ESSENTIAL SERVICES COMMISSION

Minimum electricity feed-in tariffs to apply from 1 July 2018

Draft decision

19 December 2017

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Summary

The commission's draft decision is to set two feed-in tariffs (FiTs) to apply from 1 July 2018, of which retailers must offer at least one:[1]

- the time-varying feed-in tariff, and/or
- the single rate feed-in tariff.

The draft tariff rates are set out in table S.1 and S.2, respectively.

Table S.1 Time-varying minimum feed in tariff – draft tariff rates

Tariffs	Minimum rates to apply (c/kWh)		
	Off peak	Shoulder	Peak
Rates	7.2	10.3	29.0

The draft tariff rates are distributed as expected, with peak rates higher than shoulder rates, which themselves are higher than the off peak rates. Peak rates are significantly higher than the shoulder and off peak rates because wholesale prices during the evening peak in 2018-19 are forecast to be notably higher than during other periods of the day. This tendency is more pronounced in the forecast for 2018-19 than in previous forecasts that have been used to set the FiT.

Table S.2 Single rate minimum feed in tariff – draft tariff rate

Tariff	Minimum rate to apply (all times) (c/kWh)
Single rate minimum feed-in tariff:	9.9

The draft single rate FiT of 9.9 cents per kilowatt hour (c/kWh) represents a 1.4c reduction from the FiT that applied in 2017-18. This outcome may appear counterintuitive given that average wholesale prices between the two forecast periods have increased by around 18 per cent. It is caused by changes in the prices during the daylight hours when solar photovoltaic (PV) units are

[1] Pursuant to section 40FBB(1) of the *Electricity Industry Act 2000* (Vic),

exporting electricity relative to prices during the evening peak. Prices during daylight hours are the prices relevant to setting the single rate FiT.

Forecasts provided by ACIL Allen indicate that daytime prices are expected to marginally decrease, while prices in the evening are expected to increase significantly, compared to the previous year. The reasons for this change in price profile include the introduction of around 190 megawatts (MW) of utility scale solar PV in Victoria, and additional utility scale solar in South Australia and New South Wales, during the forecast period.[2] Chapter 3 contains further discussion of this trend.

Furthermore, when calculating the single rate FiT, prices during daylight hours are weighted to account for how much electricity solar PV units typically export at different times of day (the 'solar export profile'). Prices are forecast to be higher at the start and the end of the day, when solar is exporting less. By contrast, in the middle of the day, when prices are forecast to dip, solar is exporting the most. This explains why the single rate FiT is slightly lower than the rate during the shoulder period of the time-varying FiT, even though both rates are based on prices during broadly the same time of day.

[2] ACIL Allen forecast that over 600MW of utility scale solar capacity will come online in South Australia and New South Wales during the forecast period.

1. Introduction

Purpose

This document sets out the commission's draft decision on the minimum feed-in tariffs (FiTs) to apply from 1 July 2018.

Context

The commission is required under the *Electricity Industry Act 2000* (the Act) to determine one or more rates an electricity retailer must pay its customers for the electricity they export to the grid, referred to as the minimum FiT.[3] This is a credit paid to small renewable energy generation facilities which use fuel sources such as wind, solar, hydro or biomass.[4]

Last year, the commission concluded its inquiry into the true value of distributed generation (energy value). This represented a major body of research examining the introduction of time-varying FiTs, that is, FiTs for which the rate varies throughout the day (for instance, on the basis of 'peak' and 'off peak' periods). This variation in the rate is intended to reflect the underlying value of the electricity, which is based on a wholesale electricity market in which prices change every 30 minutes, and which varies considerably across time.[5]

The inquiry explored how the FiT could be restructured to reflect, on a more granular basis, the varying value of electricity throughout the day. The principle underlying this work is the same as that underlying the general move towards more cost reflective pricing models in the energy industry – that more granular price signals provide incentives for more efficient use of resources. In the case of FiTs, this translates to encouraging customers (acting as generators) to export more power into the grid when demand for electricity is higher.

Our inquiry examined a range of options for restructuring the FiT on a time-varying basis. A time-varying FiT is one in which the rate paid to eligible small scale generators varies depending on the

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[3] See section 40FBB of the *Electricity Industry Act 2000* (the Act).

[4] An important exception is that a 'small renewable energy generation facility' does not include a generating facility that is under the premium solar feed-in tariff scheme (*Electricity Industry Act* section 40F(1)). Further, the Governor in Council, by order published in the Government Gazette, can specify a facility or class of facility that generates electricity in any way as a small renewable energy generation facility (*Electricity Industry Act* section 40F(2)).

[5] The wholesale spot price of electricity is determined though an auction, which is conducted every five minutes by the Australian Energy Market Operator (AEMO). Currently, the process is repeated six times each half hour and generators are paid the average of the six marginal prices for the electricity they generate during that half hour. On 28 November 2017, the Australian Energy Market Commission made a determination to change the settlement period from 30 minutes to five minutes. As a result, the half hourly averaging process will not be required from the proposed commencement date of the rule change of 1 July 2021.

time of the day. Specifically, each day is divided into predefined time periods, or 'time blocks'. Common ways of structuring a time varying tariff include defining 'peak', 'off peak' and/or shoulder periods.[6]

Our work through the inquiry included different ways of defining 'peak' and 'off peak', the use of seasonal pricing, and also the introduction of 'critical peak' pricing. The concept of critical peak pricing refers to (typically high) prices that apply in very short periods of peak demand.

To assess the various options, we considered the principles of market reflectiveness, simplicity, and the potential to elicit a behavioural response. In our final report, we set out our preferred structure for such a tariff, which was based on the peak, shoulder and off peak periods used to the introduction of flexible retail pricing in Victoria, coupled with a critical peak price to apply during price spikes in the wholesale market.[7] Critical peak periods were defined as any wholesale market interval in which prices exceeded $300 per megawatt hour (MWh). We considered this structure to strike a good balance between the principles outlined above.

The Act has since been amended to allow the commission to set time-varying feed-in tariffs.

Structure of this document

After this introduction, our draft decision has three sections:

- Section 2 sets out the proposed minimum feed-in tariffs to apply from 1 July 2018
- Section 3 describes the methodology used to calculate the minimum feed-in tariffs
- Section 4 sets out the next steps, including the process for making a submission in response to our draft decision.

