	6 am to 3 pm	6.5 to 7.9	86.2
3:30 to 4:30 pm	8.9 to 11.7	3 to 4 pm	7.4 to 9.1	8.0
4:30 to 5:30 pm	11.3 to 13.3	4 to 5 pm	11.2 to 13.7	4.0
5:30 to 6:30 pm	12.8 to 20.9	5 to 6 pm	14.1 to 17.2	1.5
6:30 to 7:30pm	8.7 to 9.6	6 to 7 pm	10.7 to 13.0	0.27
7:30 to 8:30 pm	8.4 to 8.5	7 to 8 pm	7.8 to 9.5	0.01

In response to our draft benchmarks (shown in Table 3.2), some stakeholders submitted that our time-dependent benchmark ranges were too wide to be useful.[21] These wide ranges were the result of the solar multipliers used. The value of the solar multiplier for each time window depends on the historical price and export data.

For our Draft Report, we modelled the solar multiplier for three historical periods (2014-15 to 2016-17, 2015-16 to 2016-17 and 2016-17 only), and set the range based on the highest and lowest multipliers from these modelling runs. For example, for the 5:30 to 6:30 pm time window, the bottom of the range (12.8 c/kWh) was based on solar multiplier (1.75) from the three years of historical data, and the top of the range (20.9 c/kWh) was based on the solar multiplier for the 2016-17 period (2.76).

For our final benchmarks, we have decided to use the midpoint of the minimum and maximum solar multipliers for the three modelling runs (rather than the highest and lowest values), which has narrowed these time-dependent ranges.

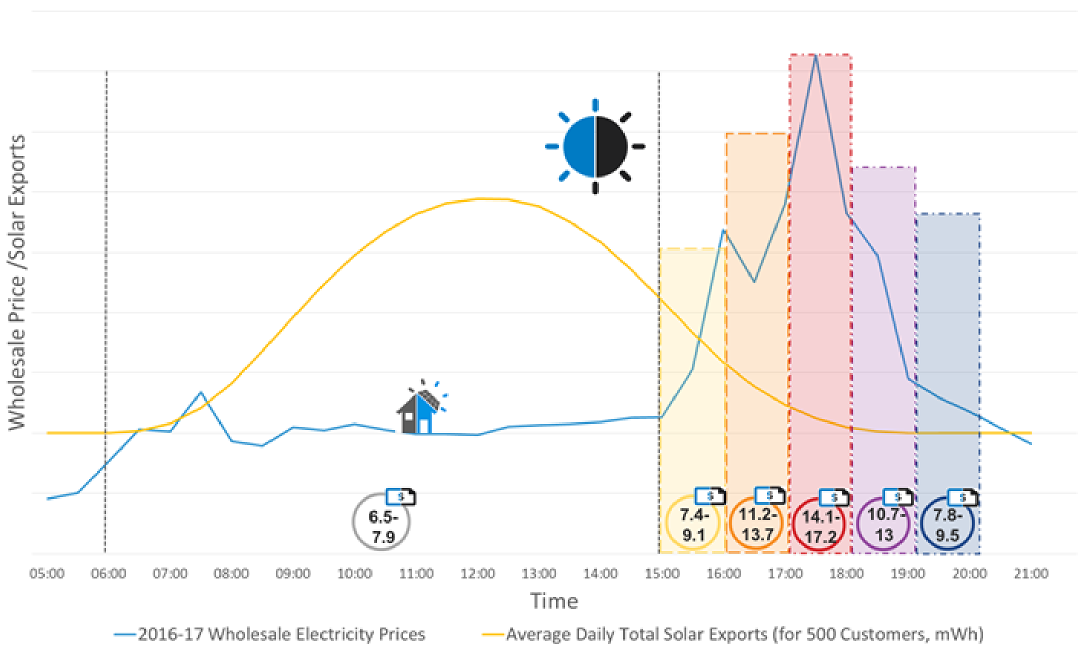
18 For example, see submission to IPART Issues Paper from PIAC, April 2018, p 2.
19 Submission to IPART Issues Paper from L. Johnson, March 2018, p 1.
20 Australian Energy Council, Solar Report – January 2018, p 6.
21 J Muller, Transcript of Public Hearing on IPART's Draft Report, 15 May 2018, p 26.

3.4.1 Our time-dependent benchmark are based on the main shifts in the value of solar exports over the day

We set the benchmarks based on the key shifts in the value of solar exports throughout the day, which can be seen in Figure 3.2. In particular, we:

- set one benchmark between 6 am and 3 pm, because there is very little variation in wholesale prices across these times,
- set benchmarks for each one-hour period after 3 pm, when there is much more wholesale price variation, and
- did not set a benchmark between 8 pm and 6 am because exports are immaterial, and wholesale prices are relatively low.

Figure 3.2 Time-dependent feed-in tariffs



Data source: IPART analysis, based on data from AEMO and Ausgrid.

PIAC submitted that IPART should align the time intervals for our time-dependent benchmark ranges with time-of-use time consumption tariffs bands where it is practical, and not inefficient to do so.[22] However, the time-of-use time periods are different across each network (Table 3.3). Because we are setting a state-wide benchmark, we have decided to continue to set hourly time-dependent bands, which provides more information about the value of solar exports across the day. However, in response to feedback from PIAC, we have decided to set these on the hour rather than the half hour to improve their alignment with the time-of-use consumption tariff blocks.[23]

22 PIAC submission to IPART Issues Paper, April 2018, p 1.
23 PIAC, Transcript of Public Hearing on IPART's Draft Report, 15 May 2018, p 32.

Table 3.3 Time-of-use periods are different for each network 2018-19

Network	Peak	Shoulder	Off-peak
Ausgrid	2 to 8 pm weekdays during 1 Nov and 31 March 5pm to 9pm weekdays during 1 June and 31 August	7am to 2 pm and 8 to 10 pm weekdays during 1 Nov and 31 March 7am to 5 pm and 9pm to 10 pm weekdays during 1 June and 31 August, else 7 am to 10 pm	10 pm to 7am
Essential	7 am to 9 am and 5 to 8 pm weekdays	9 am to 5 pm and 8 pm to 10 pm weekdays	All weekend hours, 10 pm to 7 am weekdays
Endeavour	1 to 8 pm business days	7am to 1pm and 8pm to 10pm business days	All other times

Note: Times in the table for Ausgrid are for residential customers only. Time use periods for Ausgrid business customers are available at https://www.aer.gov.au/system/files/Ausgrid%20Pricing%20Proposal%20Final.pdf, page 16.

Source: Ausgrid: https://www.aer.gov.au/system/files/Ausgrid%20Pricing%20Proposal%20Final.pdf page 15-16, Essential: https://www.essentialenergy.com.au/-/media/Project/EssentialEnergy/Website/Files/Our-Network/TimeofUseBrochure.pdf, p 2, Endeavour: http://www.endeavourenergy.com.au/wps/wcm/connect/eafa56af-2669-42e6-a5d1-6107a547ec3b/NUOS+Price+List_201718_v2.pdf?MOD=AJPERES, p 17.

Figure 3.2 shows that solar exports after 6 pm are negligible. As noted above, the main reason for setting these benchmarks is to provide a price signal for the value of battery exports. Therefore the 6 pm and 7 pm benchmarks are not solar output-weighted because battery exports during these windows could occur equally at any time. It also shows that the average value of solar is higher in the afternoon. This means it would be more cost-reflective if retailers offered a higher feed-in tariff in the afternoon, compared to the morning rate.

The peak prices in the late afternoon and evening are being driven by high levels of electricity demand at the same time of the day as solar output is falling. Higher wholesale prices in the evening also reflect increasing 'peakiness' of wholesale prices in recent years, as the demand-supply balance has tightened, particularly following the closure of the Hazelwood power station in Victoria in March 2017. This means that prices are often driven by higher cost generation (such as gas generators) when demand is highest.

3.4.2 The time-dependent tariffs create weak incentives to change panel orientation

While time-dependent feed-in tariffs are likely to be more cost-reflective, retailers predominately offer an all-day rate. AGL submitted that its current practice of offering only a single all-day solar feed-in tariff is simple to understand and does not create complexity and additional costs to retail operations.[24] Red Energy also noted that without the requisite customer uptake, retailers would incur system and process costs to implement more granular feed-in tariffs with the risk of under-recovery. Further, it submitted that most consumers in NSW do not have a smart meter and will not benefit from more granular feed-in tariffs.[25]

We considered whether the time-dependent solar feed-in benchmarks could create incentives for customers to change the orientation of their panels to generate more solar electricity in the afternoon. Our analysis shows that the benefit from reorienting solar panels is very small because the value of solar electricity varies very little during daylight hours (Box 3.1). Compared to north-facing panels, northwest-facing panels may increase

24 AGL submission to IPART Issues Paper, April 2018, p 2.
25 Red Energy and Lumo Energy Australia submission to IPART Issues Paper, April 2018, p 1.

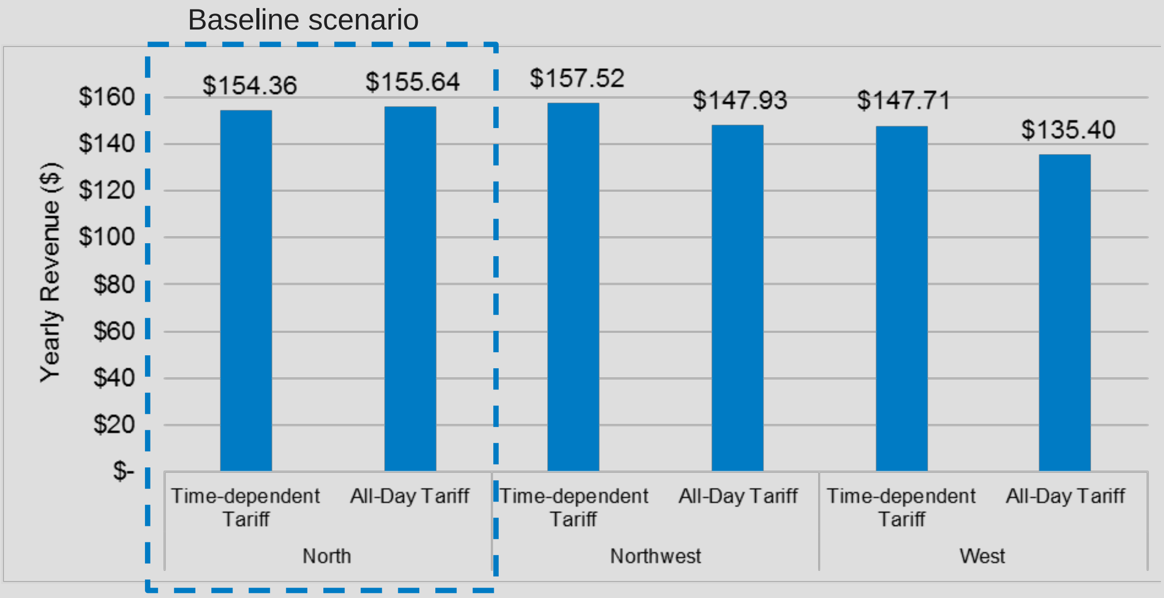
feed-in tariff revenue slightly (around 2%), resulting in an average of $3 per year extra, under the time-dependent tariffs. We found that orienting the panels further west would reduce overall feed-in tariff revenue because even though more solar electricity could be exported when the value is high, this is offset by reduced total generation throughout the day.

