Independent Pricing and Regulatory Tribunal
New South Wales

REVIEW OF SOLAR FEED-IN TARIFF BENCHMARKS

METHODOLOGY

TECHNICAL PAPER

Draft Report

April 2021

We have made incremental improvements to our previous approach

Our feed-in tariff benchmarks are a guide as to what customers could expect to receive from their retailers for their solar exports. Retailers are free to set their own feed-in tariffs.

This technical paper provides our draft decisions on our methodology for setting feed-in tariff benchmarks. We have updated our previous approach to setting the feed-in tariff benchmarks to:

- Recognise that not all retailers set their feed-in tariffs the same way. Our draft methodology reflects the range of approaches that retailers take to setting their feed-in tariffs. This should mean that our benchmark is a better guide to the tariffs that customers could expect to receive from retailers for their solar exports.
- Simplify our approach to improve transparency and ensure that the regulatory costs are proportionate to setting a benchmark.

We also explain how we have considered stakeholder submissions to our Issues Paper in making our draft decisions.

We will use this methodology to update our feed-in tariff benchmarks in 2022 and 2023.

Draft decisions

1. We will include a longer historical average of Australian Securities Exchange energy futures for our forecast wholesale electricity costs, in addition to the short term (40-day) average.
2. To calculate the solar multiplier, we will calculate the average solar weighted and time weighted prices directly from three years of historical data. Previously, we used this historical data to generate a Monte Carlo simulation and used the median from the distribution of modelled scenarios.
3. We will use solar export data from all 3 distribution network service providers (Ausgrid, Endeavour Energy and Essential Energy) to calculate a solar multiplier for each network. We will reflect the variations in the solar multipliers within our state-wide benchmark ranges.

In line with our draft decisions, we will set the feed-in tariff benchmarks by:

1. Forecasting the average wholesale electricity price for 2021-22 using NSW baseload electricity futures contracts traded on the Australian Securities Exchange (ASX). We will take a 40-day average to reflect the latest market information on forecast wholesale spot prices to establish one end of the range. We will also take a volume-weighted average of all historical trades available to establish the other end of the range to reflect retailers' actual practices in purchasing wholesale electricity.

   Previously, we only took the 40-day average of the ASX energy futures. We provide further detail below on our draft decision on forecast wholesale electricity prices.

2. Applying a 'solar multiplier' to reflect whether wholesale prices are likely to be lower or higher than the average wholesale price at the times when solar exports occur. Typically, wholesale prices in the National Electricity Market (NEM) are lowest at night (when demand is lowest) and through the middle of the day (when solar energy meets a proportion of demand). We will calculate the ratio of the average solar-weighted price to the average time-weighted price using the most recent three years of historical wholesale spot prices and net solar export data.[1]

   We will calculate individual solar multipliers for each of the 3 distribution network areas, and reflect the variations within our benchmark range. Previously, we only had data from Ausgrid.

3. Increasing the value of our benchmark range by an avoided loss factor (Box 1). When electricity is purchased from the NEM and flows through the transmission and distribution networks some of it will be lost. However, given that solar exports are located closer to where it will be used by other customers, less needs to be purchased by retailers to meet the same level of demand.

4. Adding the value of the NEM fees and charges that retailers avoid paying when they supply customers with other customers' solar exports because these charges are levied on retailers' net purchases.

Using this methodology, our draft all-day solar feed-in tariff benchmark for 2021-22 is **4.4 to 5.9 c/kWh** (Table 1). More detail on each of these aspects of our calculation are provided in this paper.

1 For the purposes of setting our feed-in tariff benchmarks we are focussing on customers' net solar exports – the unused electricity that is exported to the grid. This is the volume of electricity for which customers will earn feed-in tariff revenue.