[6] The concept of a time-varying FiT is also sometimes referred to as a 'time of use FiT', a 'time of export FiT', or a 'multi-rate FiT'.

[7] Essential Services Commission 2016, *The Energy Value of Distributed Generation: Distributed Generation Inquiry Stage 1 Final Report*, August, p.53.

2. Draft decision

Transition to time-varying rates

Our draft decision is to commence the process of transitioning to time-varying feed-in tariffs (FiTs) in Victoria by setting two FiTs for the period starting 1 July 2018, namely:

- a new time-varying tariff, with peak, shoulder and off peak rates, using the methodology developed and consulted on through our inquiry into the true value of distributed generation, and
- a single flat rate FiT using the same methodology developed and consulted on in previous years.

Our draft decision is to allow retailers to select which tariff they offer, or whether they offer customers a choice of the two options, in 2018-19 as part of the transition to time-varying feed in tariffs.

For this transition year, we are not proposing to include a critical peak rate within the time-varying FiT structure.

During our earlier inquiry, and in consultation with industry since that time, retailers have argued that the addition of a critical peak price makes the implementation of a time-varying tariff significantly more difficult. This is because – unlike for the peak, shoulder and off peak rates – retailers will not know in advance when the critical peak price will apply. It will be necessary for retailers to retrospectively identify when the wholesale market had exceeded the $300/MWh threshold, and then 'true up' the customers' account to reflect the rate which should have applied during that time interval.

In recognition of this added complexity, we are proposing not to include critical peak pricing within the time-varying price structure for this transition year on the basis that including it would decrease the likelihood that retailers will offer the time-varying tariff to their customers in 2018-19.

We also consider this deferral to allow more time to better understand any potential impact of the changing profile of forecast wholesale prices on retailer contracting behaviour, which is relevant to the choice of $300/MWh threshold for the critical peak price.

We will review the inclusion of a critical peak price in the lead up to the next FiT decision, applying to 2019-2020.

Rates to apply from 1 July 2018

The tariff structures and rates are set out as follows:

Table 2.1 Time-varying minimum feed in tariff – draft rates

Tariffs	Minimum rates to apply (c/kWh)		
	Off peak	Shoulder	Peak
Rates	7.2	10.3	29.0

The draft tariff rates are distributed as expected, with peak rates higher than shoulder rates, which themselves are higher than the off peak rates. Peak rates are significantly higher than the shoulder and off peak rates because wholesale prices during the evening peak in 2018-19 are forecast to be higher than during other periods of the day. This tendency is more pronounced in the forecast for 2018-19 than in previous forecasts that have been used to set the FiT.

The time periods – or 'time blocks structure' – for the time-varying FiT are set out in table 2.2.

Table 2.2 Time block structure for time-varying feed-in tariff

Period	Weekday	Weekend
Off peak	10pm – 7am	10pm-7am
Shoulder	7am-3pm, 9pm-10pm	7am-10pm
Peak	3pm-9pm	n/a

Table 2.3 Single rate minimum feed in tariff – draft rate

Tariff	Minimum rate to apply (all times) (c/kWh)
Single rate minimum feed-in tariff:	9.9

The draft single rate FiT of 9.9 c/kWh represents a 1.4c reduction from the FiT that applied in 2017-18. This outcome may appear counterintuitive given that average wholesale prices between the two forecast periods have increased by around 18 per cent. However, it is caused by changes in the prices during the daylight hours that solar photovoltaic (PV) units are exporting electricity

relative to prices during the evening peak. Prices during daylight hours are the prices relevant to setting the single rate FiT.

Forecasts provided by ACIL Allen indicate that daytime wholesale prices are expected to marginally decrease, while wholesale prices in the evening are expected to increase significantly, compared to the previous year. The reasons for this change in price profile, which include the coming online of around 190MW of utility scale solar PV, are discussed in chapter 3.

Furthermore, when calculating the single rate FiT, prices during daylight hours are weighted to account for how much electricity solar PV units typically export at different times of day (the 'solar export profile'). Prices are forecast to be higher at the start and the end of the day, when solar is exporting less. By contrast, in the middle of the day, when prices are forecast to dip, solar is exporting the most. This explains why the single rate FiT is slightly lower than the rate during the shoulder period of the time-varying FiT, even though both rates are based on prices during broadly the same time of day. Under both the single rate and the time-varying options, the FiT operates as a minimum rate. That is, for each kilowatt hour (kWh) of electricity exported by a small renewable energy generator, retailers must pay at least the minimum FiT rate, but they may offer more.

For retailers who offer the single rate FiT, this means they must pay at least 9.9c/kWh for all exports, regardless of what time of day they occur. Retailers who offer the time varying FiT must, at a minimum, pay the rate that applies at any given time of day. For instance, for electricity exported at 4pm on a weekday, the retailer must pay at least 29.0c/kWh, but for exports at midday on a weekend it would only be required to pay a minimum of 10.3/kWh. Moreover, so long as the minimum is met or exceeded in each time period, retailers may structure their FiTs in any way they deem appropriate.

Benefits of setting two FiTs as a transitional measure

A time-varying FiT provides a more granular reflection of how the value of wholesale electricity varies throughout the day than is possible with a single, flat-rate tariff. This provides the opportunity for solar owners to modify their export profile in response to higher and lower prices, if they so choose. Solar owners who modify their behaviour to take advantage of the higher rates during peak periods may be able to capture higher revenues.

However, we recognise that implementation of a time-varying FiT involves various challenges, including for retailers. Consequently, our draft decision is to use the 2018-19 period to commence a transition to time-varying rates by allowing retailers to choose which FiT they offer.