However, we found that customers with solar panels and a home battery may be able to double their feed-in tariff revenue and reduce their annual bill by around 16% with a time-dependent feed-in tariff compared to an all-day rate (Box 3.2).

Box 3.1 Annual feed-in tariff revenue with different panel orientations

We have considered how much revenue a solar customer might receive under our time-dependent benchmarks compared to the all-day benchmark, and whether or not they provide an incentive to export more electricity in the late afternoon by changing the angle of the solar panels. Figure 3.3 shows that there is very little overall difference in revenue with different panel angles, using our time-dependent tariffs.

Figure 3.3 Panel orientations compared



The baseline scenario represents an average customer in Sydney with panels faced north to maximise overall output. When the panels are oriented further west, although more energy is produced in the afternoon, the overall amount of energy produced is lower. With a north-facing panel, we estimate that an average customer with a panel size of around 2kW would receive about $156 annually under our proposed all-day tariff. Under our time-varying tariff, the customer could slightly increase their feed-in tariff revenue to around $158 by facing the panels northwest. This is due to the increased revenue gained under the time-dependent tariffs from peak generation in the afternoon, which compensates for the overall fall in panel output.

However, our modelling indicates shifting panels further west would result in less revenue (around $148 on the time-dependent tariff) compared to either a north or a northwest orientation. This is because at best west-facing panels can only produce around 87% of the energy of an optimal north-facing panel, and this reduced total generation offsets the increased revenue from afternoon peak generation.

Box 3.2 Annual feed-in tariff revenue for solar customers with home batteries

We have considered a customer with both solar panels and a home battery, using the same assumptions as in Box 3.1. We found that with time-dependent tariffs, this customer could double their feed-in tariff revenue by shifting all of their solar panel exports into the most profitable two hours of the day as shown in Figure 3.4. This feed-in tariff revenue for this customer would be around $310, compared to around $155 if they were being paid the all-day feed-in tariff. As a result, this customer could save around 16% off their annual bill (Table 3.4).

This is based on a scenario where a customer charges their battery instead of exporting the electricity to the grid. The battery then discharges when it is most profitable subject to the technological constraints of the battery. In this case, the battery exports around 0.5 kW between 4 and 5pm and 5 kW between 5 and 6pm (Figure 3.4). A customer with more solar panels would be able to export more electricity during these times and increase their revenue.

Figure 3.4 Export profiles for solar customers with and without home batteries

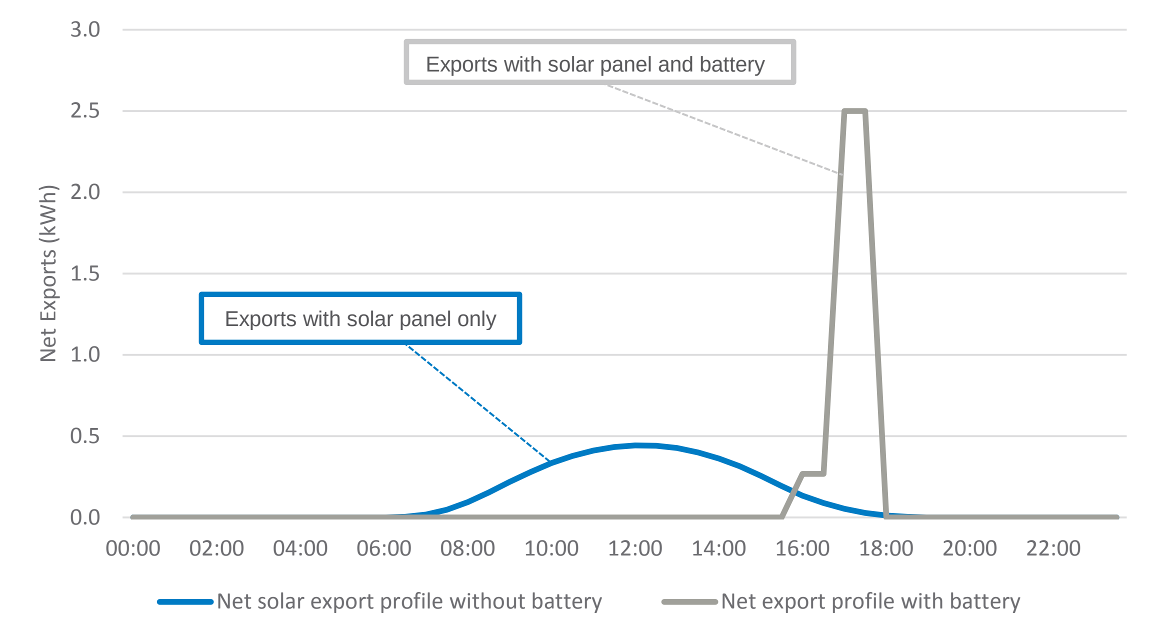


Table 3.4 Impact of time-dependent benchmarks on solar customers with batteries

	Bill before feed-in tariff	Annual feed-in tariff Revenue		Final Bill	
Scenario		**All-day rate**	**Time-varying rate**	**All-day rate**	**Time-varying rate**
Baseline – north-facing panels, no battery	$1,144	$156	$154	$988	$989
North-facing panels, with battery	$1,144	$156	$310	$988	$833
Impact	-	-	**+101%**	-	**-16%**

Final decision

2 The time-dependent solar feed-in tariff benchmarks are:

- 6.5 to 7.9 c/kWh between 6 am and 3 pm (when 86.2% of solar exports occur)
- 7.4 to 9.1 c/kWh between 3 pm and 4 pm (when 8% of solar exports occur)
- 11.2 to 13.7 c/kWh between 4 pm and 5 pm (when 4% of solar exports occur)
- 14.1 to 17.2 c/kWh between 5 pm and 6 pm (when 1.5% of solar exports occur)
- 10.7 to 13 c/kWh between 6 pm and 7 pm (when less than 1% of solar exports currently occur), and
- 7.8 to 9.5 c/kWh between 7 pm and 8 pm (when less than 0.1% of solar exports currently occur).

3.5 Our benchmark ranges are for one-year

In submissions to this review, some stakeholders suggested we should provide a longer term view of the value of solar exports, as solar panels are a longer term investment.[26]

For example, the submission from the Central NSW Councils argued that feed-in tariff pricing should be provided for more than one year, such as on a three to five year basis. It argued that a longer time period was necessary to provide medium term certainty on feed-in tariffs for households and solar investors, and to allow people to assess the likely savings the solar electricity would provide.[27]

However, wholesale prices are volatile reflecting changes in supply and demand driven by changing weather, fuel costs and investment conditions. Due to this volatility, most retailers review their retail prices at least once a year, rather than lock them in over the longer term. Similarly it would not be possible for IPART to establish a longer term benchmark that is reliable.

Our Terms of Reference require us to continue setting benchmarks for solar feed-in tariffs annually until 2020-21. This allows us to update our benchmarks to reflect the most up to date market conditions.

The Central NSW Councils also submitted that our reviews are brought forward six months, so there is more time for retailers to signal their feed-in tariffs for the following financial year.[28] We agree with stakeholders that having the benchmark available before June would assist both consumers and retailers.

As the benchmark is based on forecasting wholesale electricity prices for the next financial year we consider that on balance, completing the review in April (so that our forecast captures data up to the end of March) would be more useful for stakeholders than completing our reviews in December (so that our forecast captures data to the end of November).

26 Central NSW Councils submission to IPART Issues Paper, April 2018, pp 3-4. See also submissions to IPART Issues Paper from Sunny Shire, April 2018, p 1, L Johnston, 31 March 2018, p 1.
27 Central NSW Councils submission to IPART Issues Paper, April 2018, pp 3-4.
28 Ibid.

3.6 We continue to prefer setting benchmarks for solar feed-in tariffs over regulating minimum feed-in tariffs

As in previous years, some stakeholders submitted that retailers should be required to pay a minimum feed-in tariff, as is the case in some other states (See Box 3.3), rather than IPART setting a voluntary benchmark range.[29]

On the other hand, Red Energy and Lumo Energy Australia submitted that IPART's role in publishing a benchmark feed-in tariff is unnecessary as there is substantial competition in the NSW market.[30]

PIAC submitted that it accepts that a regulated minimum for feed-in tariffs may not be required at this time, but it stresses that retail feed-in tariff offerings must be monitored to ensure a reasonable value is passed on to consumers. It submitted that IPART should monitor feed-in tariffs and whether metering charges for solar customers are reasonable. It considered that there are commercial incentives for retailers to not pass on the full value of distributed energy to customers, including that it may not be in their interests to promote the entry of solar customers into the market.[31]

Box 3.3 How NSW regulatory requirements for solar feed-in tariffs compare to those in other states

The regulatory requirements related to offering solar feed-in tariffs are different in each state. NSW is the only state in which the price regulator sets a voluntary benchmark range.

As in NSW, retailers are not obliged to offer feed-in tariffs in South East Queensland, South Australia, and the ACT. Price regulators in South Australia and Queensland monitor the feed-in tariffs that are offered in the market. For example, the current market offers in South Australia range from 6.8 to 22 c/kWh.

In Victoria, regional Queensland and Tasmania, retailers are obliged to offer solar customers a feed-in tariff, and regulators or State Governments set a minimum solar feed-in tariff. The current regulated minimum rates are around 9-10 c/kWh. In Western Australia, retailers are also obliged to offer customers a feed-in tariff, which must be approved by the Public Utilities Office, but the Government does not set a minimum.

Source: Essential Services Commission, *Minimum Electricity Feed-in Tariffs to Apply from 1 July 2018*, Final Decision, 27 February 2018, p iv;

Queensland Competition Authority, *Solar Feed-in Tariff Report 2016-17,* October 2017, p ii; QCA, *Solar feed-in tariff for regional Queensland for 2017-18,* May 2017, p 7. Essential Services Commission of South Australia, *Monitoring South Australian Feed-in Tariffs Paid by Electricity Retailers to Solar Energy Exporters: July 2017 update,* 31 August 2017, p 1. Synergy, *Renewable Energy Buyback Scheme, https://www.synergy.net.au/-/media/Files/PDF-Library/REBS_Pricing_Schedule.pdf?la=en&hash=F17D284A297E4097400F1E8FA44BB106C7B98824,* accessed 16 April 2018; Office of Tasmania Economic Regulator, *Feed-in Tariffs, http://www.economicregulator.tas.gov.au/electricity/pricing/feed-in-tariffs*, accessed 16 April 2018.

We don't have the power to set a mandatory feed-in tariff, as the Government has asked us to recommend a benchmark range. However, we have considered whether this would be in the long-term interest of customers.

29 See submissions to IPART Issues Paper from I Anderson, April 2018, p 1, J Everingham, April 2018, p 1; and L Martello, April 2018, p 1.

30 Red Energy and Lumo Energy Australia submission to IPART Issues Paper, April 2018, p 1.

31 PIAC submission to IPART Issues Paper, April 2018, p 2.

In our view, there is no need to regulate solar feed-in tariffs. Our view is that competition is providing an effective incentive to retailers to offer customers cost-reflective feed-in tariffs, and a range of offers are available to customers. In addition, much of the recent innovation in the electricity retailer market has been in relation to solar electricity. For example, some retailers have partnered with technology companies and are offering pricing plans that intermittently pay customers more than $1 per kWh, or around 10 times the usual rate to provide an incentive for customers to export electricity during extreme price events (See Box 3.4).