Table 1 Components for the draft all-day solar feed-in tariff benchmark range 2021-22

Benchmark component	Value
Forecast wholesale electricity price range	4.6 to 6.1 c/kWh
ASX futures baseload contracts for the 12-month period 2021-22 using the 40-day average price (including 5% adjustment to remove contract premium)	*4.6 c/kWh*
ASX futures baseload contracts for the 12-month period 2021-22 using a volume-weighted average of all historical trades	*6.1 c/kWh*
Solar multiplier range	0.88 to 0.91
Ausgrid	*0.90*
Endeavour Energy	*0.88*
Essential Energy	*0.91*
Network loss factor	1.06
NEM fees and ancillary charges	0.09 c/kWh
Solar feed-in tariff benchmark range	**4.4 to 5.9 c/kWh**

Note: Prices taken at 12 April 2021. For our longer-term historical average, the trades available were up to 21 months.
Source: IPART analysis

Box 1 How we calculate avoided loss factors

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 avoided 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 the Australian Energy Market Operator (AEMO). We weight the average loss factor across the 3 distribution network areas in NSW, accounting for both transmission and distribution line losses. We include:

- **Marginal Loss Factor (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.
- **Distribution Loss Factor (DLF)** which is distribution loss factors for small customers for the coming financial year, weighted by customers' actual consumption.

We will set time-dependent benchmarks for all times of the day

Retailers could offer different feed-in tariffs across the day as an alternative to an all-day rate. However, retailers are choosing to offer their customers a single feed-in tariff that applies at all times.[2]

Under our Terms of Reference, we are required to set time-dependent feed-in tariff benchmarks. We have set prices for different times based on how much price variation occurs throughout the day. Very little price variation occurs in the earlier part of the day between 6 am and 3 pm. Therefore, we have set one price for this time. On the other hand, prices vary a lot between 3 pm and 8 pm so we have set hourly benchmarks for these times. This is consistent with our previous approach. Table 2 provides our draft time-dependent tariff benchmarks.

We have also set a price for between 8 pm to 6 am so that we have a time-dependent benchmark tariff available for all times of the day. This will accommodate solar exports from batteries at any time during the day.

Table 2 Draft benchmark ranges for time-dependent feed-in tariffs

Time window	(c/kWh)	% of solar exports (2019-20)
6 am to 3 pm	4.1 to 5.5	83.89
3 to 4 pm	6.4 to 8.8	9.11
4 to 5 pm	9.2 to 14.2	4.89
5 to 6 pm	11.0 to 17.0	1.70
6 to 7 pm	8.2 to 10.7	0.32
7 to 8 pm	6.0 to 7.9	0.03
8 pm to 6 am	4.2 to 5.4	0.05

Note: The multipliers used for the 6 pm to 7 pm, 7 pm to 8 pm and 8 pm to 6 am time windows are not solar-weighted. These times cover less than 1% of solar exports. We previously did not set a benchmark between 8 pm to 6 am because exports are immaterial and wholesale prices are relatively low at those times (IPART, Solar feed-in tariffs 2018-19, June 2018, p 8).
Source: IPART analysis based on financial year 2020 export data provided by Endeavour Energy, Essential Energy and Ausgrid, February 2021.

2 An exception is Amber Electric that is offering a real-time feed-in tariff that varies every 30 minutes in line with changes in the wholesale spot price of electricity, as at 23 April 2021.

We set a range for the forecast wholesale price using the latest market and historical information

The forecast average wholesale electricity price is the key determinant of our benchmark tariffs. Retailers avoid this cost when they use exports from customers rather than purchasing electricity from the NEM.

Our draft decision is that the forecast average wholesale electricity price for 2021-22 is 4.6 to 6.1 c/kWh.

Under our Terms of Reference, we have been asked to set a voluntary benchmark **range** for solar feed-in tariffs paid by retailers. To establish the range, our draft decision is to use a:

- 40-day average of ASX energy futures to reflect that retailers may base their prices using the latest market information (4.6 c/kWh)
- a volume-weighted average of all historical trades of ASX energy futures to reflect retailers' actual practices in purchasing electricity (6.1 c/kWh).[3]

Our previous approach was to only use the 40-day average of ASX energy futures. We then established a range by multiplying our forecast by ± 10% to recognise the forecasting uncertainty around wholesale prices. We will no longer apply the ± 10% to our wholesale price estimates.

Our draft decision recognises that retailers may have different approaches to setting feed-in tariffs. Because it reflects the different ways that retailers may value solar exports, our benchmark range could provide a more helpful guide to customers of the feed-in tariffs they might receive from retailers.