Allowing retailers the choice between two FiTs for 2018-19 will have the following benefits:

1. **Retailer systems** - A transition to a mandatory, time-varying FiT will provide retailers with additional time to update their billing systems.
2. **Competition -** Allowing retailers to choose between tariffs[8] will give them the opportunity to differentiate their service offerings, promoting competition in the retail market. This will benefit consumers as they can choose the retailer whose offering best fits their needs, while still ensuring they receive a regulated minimum regardless of which tariff structure they are on.
3. **Metering technology -** Some solar customers may still be using analogue (i.e. not smart) metering systems or manually read interval meters (MRIM). These customers may noe be able to easily adopt time-varying feed-in tariffs without installing additional equipment because their metering technology cannot be read remotely (and analogue meters do not measure and record the time that electricity is exported).
4. **Technical impacts -** A transition period allows more time to consider any impacts a time-varying FiT may have on the network, for instance through large numbers of customers exporting simultaneously to take advantage of higher peak prices.

Commencement

Retailers must offer at least one of the tariffs – that is, the time-varying tariff set out in table 2.1 or the single rate tariff set out in table 2.3 – from 1 July 2018.

[8] That is, between offering the time-varying FiT and the single-rate FiT.

3. Method

Introduction

This chapter sets out the method used for calculating the feed-in tariff (FiT). It provides a high level summary of the methodology used for setting both single rate and time-varying FiT, and explains the process for determining the wholesale market projections. For a further discussion of these matters see our final report of the energy value stage of our inquiry into the true value of distributed generation.[9]

The chapter also addresses the social cost of carbon and avoided human health costs. The final section contains a break-down of the components of both the single rate and time-varying tariffs.

The legal context to this method is outlined in Appendix A.

Method summary

The broad principle underlying the minimum feed-in tariff is that the rate or rates should be equal to costs avoided by the retailer when they purchase electricity from a small scale generator instead of via the wholesale electricity market. This includes the costs of the electricity the retailer would otherwise need to purchase from the wholesale market, adjusted for line losses,[10] and any ancillary charges or market fees the retailer would otherwise incur.

Following legislative amendments in February 2017, the method has also included consideration of the avoided social cost of carbon and the avoided human health costs associated with conventional fossil fuel electricity generation.

With the exception of the calculation of the wholesale component of the feed-in tariff, all elements of the method are identical for both the single rate tariff and the time-varying tariff.

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[9] Essential Services Commission 2016, *The Energy Value of Distributed Generation: Distributed Generation Inquiry Stage 1 Final Report*, August.

[10] Line losses refer to the electricity that is lost during transportation from central generators, such as the coal fired power stations located in the Latrobe Valley. Because some energy is lost in transportation, retailers must purchase more electricity from the wholesale market than is ultimately consumed by the customer. When they instead purchase electricity from a small scale generator, such as a rooftop solar photovoltaic (PV) system, the electricity typically is not transported long distances before it is consumed, meaning the losses are avoided. The wholesale value of small scale generation electricity is therefore 'adjusted for line losses' to account for the fact the retailer avoids purchasing from the wholesale market both the customer's electricity and the additional amount that would have otherwise been lost transporting it from a central generator to the customer.

The steps we use to determine the FiT are therefore:

1. Develop a projection of wholesale electricity prices for the relevant year (2018-19).
2. *For the single rate tariff* – using the projected wholesale prices, calculate the value of wholesale electricity during the hours solar photovoltaic (PV) systems typically export to the grid.[11]
3. *For the time varying tariff* – using the projected wholesale prices, calculate the value of wholesale electricity during each of the time blocks that form the tariff structure.
4. Adjust the wholesale values to account for line losses.
5. Incorporate market fees and ancillary services charges that are avoided by retailers when they purchase from small scale generators as opposed to the wholesale market.
6. Incorporate any value associated with the avoided social cost of carbon and the avoided human health costs.

A breakdown of the FiTs that illustrates the value of each of these components is provided in Table 3.3 and Table 3.4. More information, including technical detail and mathematical formulae, can be found in Appendix B

Wholesale market projections

We commissioned ACIL Allen Consulting's proprietary wholesale market model, *PowerMark*, to forecast prices on the wholesale electricity market for 2018-19.

ACIL Allen estimates that the unweighted average wholesale market spot price for 2018-19 will be $91.2/MWh.[12]

Calculation of base rates

Base rate for single rate tariff

While the forecast average wholesale price of electricity for 2018-19 is $91.2/MWh, this does not mean that wholesale electricity is projected to cost exactly that amount at all times. The price of electricity varies with supply and demand. Wholesale prices will typically be low at those times when the amount of energy offered into the wholesale market is high relative to the amount consumers require (and vice-versa).

[11] Sometimes referred to as a 'solar weighted' or 'time weighted' wholesale value.

[12] ACIL Allen's report has been published on the ESC website.

Most of the small scale renewable generation in Victoria is rooftop solar photovoltaic (PV). Such systems typically export electricity into the grid during the day, whenever the amount of electricity the solar PV system generates exceeds the household's demand. In order to accurately reflect the value of wholesale electricity produced by these systems, and because the wholesale value of electricity varies across the day, the single rate FiT is weighted to account for the timing of these exports. This process is known as solar weighting, and ensures that the value of electricity during periods in which solar PV is *not* exporting electricity – such as in the middle of the night – is not included when establishing the rate they receive.

To develop the solar weighting, we calculated average profiles for solar PV exports based on sample data provided to the commission by Victoria's network businesses in 2016.[13] The export data is of a sample of Victorian electricity customers in approximately the three years leading up to early 2016.

After applying solar weighting, the base rate for the single rate FiT for 2018–19 is $68.4/Megawatt hour (MWh).

As noted above, the application of solar weighting for 2018-19 produced an unexpected result when compared to the trend in previous years. Namely, the solar weighted average wholesale price is lower than the unweighted average wholesale price. Furthermore, the solar weighted average wholesale price has dropped between years – the rate for 2018-19 is lower than the solar weighted wholesale price for 2017-18. In practical terms, this means that the single rate FiT for 2018-19 is lower than in the previous year, even though wholesale prices have, on average, been trending upwards over this period.

This initially counterintuitive result is explained by the changing profile of wholesale prices across the day. Specifically, ACIL Allen's forecasts indicate that prices during the middle of the day, when solar is exporting, are expected to marginally decrease in 2018-19 relative to prices in that period in the previous year. Part of the explanation for this is the anticipated commissioning of several utility scale solar PV projects during 2018-19 (around 190MW) which will increase the supply of electricity during the hours that solar systems export to the grid, thus dampening prices.[14] Complementing this trend is the ongoing installation of rooftop solar PV, which adds additional supply during solar export periods.