There could be benefits to customers and retailers if customers were offered a more cost reflective price signal to reflect these types of events, and lower feed-in tariffs the rest of the time. A regulated minimum feed-in tariff at *all times* might impede such innovation.

We also note that since other components of electricity tariffs are not regulated, it would be inconsistent to regulate only the feed-in tariff. In addition, regulating just the feed-in tariff would be unlikely to benefit customers as retailers would adjust the other components of their tariffs to account for any losses or gains from the regulated rate. As shown in Chapter 2, a likely consequence of a higher feed-in tariff is higher retail rates.

Box 3.4 Tariff innovation for solar customers

Retailers currently do not offer time-dependent solar feed-in tariffs in their generally available offers. However, some retailers are partnering with technology companies and trialling pricing plans that intermittently pay customers over and above their feed-in tariffs for exporting to the grid during extreme high price events.

An example is technology provided by Reposit Power. Reposit began trialling its software in late 2014 after receiving funding from the Australian Renewable Energy Agency. Reposit currently offers a range of smart energy management products in NSW including:

- **Consumption optimisation software**, which intelligently controls when the home draws power from batteries, straight from rooftop panels, or from the grid to minimise bills.
- **Virtual Power Plant packages for commercial customers** (such as networks, retailers, property developers, solar installers, community groups). These are fleets of distributed electricity generating assets (solar panels, batteries, and possibly electric vehicles owned by homes and businesses) that are coordinated centrally to smooth peak demand, manage wholesale market volatility risk, and minimise costs. Networks are also offered control over power quality factors like voltage.

Reposit has partnered with retailers including Diamond Energy, Powershop, and Simply Energy, and these retailers offer their customers up to $1/kWh for panel or battery exported solar electricity during extreme price events, on top of their existing feed-in tariff. The Reposit app alerts customers when and for how long their battery will be required to discharge, and what their payment will be.

Source: Reposit Power Pty Ltd, A Commercially Viable Application of Electricity Storage for Australia's National Electricity Grid – A Final Report, (part of the Australian Renewable Energy Agency Emerging Renewables Project), October 2016; https://repositpower.com/fleet/; https://repositpower.com/gridcredits/

4 Our approach for setting the benchmark ranges

Consistent with previous reviews, our approach for setting our benchmark ranges for solar feed-in tariffs involves estimating what retailers would pay for customers' solar exports if this electricity were sold into the wholesale spot market in 2018-19 (the National Electricity Market or NEM) in the same way as other generators' output.[32]

Retailers who made submissions to our review were supportive of this overall approach,[33] but many other stakeholders, including customers with solar panels submitted that our feed-in tariff benchmark should be higher. They commonly argued that:

- retailers unfairly profit from solar customers because the feed-in tariff is lower than retail prices,
- feed-in tariffs should include a subsidy to reflect the value of the environmental and health benefits that solar electricity provides to the broader community,
- feed-in tariffs should also reflect the financial benefit to electricity network suppliers, particularly the potential to defer network investment, and
- setting feed-in tariff benchmark in line with (falling) wholesale electricity prices effectively punishes solar panel owners for their contribution in helping to reduce the wholesale power price for all consumers.

The sections below discuss our overall approach to setting solar feed-in benchmark tariffs, and our responses to stakeholder feedback to explain why we have maintained our approach.

4.1 Our approach to setting the benchmarks

As Chapter 3 discussed, our approach for setting our benchmark ranges for solar feed-in tariffs in 2018-19, involves estimating the value of solar exports to retailers in 2018-19 by:

1. Forecasting the average wholesale electricity price on the NEM in 2018-19 using NSW baseload electricity futures contracts traded on the Australian Stock Exchange (ASX), averaging the daily close price over 40 days, including a range of +/-10% around this average to recognise the forecasting uncertainty around wholesale prices, and then adjusting each end of the range down to subtract a 5% premium to reflect that contracts typically trade at a premium to spot prices.

32 This is a hypothetical concept, as customers with small-scale solar PV cannot sell their exported energy into the wholesale spot market.

33 For example, see EnergyAustralia submission to IPART Draft Report, June 2019, p 2; Simply Energy submission to IPART Draft Report, May 2018, p 1; and Red Energy and Lumo Energy submission to IPART Issues Paper, April 2018, p 2.

2. Estimating then applying a ‘solar multiplier’ to adjust this forecast price to account for whether wholesale prices are likely to be higher or lower than this average price at the times when solar exports occur. We estimate the multiplier using historical data on wholesale prices and the timing of solar exports.
3. Estimating then applying a loss factor to the adjusted forecast wholesale electricity price to account for the electricity losses that retailers avoid paying for when they supply customers with other customers’ solar exports (Box 4.1).
4. Adding the value of the NEM fees and charges that retailers avoid paying when they supply customers with other customers’ solar exports (Box 4.1).

In our Terms of Reference, the NSW Government also asked us to consider forward-looking measures of wholesale prices when solar electricity is likely to be exported in estimating the value of solar exports. It specified that:

> IPART may incorporate forecasted electricity wholesale cost fluctuations instead of historical data.

This would involve modelling prices at the times that solar electricity is likely to be exported, rather than using historical data to adjust the price for the times that solar energy is likely to be exported. We considered this approach and decided to continue to use historical data to forecast price fluctuations throughout the day. We consider that this is the best way to account for patterns in wholesale electricity prices because it captures all the factors that contribute to price volatility, whereas market modelling relies on assumptions which can be incomplete. This approach was generally supported by stakeholders.[34]

The next two chapters provide a more detailed explanation of our estimates of average wholesale prices and the solar multiplier.

34 For example, see Red Energy and Lumo Energy submission to IPART Issues Paper, April 2018, p 2; and Simply Energy submission to IPART Issues Paper, April 2018, p 1.

Box 4.1 How we calculate loss factors and NEM fees and charges

When retailers purchase electricity on the NEM, they must buy more than they supply to customers because some will be lost as the electricity flows along the transmission and distribution networks. However, when retailers supply solar exports, these losses don't occur because solar exports tend to be consumed close to where they are produced. This results in a saving (or avoided cost) for retailers.

To account for this cost, we multiply our adjusted forecast average wholesale price of solar exports by a loss factor. We estimate this loss factor using loss factors published by AEMO. We weight the average loss factor for 2018-19 across the three distribution network areas in NSW, accounting for both transmission and distribution line losses. We include:

- *MLF*, which is transmission line losses between the Regional Reference Node and each bulk supply connection point for the coming financial year, weighted by actual energy consumption at each connection point, excluding industrial customers.
- *DLF*, which is distribution loss factors for small customers for the coming financial year, weighted by customers' actual consumption.

When retailers purchase electricity on the NEM they must pay NEM fees and charges. As they avoid this cost when they supply solar exports, the final step in our approach is to add the value of these fees and charges in the coming year.

4.2 Retailers do not profit unfairly from solar customers as they only avoid wholesale costs when they supply solar exports

Under our approach, the benchmark ranges for solar feed-in tariffs largely reflect the forecast wholesale cost of electricity, not the retail price. This is because retailers only avoid the wholesale cost when they supply their customers with solar exports.

The retail price customers pay for the electricity retailers supply recovers a range of cost components, including:

- the wholesale costs of purchasing the electricity on the NEM, which include the wholesale price plus associated costs, fees and charges
- network costs, which retailers pay the network businesses for transporting the electricity to the customers' premises
- green scheme costs, including retailers' obligation to purchase renewable energy certificates (under the Commonwealth Renewable Energy Target) and energy savings certificates (under the NSW Energy Savings Scheme) in line with government environmental policies, and
- retail costs, which retailers incur in serving their customers, and which include costs related to billing, responding to customer inquiries, and complying with regulations.

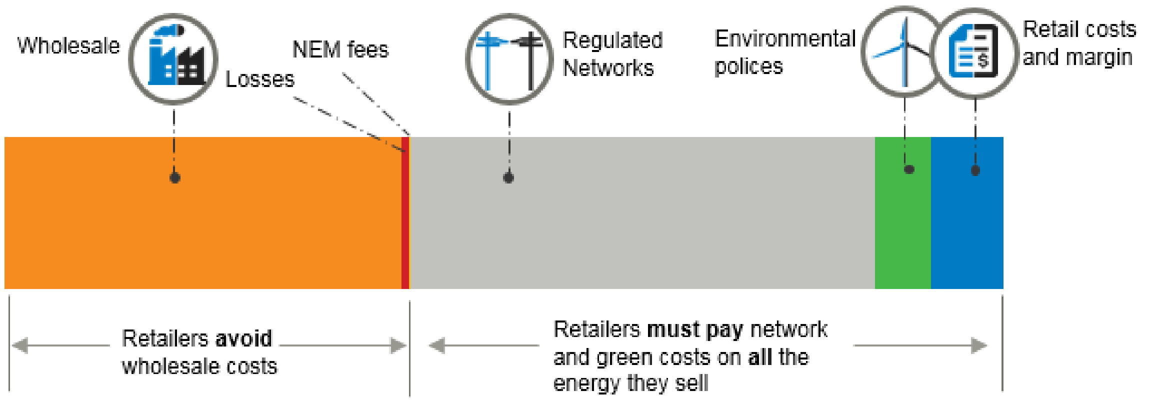
For each kWh that solar customers export to the grid, retailers avoid paying the wholesale costs of purchasing this electricity on the NEM. As Figure 4.1 shows, these wholesale costs typically make up around **30-40% of retailers' total costs**.

However, they still pay the other cost components. The metering and settlement arrangements in the NEM mean that retailers incur network and green scheme costs for every kWh of electricity they supply to a customer, **regardless of where and how the**

electricity was generated. Thus they still pay these costs when they supply electricity from solar exports.

Retailers also incur costs in running their retail business (although unlike other costs, these depend more on the number of customers they have, rather than how much energy is exported).

Figure 4.1 Cost components recovered in retail electricity prices, based on representative market offer price in NSW, 2017-18



Data source: AEMC, *2017 Residential electricity price trends, Final report*, December 2017, p 100.

Many stakeholders submitted that retailers are unfairly profiting from solar customers because they offer feed-in tariffs that are much lower than their retail charges.[35] For example one stakeholder argued that the price they were receiving for their solar exports was too low, and that exports were undervalued, as they had to buy electricity from their retailer for considerably more than the feed-in rate.[36]

However, this is simply not true. Retailers cannot sell the solar exported by their customers to other customers at little or no cost on top of any feed-in tariffs they pay.

Similarly, while many stakeholders submitted that retailers should be required to pay a feed-in tariff equal to the retail price of electricity ('1-for-1'), this would result in them making a substantial loss on solar exports. As a result, they would have to increase retail prices substantially to recoup this loss. We estimate that the loss would be equal to $130 million state-wide over a year, which would add $50 to the average annual household bill. Alternatively, they would choose not to supply these customers.[37]

One stakeholder said that the metering and settlement arrangements in the NEM are unfair and should be changed.[38] These arrangements are governed by National Electricity Rules and so are outside the scope of this review.

35 For example, see submissions to IPART Issues Paper from R Naprta, April 2018, p 1; P Stanhope, April 2018, p 1; and W Brenton, April 2018, p 1.