We will continue to adjust our 40-day average of ASX energy futures downwards by 5% to reflect that contracts typically trade at a premium to spot prices. This approach is the same assumption we used when we regulated retail electricity prices. However, for our longer-term average we will not make the same adjustment. This is because we are reflecting retailers' actual practices in purchasing electricity, rather than prevailing spot prices, as the costs they avoid by purchasing solar exports.

AGL and Red Energy supported our previous approach to valuing the wholesale value of solar exports.[i] Origin Energy submitted that we should adopt the Australian Energy Regulator's (AER) approach to estimating wholesale prices when determining its Default Market Offer.[ii] It indicated that the AER uses a contracting strategy that a prudent and efficient retailer would use to manage its electricity risks (see Box 2), rather than the latest view of forward prices. Origin Energy also considered that there should be consistency in regulatory pricing decisions across state and national regulators. It submitted that to do otherwise introduces potential for regulatory risk.

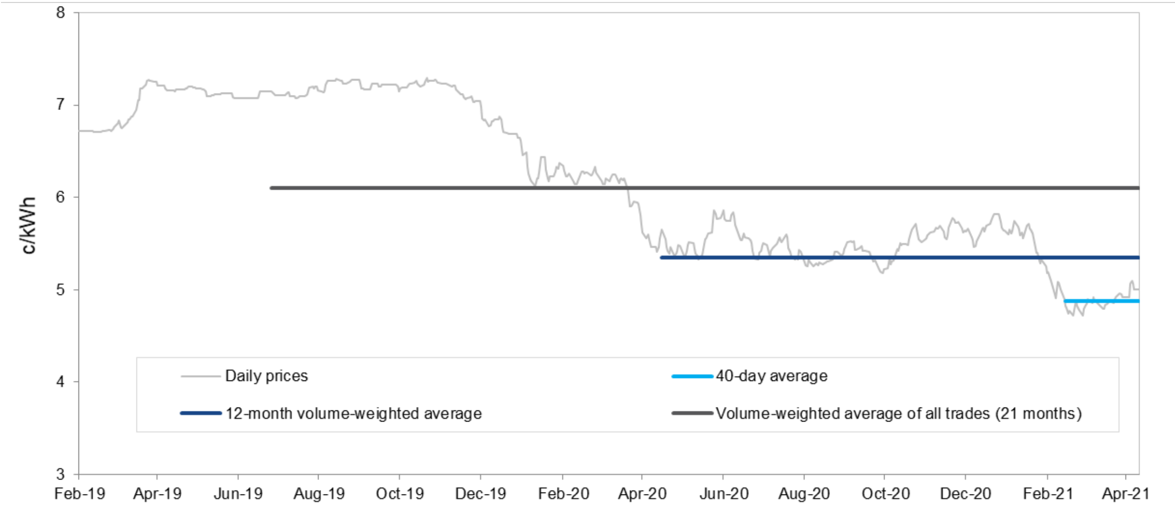
3 Only trades for the past 21 months were available for ASX energy futures for 2021-22, and so 6.1 c/kWh represents a 21-month volume-weighted average price.

Including a longer-term average of ASX futures contracts in our range would recognise that retailers may have different approaches to purchasing wholesale electricity. It would also better align our approach with other regulators in setting solar feed-in tariffs, regulating electricity prices, and forecasting costs. For example:

- The Essential Services Commission uses a 12-month volume-weighted average price of ASX quarterly baseload futures when setting its minimum feed-in tariff for Victoria.[iii]
- The AER uses a market hedging approach and adopts a volume-weighted average of ASX Electricity futures contract prices using all available trade and price data when setting its Default Market Offer. The majority of trades are 24 months prior to the start of the determination period.[iv]
- The Queensland Competition Authority adopts the same approach as the AER for forecasting wholesale costs when setting the feed-in tariff for regional Queensland.[v]
- The Australian Energy Market Commission uses contract prices based on an exponential book build where futures hedge contracts are procured over a 24-month period prior to delivery. This is for its wholesale market costs modelling which underpins its residential electricity price trends forecasts.[vi]

Figure 1 below compares the different averaging periods of ASX futures contracts. It shows that forecast average wholesale prices have been decreasing significantly in recent months. Depending on retailers' actual practices, some may offer feed-in tariffs higher than the latest forecasts, reflecting their hedging strategies.