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[13] During the commission's True Value of Distributed Generation Inquiry.

[14] One utility scale solar project is listed by AEMO as 'committed' during this period – Gannawarra (50MW) – while ACIL Allen advises that another two are also expected to come online during the period – Numurka (38MW), Bannerton (100MW).

Meanwhile, prices during the evening peak are forecast to increase, which is partly a result of the ongoing rebalancing between baseload and renewable sources of electricity. As a result, more expensive generators (such as gas peaking plants) are expected to be required to meet evening peak demand, meaning that prices during these periods are forecast to be significantly higher. This is a major factor explaining the increase in the overall average wholesale price for 2018-19. Additional discussion on the changing price profile is contained in appendix D.

Base rates for time-varying tariffs

In previous years we have applied a flat rate FiT for all times of the day and year. This year, we are also applying a time-varying FiT containing peak, shoulder and off peak periods. Consistent with the findings of our inquiry into the true value of distributed generation, these time blocks are identical to those used for the introduction of flexible pricing in Victoria. The time periods – or 'time blocks structure' – for the time-varying rates are set out in table 3.1.

Table 3.1 Time block structure for time-varying feed-in tariff

Period	Weekday	Weekend
Off peak	10pm-7am	10pm-7am
Shoulder	7am-3pm, 9pm-10pm	7am-10pm
Peak	3pm-9pm	n/a

Using the wholesale market projections described above, we identified the mean price in each of the time blocks to generate the base rates, which are set out in table 3.2.

Table 3.2 Base rates for time-varying feed-in tariff

Tariffs	Base rates (unadjusted wholesale value) (c/kWh)		
	Off peak	Shoulder	Peak
Base rates	4.7	7.2	24.7

Source: ACIL Allen Consulting

The draft FiT rates are distributed as expected, with peak rates higher than shoulder rates, which themselves are higher than the off peak rates. Peak rates are significantly higher than the shoulder and off peak rates because wholesale prices during the evening peak in 2018-19 are forecast to be higher than during other periods of the day. This tendency is more pronounced in the forecast for 2018-19 than in previous forecasts that have been used to set the FiT.

Line losses, ancillary services and market charges

Market charges and ancillary services

When retailers buy energy from the wholesale market they must pay market fees and ancillary service charges to the Australian Energy Market Operator (AEMO). They pay these fees based on the amount of electricity they purchase from the wholesale market, and avoid them to the extent they source electricity from small renewable generators. We have included these fees as part of calculating avoided wholesale costs.[15]

The market fees levied by AEMO are set in advance through its budgeting process. AEMO has estimated its 2018-19 market fees[16] to be $0.51 per MWh or 0.051c/kWh.

For the purpose of determining a FiT that applies from 1 July 2018, we have assumed that the average cost of ancillary services in 2018–19 will be consistent with the average for the period from 2012 to the present. Adding this cost to the market fees described above, the value of ancillary services charges and market fees avoided when a retailer obtains electricity from a small scale renewable generator is 0.72 $/MWh. In keeping with previous years, when rendered in cents per kilowatt hour we have rounded this amount to the nearest 0.1 cent, meaning the value applied for market fees and ancillary services in the FiTs for 2018-19 is 0.1 c/kWh.

Line losses

Typically, energy purchased on the wholesale market is supplied by large central generators located some distance away from the point where the energy is used. Electricity is transported to households and other users via the transmission and distribution network (also known as the grid). During that transportation process, some portion of the energy originally generated is lost as heat. This is known as ‘line losses’.

Small scale renewable generation reduces line losses since electricity does not need to travel as far from the point where it is generated to the point it is consumed. The extent of this saving varies depends on where the generation is located (and other factors). We have incorporated these cost savings into the FiTs by applying a ‘loss factor’ as part of the avoided cost of purchasing energy on the wholesale market.

Using loss factors for Victoria as published by AEMO, we have estimated a loss factor of 1.0675. We apply the loss factor to the forecast solar weighted average pool price, including market fees

[15] Pursuant to section 40FBB(3) of the Act.

[16] Australian Energy Market Operator 2017, *Consolidated Final Budget and Fees 2017-18*, May.

and ancillary charges, of 6.9c/kWh to produce the loss adjusted amount of 7.4c/kWh, an increase of 0.5c/kWh. The effect of the loss adjustment on the each of the rates within time-varying tariff is set out in table 3.3.

Social cost of carbon and avoided human health costs

Energy sold on the wholesale market is generated using a variety of fuel sources and technologies. These include coal, gas, wind farms and hydroelectric power. In Victoria, most wholesale electricity is generated by coal fired power stations, which produce carbon emissions. These emissions are reduced when energy is sourced from small scale renewable generators.

During our inquiry into the true value of distributed generation, we examined the benefit of reduced carbon dioxide emissions and found that while it was possible to estimate the quantum of this benefit, it was not possible for us to determine a value for it. We arrived at this conclusion on the basis that in the absence of a market, the value of greenhouse gas reductions is a matter for policymakers.[17]

We also examined the potential health benefits associated with a reduction of fossil fuel generation caused by the uptake of small renewable distributed generation systems, such as solar PV. We found that it was possible to link the generation of electricity from these distributed generation systems with a reduction of fossil fuel generation, and therefore a reduction in the negative health effects associated with the latter. For example, this could include avoided respiratory-related health impacts from air pollution caused by coal fired power stations. However, we also found the causal chain was too lengthy and uncertain to reliably attribute a given quantum of health benefit with a given unit of output from distributed generation. As a result, we did not seek to add a monetary value for health benefit to the feed-in tariff.[18]

In February 2017, the Government issued an Order in Council specifying a method for determining the social cost of carbon.[19] Applying that method yields a value of 2.5 cents per kilowatt hour of electricity exported by a small renewable generator, which we add to both the single rate and time varying tariffs.

The order did not specify a factor or method for determining avoided human health costs.

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[17] Essential Services Commission 2016, *The Energy Value of Distributed Generation: Distributed Generation Inquiry Stage 1 Final Report*, August, 87-8.