36 Submission to IPART Issues Paper from C Jones, April 2018, p 1.

37 Based on the consumption tariff (including discounts and excluding GST) for the median bill for a solar customer in the Ausgrid area for the average level of consumption and solar exports. See footnote 3 for information on our estimation methodology.

38 Submission from D Robinson, 16 April 2018, p 1.

4.3 Requiring retailers to pay a higher feed-in tariff would increase bills for all customers

If we were to set benchmarks for solar feed-in tariffs higher than the financial value of customers' solar exports to retailers, as many stakeholders suggested, it is highly likely that retailers would simply ignore these benchmarks. As Chapter 1 noted, offering solar feed-in tariffs is voluntary for retailers, and our benchmarks provide guidance on what tariffs are appropriate and reasonable.

But if retailers were **required** to offer a minimum feed-in tariff equal to our benchmark, we consider this benchmark should not exceed the financial value of solar exports to retailers. This is because setting tariffs higher than this value would result in:

- higher costs to retailers, which they would then need to recover from all customers, or
- retailers choosing not to supply solar customers, which would reduce competition for solar customers.

This would be contrary to our Term of Reference, which states:

> In conducting this investigation the IPART is to consider the following key parameters:
>
> - There should be no resulting increase in retail electricity prices.
> - The benchmark range should operate in such a way to support a competitive market in NSW.

Climate Change Balmain-Rozelle submitted that one interpretation of our Terms of Reference is that the feed-in tariff should not contribute to retail electricity prices that are 'higher than if there were no PV feed-in'.[39] It suggested that the feed-in tariff should be set at the wholesale prices that **would have** occurred had solar not been exporting to the grid. However, we consider that it is clear from the Terms of Reference that the **benchmark** should not result in retail prices that are higher than what they otherwise would be.

For example, if we set the solar feed-in tariff at 15 c/kWh, and all retailers were required to pay this to their customers, we estimate that retailers costs' would be $52 million higher a year across NSW compared to our benchmark feed-in tariff (where retailers' would incur no additional costs from paying customers for their exports instead of buying this electricity from the wholesale market). We have estimated that to recover these additional costs, the average annual household bill would need to increase by $19.[40]

In effect, setting solar feed-in tariffs higher than our benchmarks would result in households **without** solar panels paying higher electricity bills so that customers **with** solar could receive more for their solar exports. This would disadvantage the households who are unable to install a solar system (for example, because they rent or they cannot afford the upfront costs).

We also note that currently, average annual bills for solar customers are an average of $450 lower than customers without solar panels, **before** revenue earned from solar feed-in tariffs (see Box 4.2). This represents an ongoing saving to these customers after their payback period (which is currently approximately 6-8 years).

---

39 Climate Change Balmain-Rozelle submission to IPART Issues Paper, April 2018, p 2.
40 See footnote 3 for information on our estimation methodology.

Box 4.2 Bills for households with solar panels are significantly lower

The average electricity bill for a solar customer with a 2-kW system is around $1,550 per annum, compared to $2,100 for households without panels. Solar customers can save around $450 a year by using the solar energy they generate themselves (rather than purchasing it from their retailer), in addition to receiving any solar feed-in tariff from their retailer (an average of around $100).

Solar customers also receive an upfront subsidy for installing their panels under the Small-Scale Renewable Energy Scheme (SRES). For a 2-kilowatt solar system installed in Sydney, the subsidy is currently worth around $1,050 to $1,330. After this subsidy, the upfront costs of a solar system are around $3,400. The payback period for these upfront costs is around 6 years.

Following the payback period, the customer is able to make ongoing savings off their bills for the remaining life of the panels (around 19 years).

Even without any feed-in tariff, this customer would still pay off their panels in around 7.5 years. Similarly, if the upfront subsidy were removed, the payback period would be 8 years, with a remaining life after payback of almost 17 years.

Note: The values for financial incentives under the SRES assume the solar unit is installed in Sydney on 24 April 2018. The dollar range is based on certificate prices of $30 and $38. Assumes a solar panel life of 25 years.

Source: Clean Energy Regulator, *Small generation unit STC calculator*, https://www.rec-registry.gov.au/rec-registry/app/calculators/sgu-stc-calculator, accessed 24 April 2018; Green Electricity Markets, *STC Market Prices,* http://greenmarkets.com.au/resources/stc-market-prices, accessed 24 April 2018. Solar Choice, *Current Solar System Prices: Residential and Commercial, https://www.solarchoice.net.au/blog/solar-power-system-prices*, accessed 24 April 2018.

4.4 Customers already receive a subsidy for the external benefits of solar when they install a solar system

A large number of stakeholders, mostly individual owners of solar panels, submitted that the solar feed-in tariff should be higher to reflect the environmental and health benefits that all solar electricity generation provides to the broader community.[41] Some stakeholders noted that the Essential Services Commission is required to include a value for avoided social costs of 2.5 c/kWh when it sets feed-in tariffs for Victorian solar customers.[42]

We have not included a value for environmental, health benefits or other externalities in the benchmark range for two main reasons. First, the subsidies that customers receive under the Australian Government's Small-Scale Renewable Energy Scheme take account of community wide benefits of clean renewable energy (Box 4.3). On average, all NSW households pay around $15 each year through their bills to fund the Small-Scale Renewable Energy Scheme subsidy.[43]

Second, retailers don't capture avoided externalities associated with solar energy. If a value for these benefits were included in feed-in tariffs, retailers would need to recoup this amount from their customers (including those without solar panels) through higher retail prices.

41 For example, see submissions to IPART Issues Paper from J Scarborough, April 2018, p 1; I Noakes, April 2018, p 1.

42 For example, see submissions to IPART Issues Paper from P Youll, April 2018, p 1, R Cace, April 2018, p 1.

43 AEMC, *2017 Residential electricity price trends Final Report*, 18 December 2017, p 100.

Box 4.3 Financial incentives under the Small-Scale Renewable Energy Scheme

The aim of the Small-Scale Renewable Energy Scheme is to reduce emissions of greenhouse gases and encourage the additional generation of electricity from sustainable and renewable sources. This scheme works by allowing the owners of small-scale systems to create small-scale technology certificates for every megawatt hour of electricity they generate. Certificates are then purchased by electricity retailers and submitted to the Clean Energy Regulator to meet the retailers' legal obligations under the Renewable Energy Target. This creates a market which provides financial incentives to the owners of small-scale renewable energy systems.

Small-scale technology certificates can be created following the installation of an eligible solar system and are calculated based on the amount of electricity a system produces or replaces (that is, electricity from non-renewable sources). Generally, households who purchase an eligible solar system assign the certificates to an agent in return for a lower purchase price.

For example, the financial incentive under the Small-Scale Renewable Energy Scheme is currently worth around:

- $1,050 to $1,330 for a 2 kW solar unit
- $1,590 to $2,014 for a 3 kW solar unit
- $2,670 to $3,382 for a 5 kW solar unit

Financial incentives under the Small-Scale Renewable Energy Scheme are gradually being phased out over the period 2017 to 2030.

Note: The examples above assume the solar unit is installed in Sydney on 24 April 2018. The dollar range is based on certificate prices of $30 and $38.

Source: Clean Energy Regulator, http://www.cleanenergyregulator.gov.au/RET/About-the-Renewable-Energy-Target, accessed 3 May 2018; Small generation unit STC calculator, https://www.rec-registry.gov.au/rec-registry/app/calculators/sgu-stc-calculator, accessed 3 May 2018; Deeming period decline, http://www.cleanenergyregulator.gov.au/RET/Scheme-participants-and-industry/Agents-and-installers/deeming-period-decline, accessed 3 May 2018.

4.5 We have not included potential network benefits in the benchmark

Many stakeholders called for the feed-in tariff benchmark to include a value for the potential to defer investment in the networks.[44] For example, PIAC submitted that we should consider the localised transmission and sub-transmission networks that peak early in the afternoon, particularly those that feed into industrial locations. PIAC submitted that in these networks, solar exports have a material impact on reducing peak demand.[45]

We have not included potential network benefits in the benchmark because they are likely to be highly variable between locations. We agree that in some parts of the network, solar can produce network benefits, but in many other parts of the network, the peak occurs when the sun has set, and so solar does not help reduce congestion and defer network investment.

The value of network benefits was most recently considered by the Victorian Essential Services Commission (ESC) in 2017. It found that distributed generation such as solar can and does provide network value. It creates this value when it reduces peak electricity

44 For example, see submissions from D Robinson, April 2018, p 1.
45 PIAC submission to IPART's Draft Report, June 2018, p 2.

demand within the network in a predictable way, allowing network businesses to defer augmentation projects on parts of the network that are congested or nearing congestion.[46]

However the ESC found that network value was markedly different even between neighbouring zone substations. For the majority of locations across Victoria in 2017, distributed generators provide no network benefits or provide less than $1 per kilowatt of installed solar capacity of value.[47] In these parts of the network, solar exports are unlikely to defer network costs, because these parts of the network are not congested, and/or they do not contribute to meeting peak demand. In particular, solar exports are not able to provide material network value if a zone substation area experiences peak demand during the evenings or at night.[48] However, the ESC found that distributed generation would be significantly more valuable if it was supplemented with batteries and control systems to allow the timing of exports to be optimised to coincide with peak demand.[49]

The ESC concluded that the potential network benefits are too variable between locations, across times, and between years to be well suited for remuneration via a broad-based tariff. A broad-based payment could lead to payments to distributed generators who were not providing benefits while, at the same time, not sufficiently rewarding those who were.[50]

Valuing the costs of distributed generation was outside the scope of its review, but the ESC noted distributed generation may also impose costs on the network, including reinforcing the network to handle bi-directional flows on parts of the network where a substantial volume of distributed generation has been installed.[51]

The AEMC also considered the network benefits of distributed generation in 2016 in response to a proposed rule change to introduce a new payment mechanism from networks to small-scale embedded generators (like solar) to account for network benefits.[52] The AEMC found that the costs of a mechanism outweighed the benefits even in areas where there was projected network congestion. Like the ESC, it found that a broad-based tariff would not reflect the highly specific impact of embedded generation on network costs. As a result it did not amend the rules.[53]

A recent report released by AEMO and the Energy Networks Association on how best to transition to a two-way grid that allows better integration of Distributed Energy Resources (which includes solar panels) for the benefit of all customers notes that while distributed generation can provide network benefits it also presents many challenges that require active management by both networks and the market system operator.

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46 ESC, *The network value of distributed generation – Distributed generation inquiry stage 2 Final Report*, February 2017, pp 35-36, 45.

47 Ibid, p 45.

48 Ibid, p 57.

49 Ibid, pp 63-65.

50 Ibid, p XXII.

51 Ibid, p XVIII.

52 The National Electricity Rules contains mechanisms to provide payments to embedded generators to reflect the benefit they provide to the transmission network where they provide reliable reductions in peak demand on the transmission network. However, these mechanisms are designed for larger embedded generators, and may be less accessible for small-scale solar customers.

53 AEMC, *National Electricity Amendment (Local Generation Network Credits) Rule 2016 – Final Rule Determination*, 8 December 2016, pp vi-vii.

Because the solar exports of one household are unlikely to significantly impact the system, the report proposes that larger aggregators would need to sign up many customers and deliver their combined power to the system. Facilitating households with solar to form a virtual power plant (VPP), could also provide services like peaking generation, which increases competition and lowers costs for all customers. However rules around the operation of the market would need to be updated to facilitate this.[54] In addition, to assist potential aggregators of households with solar, more visibility of the local network conditions is required.