Figure 1 Forecast average wholesale electricity prices for 2021-22



Source: Data from Bloomberg, ASX NSW Baseload Electricity Strip June 2022, accessed 12 April 2021.

Box 2 The AER's approach to forecasting wholesale energy costs in its Default Market Offer price

The AER engaged ACIL Allen Consulting to provide forecast wholesale energy cost estimates to use in setting its Default Market Offer prices. ACIL Allen advised that given the volatile nature of wholesale electricity spot prices, and that retailers charge their customers based on fixed rate tariffs (i.e. the daily supply and variable charges are fixed for a given period), a prudent retailer is incentivised to hedge its exposure to the spot market. It also advised that it is generally assumed that a retailer is partly exposed to the wholesale spot market and partly protected through a contract hedging strategy.

In its modelling, ACIL Allen first forecasts electricity supply and demand, and then produces a distribution of around 500 simulated spot market price outcomes (which it considers is representative of the volatility in the spot market).

ACIL Allen then assumes the following (risk-averse) retailer hedging strategy:

- Retailer aims to minimise the variability in the wholesale electricity cost of supplying its forecast customer load prior to the commencement of the pricing period.
- The hedge book consists of a portfolio of base, peak and cap quarterly contracts.
- The retailer gradually builds the hedge book over time in the lead up to the determination period. There is no assumed starting point for the book build. It would start when the first trade is listed on the ASX Energy with pricing and volume information and extend up to 3 months before the beginning of a determination period. Majority of trades are 24 months prior to the start of the determination period.

The wholesale energy cost estimate used is the costs of the hedging strategy to meet the 95th percentile of the distribution of spot price outcomes.

ACIL Allen states that its approach is a simplification of the real world, and that its aim is not to over-engineer its approach and give a false sense of precision.

The AER acknowledges that selecting the 95th percentile may over-estimate wholesale costs. However, it considers that it is appropriate given:

- the objectives of the DMO price being set above efficient costs so as not to dis-incentivise competition, innovation and investment by retailers, and retain incentives for consumer to engage in the market
- the greater risks to competition and retailer cost recovery from an underestimated DMO price, compared to an overestimated price.

Source: AER, Default Market Offer Prices 2021-22 – Draft Determination, February 2021, pp 34-35; AER, Default Market Offer Prices 2021-22 – Position Paper, October 2020, pp 26-29; ACIL Allen, Report to AER, Default market offer – estimating wholesale energy and environmental costs, Phase 2: Application of methodology for 2020-21 Final Determination, 28 April 2020, pp 3-4.

We have simplified our approach to calculating the solar multiplier

The solar multiplier is the ratio of the solar output-weighted wholesale 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.

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

A stylised worked example of how we calculate the all-day solar multiplier is set out in Box 3.

Box 3 Stylised worked example of how we calculate the all-day solar multiplier

Assume that the spot price is set in the electricity market 4 times across the day, and there are only 3 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 2 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)	$70	15%	$11
	Spot price 2 (afternoon)	$40	20%	$8
	Spot price 3 (evening)	$150	0.50%	$1
	Spot price 4 (night)	$50	0%	$0
Day 2	Spot price 5 (morning)	$80	16%	$13
	Spot price 6 (afternoon)	$50	25%	$13
	Spot price 7 (evening)	$120	0.50%	$1
	Spot price 8 (night)	$40	0%	$0
Day 3	Spot price 9 (morning)	$90	8%	$7
	Spot price 10 (afternoon)	$60	14%	$8
	Spot price 11 (evening)	$100	0.50%	$1
	Spot price 12 (night)	$50	0%	$0
Solar export weighted price			100%	**$61**
Average (time-weighted price)		**$75**		
Solar multiplier (solar weighted price / average price)				**0.82**

Our draft decision is to calculate the solar-weighted average and time-weighted averages directly using historical export and spot price data. This is simpler than our previous approach, where we used this same data to generate a Monte Carlo simulation.[4] We then selected a median value from the resulting distribution of solar multipliers.