[18] Essential Services Commission 2016, *The Energy Value of Distributed Generation: Distributed Generation Inquiry Stage 1 Final Report*, August, 67-8.

[19] Victorian Government 2017, Victoria Government Gazette No. S 36, Tuesday 21 February 2017, Order specifying a methodology and factors for the determination of the avoided social cost of carbon (Order in Council)

Feed in tariff break-down

A summary of the minimum FiT is provided in Tables 3.3 and Table 3.4 below.

Table 3.3 Time-varying feed-in tariff breakdown – draft rates

Tariff component	Value (c/kWh)		
	Off peak	Shoulder	Peak
Forecast average wholesale electricity pool price (base rate)	4.2	7.2	24.7
Avoided market fees and ancillary service charges	0.1	0.1	0.1
Sub total	*4.4*	*7.3*	*24.8*
Loss adjustment (multiply)	1.0675	1.0675	1.0675
Value of avoided distribution and transmission losses	0.3	0.5	1.7
Sub total	*4.7*	*7.8*	*26.5*
Value of avoided social cost of carbon	2.5	2.5	2.5
TOTALS	**7.2**	**10.3**	**29.0**

Table 3.4 Single-rate feed-in tariff breakdown – Draft rates

Tariff component	Value (c/kWh)
Forecast solar weighted wholesale electricity pool price (base rate)	6.8
Avoided market fees and ancillary service charges	0.1
Sub total	*6.9*
Loss adjustment (multiply)	1.0675
Value of avoided distribution and transmission losses	0.5
Sub total	*7.4*
Value of avoided social cost of carbon	2.5
TOTAL	**9.9**

4. Next steps

Consultation

Stakeholders now have an opportunity to comment on our draft decision. We invite submissions from interested parties, including energy licence holders and other stakeholders.

Submissions should be submitted preferably in electronic format by 5.00pm on 29 January 2017. Early submissions will be welcomed.

Submissions can be emailed to fitreview@esc.vic.gov.au.

You can also send submissions by mail, marked Submissions to Energy Division, to:

Essential Services Commission
Level 37, 2 Lonsdale Street
Melbourne Victoria 3000

The commission's normal practice is to make all submissions publicly available on its website. Please identify clearly any confidential or commercially sensitive information that you do not wish to be disclosed publicly.

Process for reaching our final decision

Once we have received and considered the comments and input from stakeholders, we intend to issue a final decision by the end of February 2018.

Abbreviations

Term	Definition
AEMO	Australian Energy Market Operator
c/kWh	cents per kilowatt hour
DLF	Distribution loss factor
FiT	Feed-in tariff
kW	Kilowatts
kWh	Kilowatt hour
MLF	Marginal loss factor
MWh	Megawatt hour
MW	Megawatts

Glossary

Term	Definition
the Act	*Electricity Industry Act 2000* (Vic)
commission	Essential Services Commission (Victoria)
Inquiry	Commission's 2016 inquiry into the true value of distributed generation
Small renewable energy generator	A wind, solar, hydro, biomass energy facility (or other facility if specified by Order in Council) connected to a distribution system that generates electricity and has an installed or name-plate generating capacity of less than 100 kilowatts.
Relevant retailer	A person that holds a licence to sell electricity and sells to more than 5,000 customers.

References

ACIL Allen Consulting 2016, *Victorian Feed-in Tariff: Estimate of energy value*, December.

Australian Energy Market Operator 2017, *Consolidated Final Budget and Fees 2017-18*, May.

Electricity Industry Act 2000 (Vic)

Energy Legislation Amendment (Feed-in Tariffs and Improving Safety and Markets) Act 2017 (Vic), assent date 14 February 2017.

Essential Services Commission 2016, *The Energy Value of Distributed Generation: Distributed Generation Inquiry Stage 1 Final Report*, August.

Essential Services Commission 2013, *Minimum Electricity Feed-in Tariff to Apply from 1 January 2014 to 31 December 2014 – Final Decision*, August.

Essential Services Commission 2014, *Minimum Electricity Feed-in Tariff to Apply from 1 January 2015 – Final Decision*, August.

Essential Services Commission 2015, *Minimum Electricity Feed-in Tariff to Apply from 1 January 2016 to 31 December 2016 – Final Decision*, August.

Victorian Government 2017, Victoria Government Gazette No. S 36, Tuesday 21 February 2017, Order specifying a methodology and factors for the determination of the avoided social cost of carbon (Order in Council).

Appendix A – Legal context

The Essential Services Commission (the commission) is required under the *Electricity Industry Act 2000* (the Act)[20] to determine the minimum rate or rates an electricity retailer must pay its customers, who are small renewable energy generators, for electricity they produce and export to the grid. This rate or rates is referred to as the minimum feed-in tariff (FiT).

The FiT is a credit paid by a relevant retailer[21] to each customer per kilowatt hour (kWh) of electricity exported. It applies to small renewable energy generation facilities with capacities of less than 100 kilowatts (kW) which produce electricity using renewable energy sources such as wind, solar, hydro or biomass.[22]

Each year, the commission determines the minimum FiT for the following year.[23] The new FiT described in this document will apply from 1 July 2018.

By law, [24] the commission must take into account certain factors in determining the minimum FiT. These factors include:

- the prices of electricity in the wholesale electricity market
- any distribution and transmission losses avoided in Victoria as a result of small renewable energy generation.

The commission must also have regard to the avoided social cost of carbon and avoided human health costs which can be attributed to reduced air pollution caused by small renewable energy generators.[25] The Act[26] allows the Governor in Council to issue an order specifying a methodology

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[20] See section 40FBB of the *Electricity Industry Act 2000* (the Act).

[21] A person that holds a licence to sell electricity and sells to more than 5,000 customers.

[22] An important exception is that a 'small renewable energy generation facility' does not include a generating facility that is under the premium solar feed-in tariff scheme (*Electricity Industry Act* section 40F(1)). Further, the Governor in Council, by order published in the Government Gazette, can specify a facility or class of facility that generates electricity in any way as a small renewable energy generation facility (*Electricity Industry Act* section 40F(2)).