We also considered whether the solar feed-in tariff benchmark should include a value for avoided transmission usage charges because solar exports are not transported through the transmission networks. However, retailers are billed for network charges (the transmission charges are included in the distribution charges) on all electricity that they supply to their customers, regardless of its source. Because retailers do not receive any transmission-related savings when individual customers export solar electricity, including a value for avoided transmission costs would mean that retailers would pay more for solar exports than for purchasing electricity on the NEM, and they would have to recoup this cost through higher prices.[55]

4.6 Customers should be paid the market value for the electricity they generate

Solar generation has contributed to reduced demand for electricity from retailers during daylight hours, which has contributed to lower prices during these times. Under our approach, the solar feed-in benchmark falls in line with wholesale costs, to reflect the lower savings to retailers that they make when they supply their customers using solar exports.

However, many stakeholders argued that reducing the solar feed-in tariff benchmark would be effectively punishing solar panel owners for their contribution in helping to reduce the wholesale power price for all consumers. For example, stakeholders submitted that:

> Rooftop solar has reduced the wholesale price of power for everyone. This is even more of a reason to pay solar owners a fair price, not punish people who've done the right thing.[56]
>
> It is unacceptable to penalise solar panel owners by lowering the Fit when they have done such a great job in lowering the cost of electricity for all Australians![57]
>
> It is laughable that IPART would blame household generated electricity for lowering the price of electricity and punish them by lowering the feed-in tariff! Surely it is a good thing to have lower electricity prices and we should look elsewhere for the party or parties to blame for the high price of electricity.[58]

54 AEMO and ENA, *Open Energy Networks - Consultation on how best to transition to a two-way grid that allows better integration of Distributed Energy Resources for the benefit of all customers*, June 2018, pp 3-5.

55 Similar to avoided transmission charges, even where solar exports do create network benefits, retailers do not capture these benefits. This means that including a value for network benefits in solar feed-in tariffs would increase electricity prices for all customers.

56 Submission to IPART Issues Paper from D Humphries, April 2018, p 1.

57 Submission to IPART Draft Report from G Olsen, May 2018, p 1.

58 Submission to IPART Issues Paper from A Jacobs, April 2018, p 1.

Similarly, other stakeholders argued that because solar exports have contributed to the lower wholesale prices upon which our solar feed-in benchmark is based, that solar customers should receive some of this benefit,[59] or that it should be 'cushioned' against the falling wholesale price.[60] Sunny Shire submitted that:

> Rooftop solar is already reducing wholesale electricity prices. Feed-in tariffs should also reflect this impact, and take into account future high prices when Liddell closure happens in 2022, if more investment in energy generation does not occur.[61]

Any new generator (or new customer) entering or exiting the electricity market would change the balance of supply and demand, and thus could lead to lower or higher wholesale electricity prices. Such a generator (or customer) would not be compensated for this impact. For example, a new generator that contributes to a reduction in wholesale spot prices does not receive any additional payment to reflect the lower wholesale price. It takes the same market price as all other generators, and so all customers benefit from the price reduction. Likewise, a customer who consumes electricity by switching on an appliance and thereby increasing the market demand for electricity, and electricity prices for all customers, is not required to compensate other customers for these higher prices. These are just normal outcomes of a competitive market.

At our public hearing, EnergyAustralia submitted that the impact of paying small-scale solar customers more than the market price of electricity would also unfairly disadvantage large-scale commercial solar generators. It stated that:

> Why would we want to encourage households and other businesses to install solar panels more so than to create solar farms? Both small-scale photovoltaic generation and commercial solar generation currently receive additional subsidies to encourage renewable generation, and that is fine, but when you are talking about what a retailer is paying for that generation, it is very, very similar, and additional subsidies are usually paid via different mechanisms and they can be quite complex.[62]

In addition, while in the short term solar exports can put downward pressure on prices, in the medium and longer term, they can contribute to higher and more volatile prices, particularly after the sun has set. This is because the reduction in wholesale prices as a result of additional supply from solar exports during the day means that over time, higher cost generators may not recover their operating and maintenance costs. In the medium-term, this may result in their exit from the market, increasing prices.

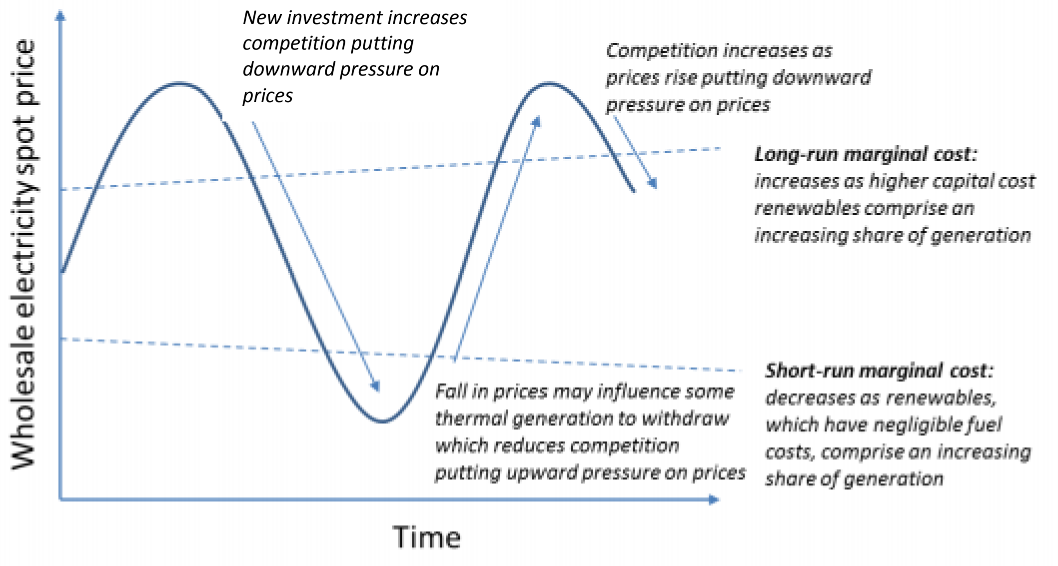
As shown in Figure 4.2, the AEMC describe a process of:

- Prices cycling up and down over time, with higher peaks and lower troughs. Long-run marginal cost (LRMC) increases over time as new renewable generation has higher capital costs than the existing capital stock of generation across the electrical system. Short-run marginal cost (SRMC) decreases over time as renewable generation has lower operating costs than the existing stock of generation.
- Greater variability results from the intermittent nature of renewable generation, which comprises an increasing share of generation. It can also increase contract premiums as intermittent

59 For example, see submissions to IPART Issues Paper from G Lockhart, April 2018, p 1, J Tager, April 2018, p 1, L Johnson, March 2018, p 2.
60 Submission to IPART Issues Paper from, P Keig, April 2018, p 1.
61 Submission to IPART Issues Paper Sunny Shire, April 2018, p 2.
62 EnergyAustralia, Transcript of Public Hearing on IPART's Draft Report, 15 May 2018, p 9.

renewable generators are not in a position to offer firm contracts, which reduces the supply of contracts.[63]

Figure 4.2 Effect of increasing renewable generation on medium term wholesale electricity price dynamics



Data source: Adapted from the AEMC, *2017 Residential electricity price trends, Final report*, December 2017, p 23.

63 AEMC, *2017 Residential electricity price trends, Final report*, December 2017, pp 22-23.

5 How we forecast the average wholesale electricity price

As Chapter 4 set out, the first step in our approach for setting benchmark solar feed-in tariffs for 2018-19 was to estimate the forecast average wholesale electricity price on the NEM for the year. This step involved:

- sourcing publicly available price data from NSW baseload electricity futures contracts for the 12 months of 2018-19 year traded on the Australian Stock Exchange (ASX),
- averaging this data over 40 trading days as at 15 May 2018,
- including a range of +/-10% around this average to recognise the forecasting uncertainty around wholesale prices, and
- adjusting each end of the range down by 5% to reflect that contracts typically trade at a premium to spot prices.

The sections below provide an overview of our estimated average wholesale spot price, and then discuss each part of the step in more detail.

5.1 Overview of forecast average wholesale electricity price

We forecast that the average wholesale electricity price for 2018-19 is 6.8 to 8.3 c/kWh (Table 5.1). This is substantially lower than our forecast for 2017-18 of 11 c/kWh.

Table 5.1 Estimated average wholesale price for 2018-19 compared to 2017-18 (c/kWh)

	2017-18 (final)	2018-19 (draft)	2018-19 (final)
ASX baseload forward contract (40-day average) price	11.6 c/kWh	7.8 c/kWh	7.5 c/kWh [a]
% range for uncertainty	-	-	+/-10%
Adjustment to removed contract premium	5%	5%	5%
Estimated average wholesale spot price	**11 c/kWh**	**7.4 c/kWh**	**6.8 to 8.3 c/kWh**

Note: Final wholesale price as of 15 May 2018.

Data source: Data from Thomson Reuters Eikon.

This reduction in wholesale costs from 2017-18 is consistent with the forecasts in the AEMC's 2017 Residential electricity price trends report:

> The trend in wholesale costs in 2018/19 and 2019/20 is downwards and is driven by:
>
> - approximately 4,100 MW of new committed and expected (modelled) generation entering the NEM in 2018/19 and 2019/20
> - the return to service of the Swanbank E gas power station (385 MW) in early 2018
> - reduced short-run costs for South Australian gas plants in 2019/20 due to the pass through of certificate revenue related to the Energy Security Target.[64]

5.2 We will continue to average ASX forward contract prices over 40 days

As in other years, we have used publicly available data to forecast the average wholesale price. We consider the baseload futures contracts published by the ASX are the best source of publicly available data on future wholesale electricity prices. These are contracts to trade a fixed amount of electricity for a certain price at all times of the day. They represent the market's view of **average** wholesale electricity spot prices. Most trade and liquidity in these contracts is around 12 to 24 months out[65] and, as they are exchange-traded and publicly reported, there is more price transparency relative to trades that occur on a confidential basis directly between counterparties.

However, a key issue for the review was the length of the period that we use to average the ASX baseload electricity forward contract prices. We forecast wholesale electricity prices using the ASX baseload electricity contract prices for the 12 months for 2018-19 using the 40-day average of these prices to 15 May 2018. This data reflects the prices currently being paid to purchase baseload electricity contracts based on expectations of what this electricity will be worth for the next financial year using the latest available information.