In March 2021, we released a Working Paper that showed the difference in solar multipliers between the simplified approach and the Monte Carlo method:

- For the all-day solar multipliers, the difference was small.
- There could be some variation between the two approaches for the time-dependent solar multipliers during times where there is significant price volatility. The Monte Carlo method smooths out the occurrence of extreme prices in the actual data through the simulation process. The resulting difference in feed-in tariffs where most of the price volatility occurs is up to about 2 c/kWh (between 3 pm to 6 pm).

Most of the stakeholders that commented on the solar multiplier supported our simpler approach as it is more transparent and replicable compared to the Monte Carlo method.[vii] AGL also stated that Frontier Economics had recommended against the use of the Monte Carlo approach to the Essential Services Commission in Victoria for their latest feed-in tariff decision.[viii] This was because it may inappropriately preserve historical correlations between prices and exports (when a longer data set is used).

Climate Change Balmain-Rozelle suggested an alternative approach which involved constructing a data set representing many years' worth of weather conditions.[ix] For each time of year and time of day, the dataset would record a probability distribution of conditions (such as temperature and solar irradiation).

Our draft decision is to adopt a simpler approach that is more transparent and replicable. Our feed-in tariff benchmarks are a guide as to what customers could expect to receive from retailers. Therefore, we do not want to imply a false level of precision by adopting a more complex approach.

We will continue to use the last 3 years of historical data

Our draft decision is to maintain our approach of using the most recent 3 years of historical data to calculate the solar multiplier. Specifically, we would calculate separate solar multipliers for:

- the most recent year of data
- the most recent 2 years of data, and
- the most recent 3 years of data.

We will use the midpoint of the minimum and maximum values from the above 3 historical data sets.

4 See Chapter 5 of our Issues Paper for further details on how we previously calculated the solar multiplier using a Monte Carlo method.

This approach gives more weight to the most recent year of data, while balancing any one-off events by having an additional two years of historical data.

In response to our Issues Paper, stakeholders supported this approach. AGL and Origin Energy considered that the dynamic nature of solar uptake means that using longer historic data may not provide an accurate picture of current market conditions.[x] Origin Energy considered our current approach, which places more weighting on the most recent year, to be pragmatic.

Our benchmark range includes solar multipliers from each network

We calculated solar multipliers for each network (Table 3 and Table 4).[5] These are very similar for each network:

- For the all-day feed-in tariff benchmark, and for most time periods in our time-dependent benchmarks, the resulting differences in benchmark tariffs across the 3 networks would be less than 1 c/kWh.
- For the time periods with slightly larger variation in multipliers, the resulting difference in benchmark tariffs across the 3 networks would be about 2 to 3 c/kWh.

Because there is very little variation between the solar multipliers during most times, our draft decision is to set a state-wide benchmark range, which incorporates the variations between networks.

The all-day solar multiplier ranges from 0.88 to 0.91. Therefore, for our all-day feed-in tariff benchmark we have applied:

- the 0.88 solar multiplier to the lower end of our forecast wholesale electricity price (i.e. the 40-day average of the ASX energy futures)
- the 0.91 solar multiplier to the upper end of the forecast wholesale electricity price (i.e. the longer-term average).

Similarly, for the time-dependent multipliers we have applied the lower (higher) multiplier to the lower (upper) end of our forecast wholesale electricity price for each time period.

The multipliers for Endeavour are lower than for the other networks. This is because there were less solar exports from customers in Endeavour's network when wholesale prices were higher.

Our draft all-day solar multipliers are lower than the solar multiplier for 2020-21 and for previous years, which ranged from 0.97 to 0.99.[xi] The lower multipliers are due to lower historical wholesale prices during the middle of the day as a result of increased penetration of solar panels.