[23] While this has previously been done on a calendar year basis, following recent amendments to the Act the commission is now required to set one or more rates (section 40FBB(2)) by 28 February in the financial year preceding the financial year in which it is to apply (section 40FBB(1). See *Energy Legislation Amendment (Feed-in Tariffs and Improving Safety and Markets) Act 2017* (Vic), assent date 14 February 2017.

[24] The factors that the commission must have regard to in determining the FiT that applies from 1 July 2018 are set out in section 40FBB(3) of the Act.

[25] Following recent amendments to section 40FBB(3) of the Act.

or factors for determining these avoided costs. An order made in 2017[27] sets out factors and methodologies including the following:

- methodologies for determining the number of units of carbon dioxide equivalent (CO_2e) reduced per unit of electricity exported from a small renewable energy generator
- the monetary value for each of unit of CO_2e that is reduced because of the exports of a small renewable energy generator.

The order did not specify factors or methodologies for determining the avoided human health costs caused by a reduction in air pollution.

[26] Section 40FBB(3B).

[27] Victorian Government 2017, *Victoria Government Gazette No. S 36,* Tuesday 21 February 2017.

Appendix B – Technical methodology

The Commission has set two FiT rate options to apply from 1 July 2018. The methodology we have used to determine the FiT options is based on the methodology established in our determination of the 2014, 2015 and 2017 FiTs, with the inclusion of an additional component for calculating a time-varying FiT.

The methodology comprises estimating the following components:

- wholesale value of electricity produced by small scale renewable generators, which is based on the cost of purchasing the same amounts of energy, at the same times, from central generators via the wholesale electricity pool (referred to as the 'avoided energy cost'). This includes:
  - wholesale electricity price forecast
    - with solar weighting to calculate base rates for single rate FiT
    - median within timeblocks to calculate base rates for time-varying FiT
  - avoided distribution and transmission losses, and
  - avoided ancillary service charges and market fees.
- avoided social costs of carbon and avoided human health costs.

Wholesale energy value

The formula for determining the wholesale electricity value that has been used by the commission in past feed-in tariff determinations and for the flat rate feed-in tariff in this decision is:

$$Avoided\ energy\ cost = LF \times \sum_{t=1}^{n} w_t p_t \qquad \text{(AB.1)}$$

where:

LF is the loss factor

w_t is the weighting that applies in time interval t

p_t is the wholesale electricity price that applies in time interval t

n is the 17,520 half hourly time intervals in the year.

Wholesale price projections

All wholesale electricity in Victoria is traded through the wholesale National Electricity Market (NEM).

The wholesale spot price of electricity is determined through a series of auctions that are conducted every five minutes and averaged to the half hour level. There are 17,520 half hours in a year so there are 17,520 wholesale electricity spot prices in Victoria every year.

The FiT needs to be set in advance so it is based on projections of these spot prices which we prepared using PowerMark, our proprietary model of the NEM's wholesale spot market.

The projections in this report cover financial year 2018-19. They were prepared in November 2017.

They are based on demand forecasts produced by the AEMO)in its 2017 National Electricity Forecasting Report (NEFR) and ACIL Allen's internal supply assumptions. The projections were prepared on the assumption that:

- the aluminium smelter at Portland will continue to operate
- the Large scale Renewable Energy Target (LRET) will continue in its current form with the current target
- the Victorian Renewable Energy Target (VRET) will proceed as planned.

There are various policy uncertainties in the electricity market at the time of writing. These relate to questions such as the form the National Energy Guarantee (NEG) might take and indeed whether it will be implemented. The NEG is not reflected in the modelling discussed here.

Solar weighting

The weighting that is applied in each time interval is based on a small scale solar photovoltaic (PV) system export profile. This reflects the fact the predominant form of small renewable energy generation system in Victoria is rooftop solar PV.

In previous years, the commission calculated average profiles for solar PV exports based on sample data for the actual exports of approximately 1,000 solar PV customers in 2013.[28] When setting the FiT to apply from 1 July 2017, we have used an updated sample based on information provided to the Commission by Victoria's network businesses in 2016.[29] The export data is of a sample of Victorian electricity customers in approximately the three years leading up to early 2016. We continue to use this dataset to inform the solar weighting.

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[28] Essential Services Commission 2013, *Minimum Electricity Feed-in Tariff to Apply from 1 January 2014 to 31 December 2014 – Final Decision,* August, pp. 26-29, Essential Services Commission 2014, *Minimum Electricity Feed-in Tariff to Apply from 1 January 2015 – Final Decision,* August, pp. 15-17, Essential Services Commission 2015, *Minimum Electricity Feed-in Tariff to Apply from 1 January 2016 to 31 December 2016 – Final Decision,* August, pp. 11-12.

[29] During the Commission's True Value of Distributed Generation Inquiry.

The methodology for forecasting the wholesale prices and the approach to applying solar weighting accounts for and aligns the impact of weather variations.

The forecast solar weighted average pool price for 2017–18 is $68.4/MWh.

Wholesale prices based on timeblocks

A multi rate FiT energy value is the value of the projected wholesale spot price at certain times of day adjusted for losses, market fees and ancillary service charges. Unlike the single rate approach the multi rate approach does not rely on weighting so it is not 'tied' to any particular technology.

The time blocks used here are those established by the Victorian Government for the standard flexible pricing tariff.

Avoided ancillary service charges and market fees

Retailers pay market fees and ancillary service charges to AEMO to support its role of managing the wholesale electricity market and we include these as avoided costs associated with electricity that is exported to the grid. Retailers pay these fees based on the amount of their purchases from the wholesale electricity market and avoid these fees to the extent that they source electricity from small renewable generators. Consideration of these fees is therefore considered a component of the Commission's consideration of prices in the electricity wholesale market pursuant to section 40FBB(3) of the Act.

The market fees that are levied by AEMO are set in advance through its budgeting process. AEMO has estimated its 2018-19 market fees to be $0.51 per MWh or 0.051c/kWh.

The cost of ancillary services is recovered from market participants. On a weekly basis, AEMO publishes data showing the cost recovery rate for ancillary services. In 2017 (to mid-November), that recovery rate ranged from $0.10 per MWh to $0.25 per MWh, with an average in the period since 2012 of $0.22 per MWh or 0.022c/kWh.