Red Energy and Lumo agreed with this methodology,[66] but many stakeholders, including EnergyAustraila, AGL, Origin, and PIAC, submitted that our methodology, which takes an average of the forward contract prices over the most recent 40 days, drives substantial volatility in the wholesale price estimates between years, leading to fluctuating solar feed-in bencharks.[67] Stakeholders considered that averaging contract prices over a longer period would reduce this volatility. Origin submitted that:

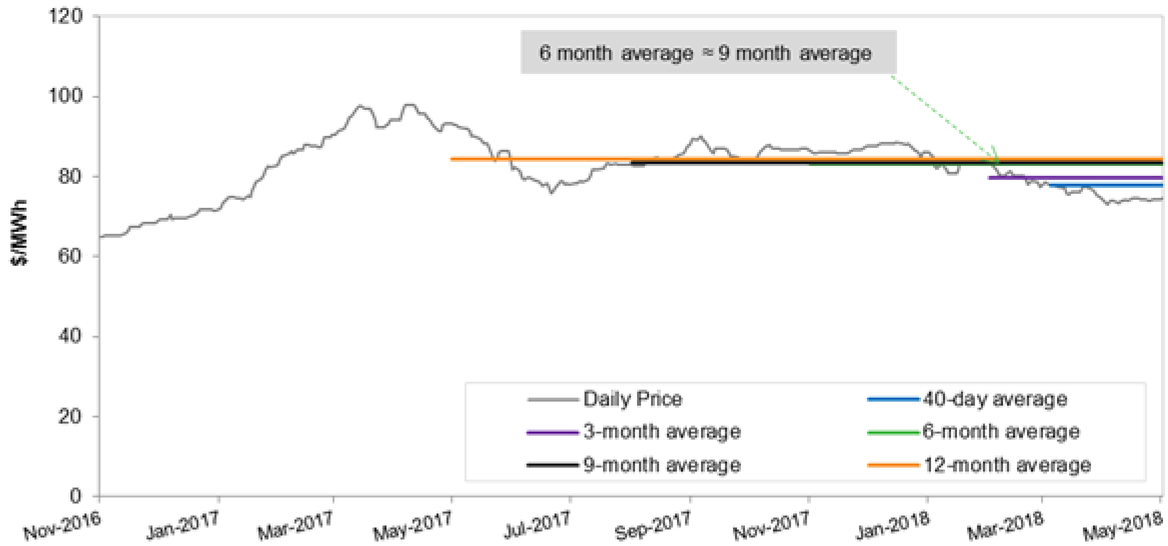
> You are likely to get less volatility in the solar feed-in tariff that a customer receives year on year. Last year we saw, under the methodology, a high wholesale prices was forecast, so the feed-in tariff leapt up, and this year it will fall a great deal. I think this is difficult for customers to adjust to when their exports are pretty much the same. This proposal would therefore have a smoothing effect on the tariff overall.

EnergyAustralia considered that the forward contract prices averaged over six months would be preferable to 40 days.

64 AEMC, *2017 Residential electricity price trends Final Report*, December 2017, p 19.
65 Australian Energy Regulator, *State of the Energy Market 2017*, May 2017, p 60.
66 Red Energy and Lumo, submission to IPART Issues Paper, April 2018, p 2.
67 Submission from AGL to IPART Draft Report, June 2018, p 1, Submission from Energy Australia to IPART Draft Report, June 2018, p 2, Submission from PIAC to IPART Draft Report, June 2018, p 2.

Figure 5.1 shows the impact of different averaging periods on our forecast of wholesale prices for 2018-19. A longer averaging period would result in a higher estimate of wholesale prices for next year. Using a longer averaging period for our estimates of wholesale prices would have reduced some volatility between years, but there would have still been substantial price fluctuations. This reflects underlying wholesale price volatility.

Figure 5.1 Forecast average wholesale electricity prices for 2018-19 using different averaging periods



Note: Averages are calculated as of 15 May 2018, and include a 5% contracting premium.

Data source: Data from Thomson Reuters Eikon.

Origin also submitted that averaging the contract prices over a longer period would better reflect how retailers purchase their electricity. It submitted that:

> The issue I see is that does not really reflect how a retailer purchases energy…That is why I would suggest that IPART looks at the wholesale forward prices over a period of time, say somewhere between, 12 months to two years, 18 months, around that sort of period. That better reflects the way most retailers will purchase their energy and, therefore, better reflects the benefit or avoided costs that a retailer has when it takes solar exports going forward.[68]

After considering submissions from stakeholders, we have decided to maintain the approach that we have taken in previous reivews, which is to take a forward looking approach to valuing electricity in 2018-19, based on our expectations of spot prices.

We acknowledge that in practice retailers might contract for future years in advance. But those contracts are worth only what the market would pay for them now. A retailer might have entered into forward contracts for energy in 2018-19 over the past two years. However, if the retailer wanted to unwind that position today, it wouldn't get what it paid for the contracts - it would get what the market thought that they were worth today. This is also the price that a new entrant would pay.

68 Origin, Transcript of Public Hearing on IPART's Draft Report, 15 May 2018, p 8.

This approach is based on a 'mark-to-market' (or 'point-in-time') approach, which we have consulted on over a number of years. A point-in-time approach is based on the principles of setting prices that reflect outcomes in a competitive market. In particular, a point-in-time approach reflects that:

- Economic decisions should be based on the current value of assets, rather than their historic value.
- The extent to which retailers have entered into contracts in the past that are either cheaper or more expensive than today's contract prices are sunk costs. A competitive market would not allow a retailer to recover the costs of 'out of the money' contracts.
- Retailers' decisions around what retail price to offer customers should reflect expectations of the cost of supplying that customer and not the consequences of prior decisions.

We maintain that the forward contracts should still be averaged over the most recent 40 days, because this information captures the most up to date expectations of the value of electricity for the forward period. Averaging it over a longer period would include expectations of the market based on out of date information that may no longer be relevant.

This approach is also consistent with how we estimated energy purchase costs when we regulated retail electricity prices, and the approach we currently use to determine market-based weighted average cost of capital (WACC) parameters.

5.3 Our estimate of wholesale prices recognises forecasting uncertainty

While we will maintain the 40-day averaging period for ASX baseload electricity contracts, we have decided to include a range of +/-10% around this average to recognise the forecasting uncertainty around wholesale prices. Even though these are the prices currently being paid in the market based on the expectations about actual prices, there is likely to be some variation between the prices paid on the forward market and actual spot prices.

5.4 Adjusting to reflect the contract premium

ASX futures contract prices typically trade at a premium to underlying spot prices. Because we are interested in wholesale electricity spot prices in the coming financial year, we need to make some adjustment to average contract prices. However, the contract premium cannot be directly observed. We have assumed a contract premium of 5%, consistent with the approach taken in previous years. We also used this same assumption when we regulated retail electricity prices.

We have received expert advice from Frontier Economics that 5% continues to be a reasonable assumption based on its recent analysis.[69]

69 Frontier Economics, *2018 Solar Feed-in Tariff Review – A Final Report prepared for IPART*, March 2018, p 15.

6 How we estimated the solar multiplier

As Chapter 4 discussed, the next step in our approach for setting our benchmark range for solar feed-in tariffs for 2018-19 was to multiply our forecast average wholesale electricity range by a 'solar multiplier'. To estimate this multiplier, we:

- used the same modelling approach as we have in previous years
- considered only the most recent three years of historical data (2014-15 to 2016-17) in this model in response to a sustained shift in when high wholesale prices occur in the market (in previous years we used data back to 2009-10).
- continued to use data from Ausgrid's area of operation only.

The sections below provide an overview of the solar multiplier, and then discuss each part of the step in more detail.

6.1 Overview of the solar multiplier for 2018-19

We have estimated that the solar multiplier across the whole day is 0.99, which means that we forecast that the value of solar exports will be around the same as the average wholesale price of electricity.

Our estimate of the solar multiplier is lower than for previous years. For example, for 2017-18, we estimated a solar multiplier of 1.14, which meant that the value of solar exports would be 14% higher than the average wholesale price across the day.

Our 2018-19 estimate reflects that in recent years, wholesale electricity prices have been relatively lower during daylight hours compared to the average price. This is largely because the demand for electricity from the National Electricity Market (NEM) is lower during these hours because a proportion of total demand is being met by solar generation.

6.2 We used the same modelling approach as previous years

We have estimated the solar multiplier as the ratio of the solar output-weighted wholesale electricity price to the time-weighted wholesale electricity price, where:

- the solar output-weighted electricity price is the average price across the year weighted by how much solar is exported at the time, and
- the time-weighted electricity price is the arithmetic average price across the year.

The solar output-weighted price is calculated by taking the spot price in each of the 17,520 half hours in the year (48 per day, 365 days a year), multiplying each price by the proportion of exports that occurred in that half hour, and summing the result. The time weighted price is simply the average price across those 17,520 half hours in the year. Box 6.1 shows a stylised example of this calculation.

Box 6.1 Stylised example of how we calculate the solar multiplier

Assume that the spot price is set in the electricity market four times across the day, and there are only three days in a year, so that there are only 12 prices in the year. The first spot price that occurs each day is for the morning, the second is for the afternoon (when the majority of exports occur), the third is in the evening (when exports are very low), and the fourth is at night (when the solar exports are negligible).

The first two days in this example are sunny days, and the third is cloudy (and so the proportion of exports over this day is lower).

		Price	Proportion of exports	Price x proportion of exports
Day 1	Spot price 1 (morning)	$60	15%	$9
	Spot price 2 (afternoon)	$80	20%	$16
	Spot price 3 (evening)	$200	0.5%	$1
	Spot price 4 (night)	$50	0%	$0
Day 2	Spot price 5 (morning)	$50	16%	$8
	Spot price 6 (afternoon)	$150	25%	$38
	Spot price 7 (evening)	$150	0.5%	$1
	Spot price 8 (night)	$40	0%	$0
Day 3	Spot price 9 (morning)	$90	8%	$7
	Spot price 10 (afternoon)	$100	14%	$14
	Spot price 11 (evening)	$120	0.5%	$1
	Spot price 12 (night)	$50	0%	$0
Solar exported weighted price			100%	**$94**
Average (time-weighted price)		**$95**		
Solar multiplier (solar weighted price / average price)				**0.99**

Source: IPART

As we have done in our previous reviews, we have used a simulation process based on the Monte Carlo method to estimate the solar multiplier, using historical half-hourly spot prices in the NEM for NSW and half-hourly solar export data. This method generates 5,000 ‘synthetic years’ and calculates a solar multiplier for each ‘synthetic year.’

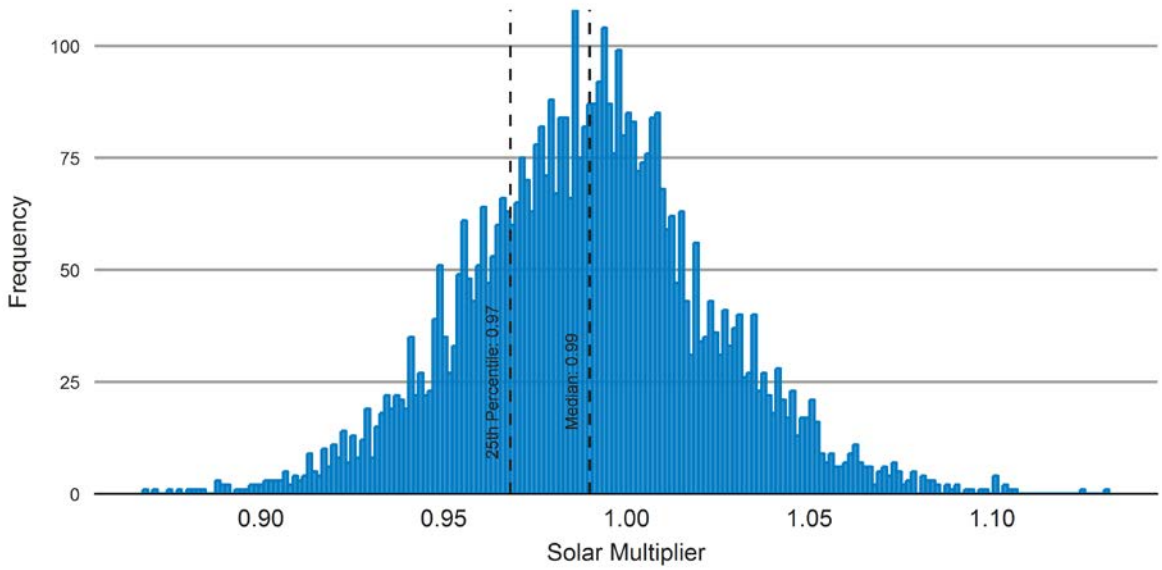
The purpose of using the Monte Carlo method is to generate a distribution of solar multipliers and identify the range of possible outcomes and the probabilities they will occur using the probability distribution. By using a range of possible values, instead of a single estimate, we can create a more realistic picture of what might happen in the future. Like any forecasting model, the simulation only represents probabilities and not certainty.