5 Previously, we only had net solar export data from Ausgrid.

Table 3 All-day solar multipliers for the 3 networks

	Ausgrid	Endeavour	Essential
2019-20	0.86	0.83	0.86
2018-19 to 2019-20	0.91	0.88	0.93
2017-18 to 2019-20	0.94	0.92	0.95
Selected value – midpoint of min and max values	**0.90**	**0.88**	**0.91**

Source: IPART analysis based on export data provided by Endeavour Energy, Essential Energy and Ausgrid for financial years 2018 to 2020.

The time-dependent multipliers represent the average value of wholesale prices during each time period relative to the average wholesale price across the day. Our draft time-dependent multipliers are higher in the evening periods compared to previous years. This is because of higher wholesale prices in the peak periods from 4pm to 6pm during 2019-20 compared to previous years. However, very few solar exports occur during these hours – about 7% of daily exports (and so do not materially affect the all-day solar multipliers).

In Table 4, the time-dependent multipliers between 6 pm to 6 am have not been weighted by solar exports. During these times solar exports are negligible, so the main reason for setting benchmarks for these periods is to provide a price signal for the value of battery exports (which could occur at any time).

Table 4 Time-dependent multipliers for the 3 networks

	6am to 3pm (Solar weighted)	3pm to 4pm (Solar weighted)	4pm to 5pm (Solar weighted)	5pm to 6pm (Solar weighted)	6pm to 7pm (Time weighted)	7pm to 8pm (Time weighted)	8pm to 6am (Time weighted)
Ausgrid	0.83	1.33	2.00	2.63	1.65	1.21	0.83
Endeavour	0.82	1.28	1.86	2.22	1.65	1.21	0.83
Essential	0.82	1.35	2.19	2.46	1.65	1.21	0.83

Source: IPART analysis based on export data provided by Endeavour Energy, Essential Energy and Ausgrid for financial years 2018 to 2020.

Stakeholders supported calculating a solar multiplier for each of the 3 networks to reflect the diversity across the different regions. AGL submitted that if we were to set different benchmarks for different networks it would not create material issues as retail contracts are already offered on a network basis.[xii] However, Origin Energy submitted a preference for a single NSW network benchmark with the potential for any network variation to be incorporated within the benchmark range.[xiii] This is because it considered the costs to implement separate network benchmarks to be significant.

If we were to adopt different time-dependent benchmarks for each network, then for the 5pm to 6pm period (which has the greatest variation), the resulting benchmarks are likely to vary by up to 2 to 3 c/kWh. For most of the other time periods, the benchmarks would be very similar with differences less than 1 c/kWh. Given that the differences are not significant, our draft decision is to adopt a single benchmark and to reflect the variations within our benchmark range.

[i] AGL submission to IPART's Issues Paper, March 2021, pp 1-2; Red Energy and Lumo Energy submission to IPART's Issues Paper, March 2021, p 1.

[ii] Origin Energy submission to IPART's Issues Paper, March 2021, p 1.

[iii] ESC, Minimum electricity feed-in tariff to apply from 1 July 2020, February 2020, p 25.

[iv] AER, Default Market Offer Prices 2021-22 – Draft Determination, February 2021, p 35.

[v] ACIL Allen, Report to QCA, Estimated energy costs – 2020-21 Retail tariffs for use by the Queensland Competition Authority in its Draft Determination on retail electricity tariffs, 8 June 2020, p 13.

[vi] EY, AEMC, Residential electricity price trends – Wholesale market costs modelling 2018, 18 December 2018, p 15.

[vii] AGL submission to IPART's Issues Paper, March 2021, p 2; Origin Energy submission to IPART's Issues Paper, March 2021, p 2; PIAC submission to IPART's Issues Paper, March 2021, p 3.

[viii] AGL submission to IPART's Issues Paper, March 2021, p 2.

[ix] Climate Change Balmain-Rozelle submission to IPART Issues Paper, March 2021, pp 3-4.

[x] AGL submission to IPART's Issues Paper, March 2021, p 2; Origin Energy submission to IPART's Issues Paper, March 2021, p 2.

[xi] See Table 2 in Working Paper – Solar feed-in tariff benchmarks, Approach to estimating the solar multiplier, March 2021.

[xii] AGL submission to IPART's Issues Paper, March 2021, p 2.

[xiii] Origin Energy submission to IPART's Issues Paper, March 2021, p 2.