For the purpose of determining a FiT that applies from 1 July 2017, we assume that the average cost of ancillary services in 2018–19 will be consistent with the average from 2012 to mid-November 2017. When this is added to the relevant market fees, the value of ancillary services charges and market fees avoided when a retailer obtains electricity from a small scale renewable generator is 0.72 c/kWh. When incorporated in the FiT rates this is rounded to a single decimal place.

Avoided distribution and transmission losses

Line losses are taken into account when determining the FiT rates by applying a loss factor to the projected wholesale electricity prices, as shown in formula AB.1.

The wholesale electricity price published by the AEMO is determined at the Regional Reference Node (RRN), and this price includes transmission losses between generators and the RRN.[30]

The loss factor used in formula AB.1 takes into account the cost of line losses that occur between the RRN and the end-customer meters. This has two parts:

- transmission line losses between the RRN and each bulk supply connection point (or terminal station) are measured by marginal loss factors (MLFs) published by AEMO[31]
- distribution line losses are measured by distribution loss factors (DLFs), which are estimated by each distribution network service provider and published by AEMO.[32]

The combined loss factor for a particular locality and voltage class can be calculated as:

$$Loss\ factor = MLF \times DLF \qquad \text{(AB.2)}$$

Formula AB.2 has been quantified as follows.

AEMO estimates the MLF for every transmission network connection point. DLFs are estimated by the distribution network service providers in each zone for each line voltage class and published by AEMO. Using this data, we estimate the weighted average loss factor for Victorian mass-market customers at 1.0675 in 2018-19. We then apply the loss factor of 1.0765 to the forecast solar weighted average pool price (including ancillary charges and market fees) of 6.9c/kWh to produce the loss adjusted amount of 7.4c/kWh, an increase of 0.5c/kWh.

Avoided social cost of carbon

An order in Council published on 21 February 2017 specifies the factors and methodologies for determination of the avoided social cost of carbon to which the commission must have regard when setting the FiT.[33]

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[30] In Victoria the RRN is at Thomastown.

[31] The MLF measures the amount of additional generation that would be required at the RRN to deliver 1 kW of electricity to the transmission network connection point (or terminal station).

[32] The DLF represents the average quantity of electricity that needs to be transported across a distribution network in order to provide for one unit of consumption at the customer's premises. DLFs are generally greater than one.

The order specifies that the avoided social cost of carbon is calculated in terms of the avoided social cost of carbon per unit of exported electricity from a small renewable energy generator, and is to be determined in accordance with the following methodology.

$$Avoided\ social\ cost\ of\ carbon = Volume\ factor \times Price\ factor \quad \text{(AB.3)}$$

The order specifies the factors the commission must use when applying this methodology.

With regard to the volume factor, the commission must use an emissions intensity coefficient factor of 1.27 kilograms (kg) of carbon dioxide equivalent (CO_2e) per kWh of electricity exported by a small renewable energy generator. This means that 1.27 kg of CO_2e is assumed to be avoided for each kWh exported by a small renewable energy generator (or 0.00127 tonne of CO_2e avoided per kWh exported).

With regard to the price factor, the order specifies a method for determining the value, which the commission has applied to determine a value per tonne of CO_2e of $19.63.

The resulting avoided social cost of carbon is $0.025 per kWh of electricity exported by a small renewable energy generator.

[33] Victorian Government 2017, Victoria Government Gazette No. S 36, Tuesday 21 February 2017, Order specifying a methodology and factors for the determination of the avoided social cost of carbon (Order in Council)

Appendix C – Comparison to previous years' feed-in tariffs (flat rate tariffs)

Table AC.1 Comparison of flat rate feed-in tariffs – 2015 to 2018-19

Feed-in Tariff Component	2015	2016	2017-18[34]	2018-19[a]
	(c/kWh)	(c/kWh)	(c/kWh)	(c/kWh)
Forecast solar-weighted average wholesale electricity pool price	5.7	4.6	8.1	6.8
Avoided market fees and ancillary service charges	0.05	0.1	0.1	0.1
Value of avoided distribution and transmission losses	0.4	0.3	0.6	0.5
Value of avoided social cost of carbon	n/a	n/a	2.5	2.5
FiT Rate	**6.2**	**5.0**	**11.3**	**9.9**

[a] Draft rates

[34] Following legislative amendments in February 2017 the feed-in tariff moved onto the financial year basis.

Appendix D – Discussion of wholesale price patterns for 2018-19

As discussed in chapter 3, the application of solar weighting for 2018-19 produced an unexpected result when compared to the trend in previous years. Namely, the solar weighted average wholesale prices is lower than the unweighted average wholesale price. Furthermore, the solar weighted average wholesale price has dropped between years – the rate for 2018-19 is lower than the solar weighted wholesale price for 2017-18. In practical terms, this means that the single rate FiT for 2018-19 is lower than in the previous year, even though wholesale prices have, on average, been trending upwards over this period.

This result is explained by the changing profile of wholesale prices across the day. ACIL Allen forecast that prices in the middle of the day will be lower in 2018-19 when compared to 2017-18. Meanwhile, they are forecasting that prices in the evening will be significantly higher, which will drive up the overall average wholesale price. Because the single rate FiT is calculated based on the value of wholesale electricity at the times that solar PV is exporting to the grid (ie during the day), this price profile explains why the single rate tariff has decreased despite the fact average wholesale prices are expected to increase.

To demonstrate the changing price profile, Figure 1 sets out the relationship between hourly wholesale prices, the average wholesale price, and the solar weighted wholesale price. It shows in simple terms how these values have shifted in the forecasts that have underpinned this FiT decision, relative to the previous two FiT decisions (for 2016 and 2017-18).

The light blue curve shows the distribution of wholesale prices across the day, while the dark blue curve shows the annual average wholesale price.[35] The orange line shows the export weighted average wholesale price during the hours that rooftop solar PV systems typically export to the grid, or in other words, the solar weighted average wholesale price.

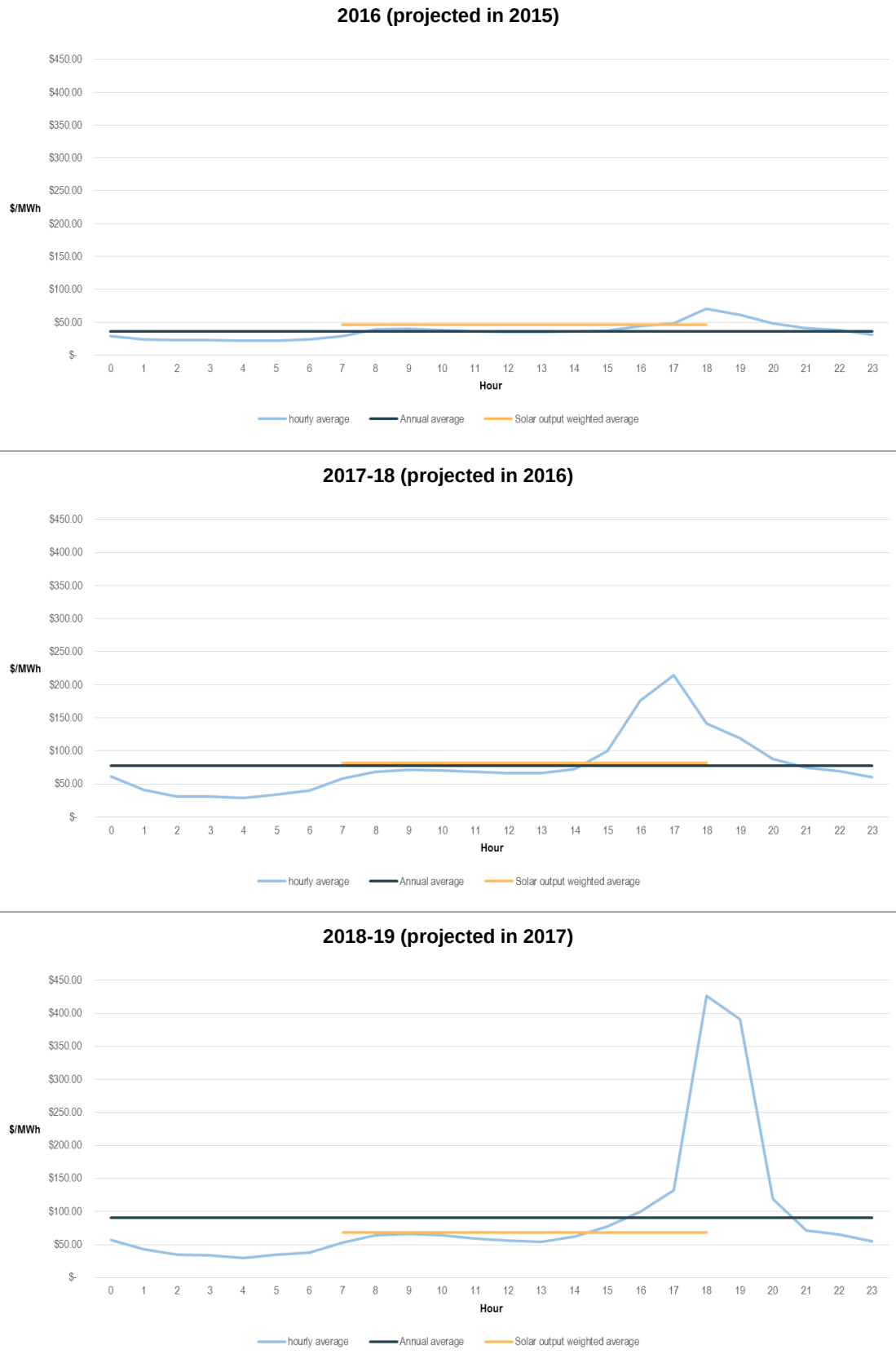
As the charts show, in the forecasts for 2016 and 2017-18, the solar weighted average wholesale price (orange line) exceeded the average wholesale price (dark blue line). By contrast, the forecast for 2018-19 shows significant evening peaks (light blue line), which are largely outside the hours that solar PV exports electricity to the grid. Accordingly, these high prices – which are driving

[35] The average annual wholesale price is unweighted (ie not load weighted).

average wholesale prices up – do not play a material role in determining the solar weighted average wholesale price. Or in other words, they do not contribute materially to the FiT rate.

Furthermore, as the third chart indicates, prices during the middle of the day – when solar is exporting the most – are actually trending downwards relative to previous years. Consequently, the forecast solar weighted average wholesale price for 2018-19 is both lower than the forecast average wholesale price for that year, and lower than the solar weighted average wholesale price for the previous year's forecast. This relationship in the chart demonstrates why the single rate FiT has dropped between 2017-18 and 2018-19, despite the fact average wholesale prices have increased.

Figure D.1 – Time and solar weighed wholesale price forecasts, by hour (2016 to 2018-19)



The reasons for this change in wholesale price profile include the fact that a number of large scale utility solar projects are expected to come on line during the forecast period. The solar generators, totally almost 190 megawatts of nameplate capacity, are:

- Gannawarra (50MW)
- Numurka (38MW)
- Bannerton (100MW)

ACIL Allen also forecast that additional utility scale solar projects will come online in neighbouring jurisdictions which contain interconnected markets. It estimates that around 320MW will be added across New South Wales and South Australia in 2018-19. A further 1,620MW of utility scale solar is projected to be added in Queensland. More information about these projections is contained in ACIL Allen's report, which is available on the commission website.

The addition of this solar capacity is forecast to apply downward pressure to prices during the daylight hours that solar PV will be exporting to the grid. Due to their lack of fuel costs, solar generators have a very low short run marginal cost and therefore bid into the wholesale market at very low prices – typically $0/MW or less. Wholesale prices during the periods the solar is generated are expected to decrease accordingly.

Supplementing the additional utility scale solar is the ongoing high rates of rooftop solar installation, which further increases the supply of electricity during the middle hours of the day. In this way, solar installation trends have been contributing to the gradual shift in wholesale price profile for a number of years, making the eventual inversion of average wholesale price and solar weighted average wholesale price an inevitability.

Another factor influencing the wholesale price profile is the rebalancing between baseload and renewable sources of electricity. As a result, more expensive generators (such as gas peaking plans) are required to meet evening peak demand, which in turn means that prices during these periods are forecast to be higher.