To generate each synthetic year, we randomly pick comparable days from previous years of data for 365 days to make up the year. For example, using three years of historical data, a synthetic year could be made up of 100 days from year 1, 200 days from year 2, and 65 days of year 3. Comparable historical days must be for the same day name and from the same quarter. For example, a Monday in January in the synthetic year could come from any Monday between January and March from the historical data, and a Saturday in August could come from any Saturday between July and September.

For each 'synthetic year' there will be 17,520 spot prices for each hour, and the proportion of solar exports for each half hour (with the total exports adding to 100% for the synthetic year).[70] To calculate the solar output-weighted electricity price for that year, the spot price for each half hour in that year is multiplied by the proportion of solar exports that occurred in that half hour, and the result is summed. This is divided by the average spot price in that year to calculate the solar multiplier.

Because we do this 5,000 times (once for each synthetic year), we can generate a distribution of the solar multipliers for each synthetic year. Figure 6.1 shows the distribution of solar multipliers for the 5,000 synthetic years when we used historical price and export data between 2014-15 and 2016-17. It shows that **the median solar multiplier from this distribution was 0.99 –** for around 50% of the synthetic years, the solar multiplier was less than 0.99, and for 50% of the synthetic years it was greater than 0.99.

Figure 6.1 Example distribution of solar multipliers (Ausgrid data 2014-15 to 2016-17)



Data source: IPART

We would set the solar multiplier equal to the median if we consider that the input data is not likely to inherently understate or overstate the results. Otherwise we can choose another point on the distribution. For example, in previous years we set the solar multiplier based on the 25th percentile because we considered that prices for several years that were included in the historical set (2009-10 and 2010-11) were unusually high in the middle of the day compared to other years, and market evidence suggested that these prices would be unlikely

70 For each half hour, we use the total (or average) solar exports in kilowatt hours for each of the 500 customers in the sample. The total exports for the 500 customers adds to different amounts each year, but for our modelling, we normalise each year to 1 GWh per annum. This is because some years comprising the sampling pool could have more solar electricity exported than other years – for example, due to weather conditions.

to reoccur. This meant that a median solar multiplier calculated from this data would overstate the likely solar multiplier for future years.[71]

Solar multipliers can also be calculated for discrete time periods across the day (for example for any two-hour period). We can do this by dividing the average price in the discrete period (weighted by solar output) by the average price across all periods in the day.

6.3 We used the last three years of historical data

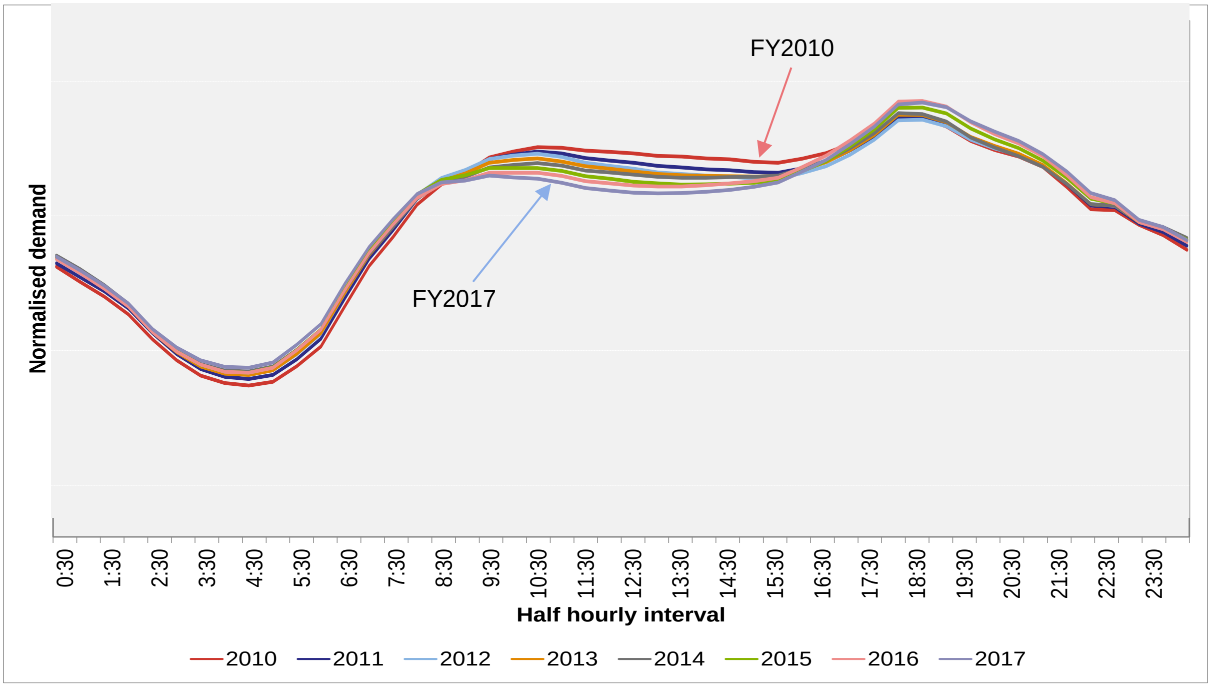
In selecting the historical data that we use in our Monte Carlo modelling, we firstly considered whether future years will continue to be like previous years. We found that there has been a sustained shift in when high wholesale prices occur in the market, which makes it unlikely that our full eight-year historical wholesale price and solar export data set from 2009-10 to 2016-17 is the best estimate of this relationship for 2018-19.

Demand has fallen during daylight hours, due to increased penetration of solar systems. Around 13% of all households in NSW (around 350,000 households in total) now have solar panels.[72] Figure 6.2 shows that in the middle of the day, demand has progressively reduced during daylight hours between financial years 2010 and 2017. As a result of this falling demand, wholesale prices have not peaked in the afternoon since 2009-10 and 2010-11, reducing the value of solar energy compared to the average price.

71 IPART, *Solar feed-in tariffs - The subsidy-free value of electricity from small-scale solar PV units in 2015-16*, Final report, October 2015, p 2.

72 Based on information from the networks on number of solar customers, and ABS 2016 Census data and New South Wales Department of Environment and Planning for number of households (4% growth assumed since 2016 based on average annual growth 2016-2021). See ABS, '2016 New South Wales (STE) Community Profile', cat. No 2001.0, Table G32, http://www.abs.gov.au/websitedbs/D3310114.nsf/Home/2016%20Census%20Community%20Profiles; http://www.planning.nsw.gov.au/Research-and-Demography/Demography/Population-projections.

Figure 6.2 Average daily demand shape in NSW for 2009-10 to 2016-17



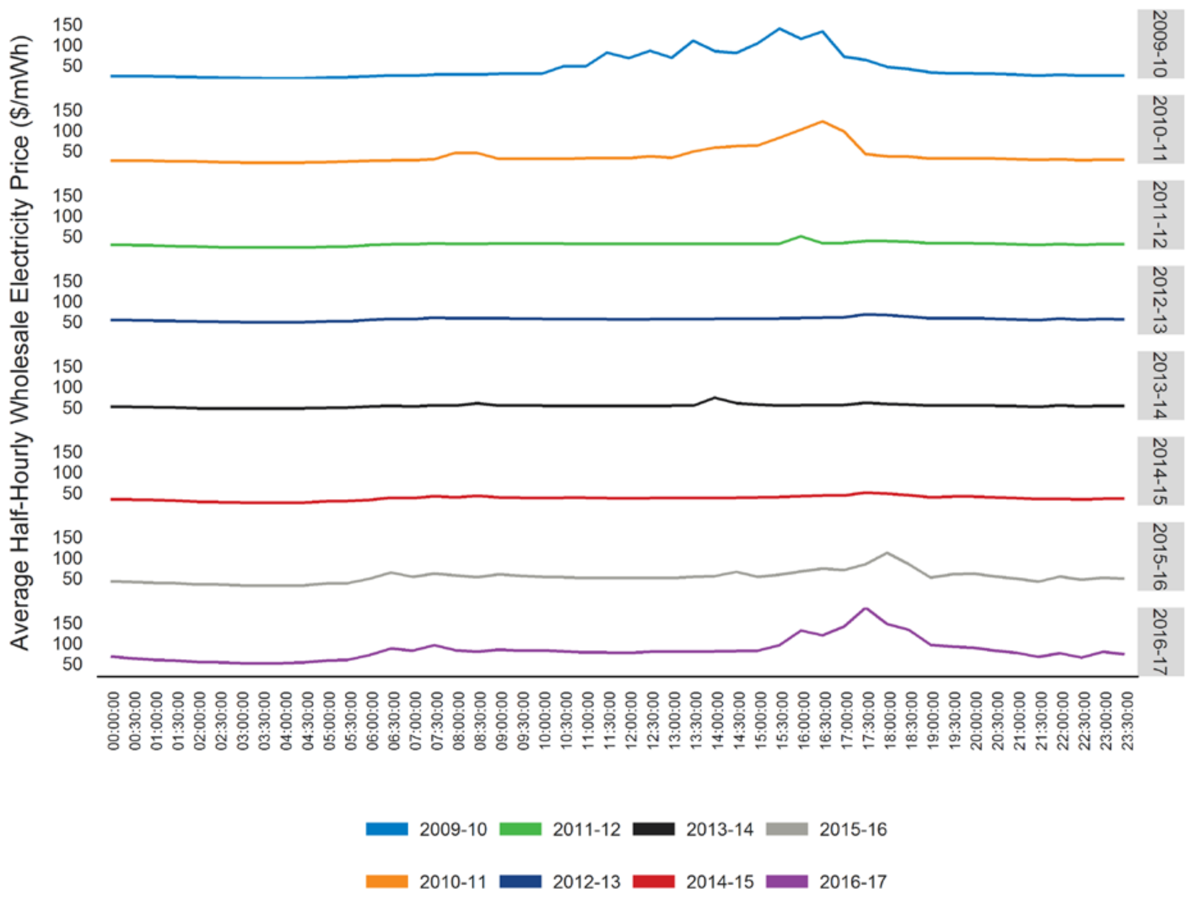
Note: Data has been normalised to keep the **total** output in each year constant to show the shift in *when* electricity is being consumed.

Data source: Frontier Economics, 2018 Solar Feed-in Tariff Review – A Final Report prepared for IPART, March 2018, p 19.

At the same time the demand-supply balance has tightened in the evening peak. This has become particularly pronounced with the withdrawal of the Hazelwood power station in March 2017. As a result, higher cost gas-fired peaking plant sets wholesale prices more regularly during the late afternoon peak, causing price spikes during this time. This contrasts with the very low levels of price volatility between 2012-13 and 2014-15. As a result of this shift, the value of solar exports in the late afternoon is substantially higher relative to the average price.

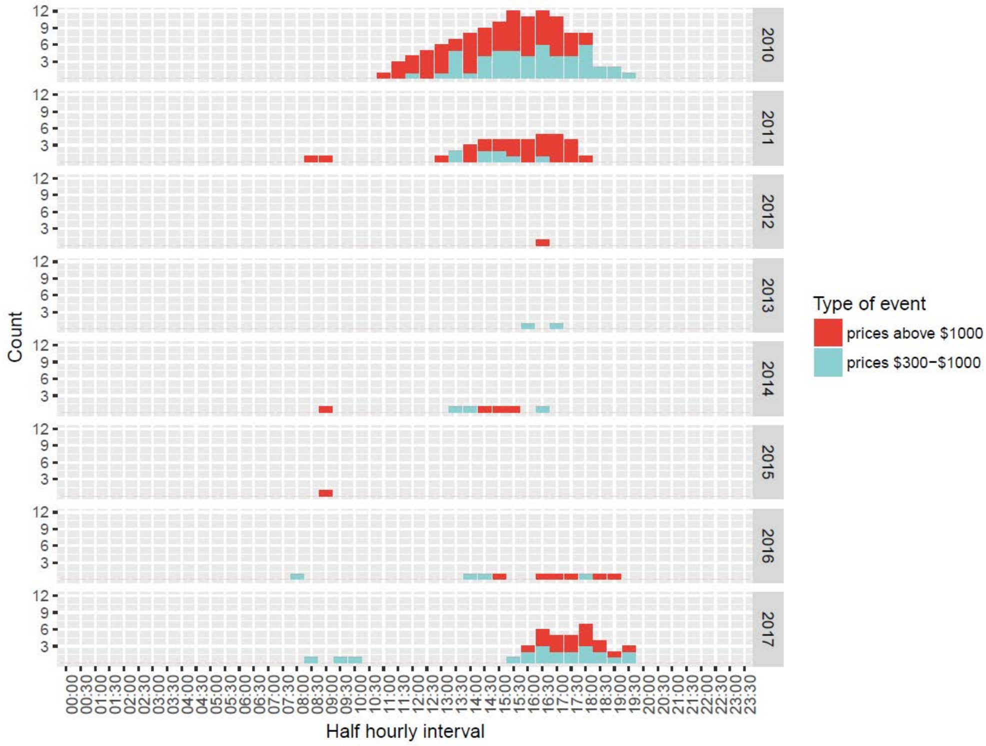
The impact of the sustained shifts when high wholesale prices occur can be seen in Figure 6.3 and Figure 6.4. They show that prices in the middle of the day have fallen relative to other times, while prices in the late afternoon have increased significantly.

Figure 6.3 Average price by time of day in NSW (2009-2010 to 2016-17) ($ nominal)



Data source: IPART, based on AEMO data.

Figure 6.4 High price events in NSW for 2009-2010 to 2016-17 ($ nominal)



Data source: Frontier Economics, *2018 Solar Feed-in Tariff Review – A Final Report prepared by IPART*, March 2018, p 25.

We also considered stakeholder comments on our Issues Paper and Draft Report. AGL submitted that it agrees with IPART's assessment of the key drivers of the wholesale market such as the exit of the Hazelwood power station, high gas prices, and the uptake of solar panels.[73]

AGL also recommended that the data used should be no more than 5 years old, as recent changes in the wholesale market means the use of older data is unlikely to be representative of future patterns.[74] Sunny Shire also argued that the use of historical data may not provide an accurate view of wholesale electricity price patterns, given rapid changes in the electricity generation market.[75] However, Simply Energy recommended the inclusion of data from 2011 onwards (using the 25th percentile) as this would represent the best estimation of conditions for modelling purposes.[76]

Overall, we concluded that that the supply conditions in 2018-19 are likely to be most similar to 2016-17 (the most recent year of data). In particular, the exit of the Hazelwood power station has tightened demand-supply conditions, affecting prices in the evening, and this is likely to continue into 2018-19 (although new generation capacity entering the market in 2018-19 may start to put some downward pressure on evening peak wholesale prices).

However, supply is not the only determinant of wholesale prices. Factors such as weather can have a significant impact on demand (and therefore wholesale prices), and can fluctuate

73 AGL submission to IPART Issues Paper, April 2018.
74 Ibid, p 1.
75 Sunny Shire submission to IPART Issues Paper, April 2018, p 2.
76 Simply Energy submission to IPART Issues Paper, April 2018, p 1.

from year to year. Other one-off events such as power plant outages may also be inconsistent between years, and so are more accurately captured with several years of data.

Therefore, to balance these supply and demand factors, we have calculated separate solar multipliers using the Monte Carlo simulation for:

- the most recent year of data (2016-17),
- the most recent two years of data (2015-16 to 2016-17), and
- the most recent three years of data (2014-15 to 2016-17).

Table 6.1 shows the all-day solar multipliers calculated with each of these historical data sets. It shows that all-day multiplier is almost the same, regardless of which of the most recent three historical data sets is used. Table 6.1 also provides the results for the longer historical data sets.

Table 6.1 All-day solar multipliers by historical periods data sets

Historical data modelled	25th	Median	75th
2009-10 to 2016-17	1.07	1.13	1.24
2011-12 to 2016-17	0.99	1.01	1.03
2014-15 to 2016-17	0.97	0.99	1.01
2015-16 to 2016-17	0.96	0.98	1.00
2016-17	0.97	0.99	1.01

Data source: IPART modelling.

Table 6.2 shows the solar multipliers for the time-dependent ranges. Unlike the all-day tariffs, there is substantial variation in the results depending on the period that we model.

As explained in Chapter 3, our draft benchmarks were based on the highest and lowest values across the most recent three historical data sets. However, stakeholders submitted that this produced ranges that were too high to be useful. Therefore we have applied a solar multiplier based on the midpoint of the minimum and maximum solar multipliers for three historical data sets.

Table 6.2 Time-dependent solar-multipliers by historical periods

	6 am to 3 pm	3 pm to 4 pm	4 pm to 5 pm	5 pm to 6 pm	6 pm to 7 pm	7 pm to 8 pm
2014-15 to 2016-17	0.94	1.05	1.37	1.73	1.40	1.10
2015-16 to 2016-17	0.92	1.05	1.46	1.86	1.75	1.10
2016-17	0.91	1.08	1.86	2.33	1.33	1.13
Midpoint of highest and lowest values	0.93	1.07	1.61	2.03	1.54	1.12

Note: The multipliers used for the 6 to 7pm and 7 to 8pm blocks are not solar-weighted. These times cover 0.27% and 0.01% of solar exporting respectively.

Data source: IPART modelling.

Based on the three year historical data set, we don't consider that the results from the Monte Carlo modelling would inherently overstate or understate the relationship between the prices when solar is exporting compared to the average price across the day for 2018-19, and therefore we have chosen the median of the distribution from the results of the Monte Carlo modelling as the solar multiplier. However as shown in Table 6.1, there is very little variation in the all-day multipliers across the distribution of results. Therefore the benchmark ranges are almost the same regardless of the point in the distribution chosen.

6.4 We used Ausgrid data on solar exports only

In our previous reviews, we estimated the value of solar electricity at the time it is exported based on the solar export profile of a random sample of 500 Ausgrid solar customers (which covers Newcastle and most of Sydney). Neither the Endeavour network (in greater Western Sydney and Wollongong), nor the Essential network (which covers the rest of NSW) had a sufficient number of solar customers with digital meters installed to provide a representative sample of solar exports.

However, as more digital meters have been installed in the Essential and Endeavour networks, for the first time we have been able to collect a sample of 500 customers' half-hourly solar export data from these network areas for 2016-17. In addition, our Terms of Reference specified that we may incorporate half-hourly solar export data reflecting customers in all three network areas. Further, in response to our Issues Paper, Simply Energy notes that customers in the Essential Energy and Endeavour Energy network areas may have very different characteristics, and we should model the solar multiplier to include all networks. It submitted that this would align the calculation more closely to the way energy is exported in a greater number of network regions and so would result in a more indicative picture of actual solar output.[77]

We agree with Simply Energy that solar exports could exhibit different patterns given their geographic locations, and bigger PV unit sizes, particularly in the Essential Energy network area. Because of this variation, it would be ideal to include data from all three network areas in our modelling of the solar multiplier.

However, at present, we consider the Ausgrid network remains the best available source for half-hourly PV exports. While we have received data from the other networks, our view is that we need more than one year of data to ensure that the data provided is representative. It is not currently possible to assess whether or not the solar export profiles of Endeavour and Essential customers are 'typical' of those networks' areas, and using them runs the risk of relying on an outlier year to forecast for next year. AGL agreed that one year of data is not sufficient for modelling purposes, and suggested that at least three years of data will be necessary to provide a more robust result.[78] Simply Energy also considered that the inclusion of three years' data from the Essential Energy and Endeavour Energy networks would provide a relevant representation of the solar generation patterns in these areas.[79]

77 Simply Energy submission to IPART Issues Paper, April 2018, p 1.
78 AGL submission to IPART Issues Paper, April 2018, p 2.
79 Simply Energy submission to IPART Issues Paper, April 2018, p 1.

We will continue to collect data on half-hourly solar PV exports from all three network areas, and incorporate the data into our modelling when we are satisfied that the data is representative.

A Terms of Reference

The investigation and determination by the IPART on annual benchmark range for feed-in tariffs for the next three financial years (FY2018-19, FY2019-20 and FY2020-2021)

Reference to the IPART under section 9 of the Independent Pricing and Regulatory Tribunal Act 1992

With the approval of the Hon. Gladys Berejiklian MP, Premier of NSW and Minister administering the Independent Pricing and Regulatory Tribunal Act 1992 (IPART Act), pursuant to section 9(2) of the IPART Act, the Independent Pricing and Regulatory Tribunal (IPART) will enter into arrangements with the Department of Planning and Environment (the Department), for investigation and report, the determination of:

- The voluntary benchmark range for solar feed-in tariffs paid by retailers for electricity produced by complying generators and supplied to the distribution network.
- Time dependent benchmark ranges paid by retailers for electricity produced by complying generators and supplied to the distribution network during different times of the day.

Conduct of investigation

In conducting this investigation, the IPART is to consider the following key parameters:

- There should be no resulting increase in retail electricity prices; and
- The benchmark range should operate in such a way as to support a competitive electricity market in NSW.

In conducting this investigation, IPART may incorporate;

- Half-hourly solar export data reflecting customers in all three network areas; and
- Forecasted electricity wholesale cost fluctuations instead of historical data.

Reporting

The IPART is to report the feed-in tariff offered by each retailer at the time of writing its report and to note whether that tariff was within the benchmark for the preceding financial year.

Consultation

In making its determination on the benchmark range, IPART may consult on any matter that it regards as material.

Timing

The IPART is to provide its determination by 30 June of each year for the next three years starting from 2018. The Department may amend the Terms of Reference to align with the government policies and to remain relevant in the energy market.

Signed:

Don Harwin MLC
Minister for Energy and Utilities
Date: