WHOLESALE PRICE FORECASTS FOR CALCULATING MINIMUM FEED-IN TARIFF

A REPORT FOR THE ESSENTIAL SERVICES COMMISSION

9 NOVEMBER 2018

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1 INTRODUCTION

Frontier Economics has been engaged to advise the Essential Services Commission (ESC) on wholesale price forecasts for the purpose of calculating a Feed-in Tariff (FiT).

1.1 Background

The ESC is required under the *Electricity Industry Act 2000 (Vic)* to determine one or more rates to be paid by electricity retailers to customers who feed-in surplus renewable energy generation into the grid. The ESC has published two minimum FiT rates used in the Financial Year (FY) 2018/19:

- A single flat-rate FiT
- A time-varying FiT (with peak, shoulder and off-peak rates).

The ESC engaged Frontier Economics to project Victorian wholesale prices for 2019/20 to inform its determination. This report details our approach, considerations, methodology and results.

1.2 Our approach

The value of small scale renewable energy fed into the grid is a function of wholesale spot prices at the times of those exports. It is therefore necessary to develop a set of half-hourly prices that can be appropriately correlated to a set of half-hourly solar PV export or generation data for the relevant period. We do this by making use of forward prices for 2019/20 from ASXEnergy, and scaling these forward prices to a recent historical year of half-hourly prices.

We begin by analysing the half-hourly historical Victorian system demand and prices over the past five years, to identify the effects of embedded solar generation on system demand and prices. This analysis informs the selection of historical wholesale prices which are then used to project a set of characteristic 2019/20 wholesale prices. Importantly, the half-hourly historical prices selected as the 'starting point' for this projection must be taken from the same time period as the embedded solar generation data (export data) used to compute the FiT in order to preserve the correlation between the two sets of data.

We then scale the selected half-hourly historical Victorian spot prices to an estimate of the average spot price for 2019/20. The price at which a quarterly base swap for Victoria trades on ASXEnergy is generally taken to reflect the market's expectation of the average electricity spot price for Victoria for the relevant quarter (after adjusting for the implied contract premium). In our analysis we make use of forward contract prices for the FiT period (2019/20) from ASXEnergy. We adjust these forward prices to remove an assumed contract premium and scale the historical spot price profiles to achieve these target prices.

1.3 Best practice

The approach used in this paper is consistent with what we consider to be best practice, and reflects the approach that we have previously adopted in providing similar advice to other regulators. More specifically:

- The approach allows the correlation between half-hourly solar exports and half-hourly market prices to be maintained, so that the resulting FiT accurately reflects the relationship between the two.

- Price profiles have been scaled to meet future expectations of spot prices. Consistent with other work, we have inferred prices from ASXEnergy contract prices (adjusted for an assumed contract premium).
- In our previous advice to IPART, we accounted for uncertainty in customer load and solar export quantities by using a Monte Carlo simulation of available data. Given our focus on forecasting half-hourly prices for this project there is not the same need to undertake a Monte Carlo simulation to account for uncertainty in load and exports. A Monte Carlo simulation could be used to generate half-hourly price profiles using historical data, but in our view there would be benefit to this only if we were confident that we could use a reasonable number of years of historical price data.

Overall, we consider the approach outlined in this report to be consistent with regulatory best practice.

1.4 About this paper

This report is structured as follows:

- Section 2 discusses our analysis of historical system demand and prices in Victoria.
- Section 3 outlines the methodology used to produce a wholesale price profile for 2019/20.
- Section 4 presents our results.

2 HISTORICAL SYSTEM DEMAND AND PRICES

We analysed the half-hourly historical demand and prices in Victoria to make observations on the effects of embedded solar generation (or other recent market developments) on system demand and prices. These observations guide the selection of historical wholesale prices used to derive a set of characteristic 2019/20 wholesale prices.

We considered five years of historical data from Q1 2014 to Q3 2018 for this analysis. We excluded older data given the changes in the market dynamics, including the supply-demand balance and carbon pricing scheme.

We discuss the observations and key findings for historical Victorian system demand (Section 2.1) and historical Victorian prices (Section 2.2), before setting out our recommendations (Section 2.3).

2.1 Historical Victorian system demand

Our analysis of historical Victorian system demand considered:

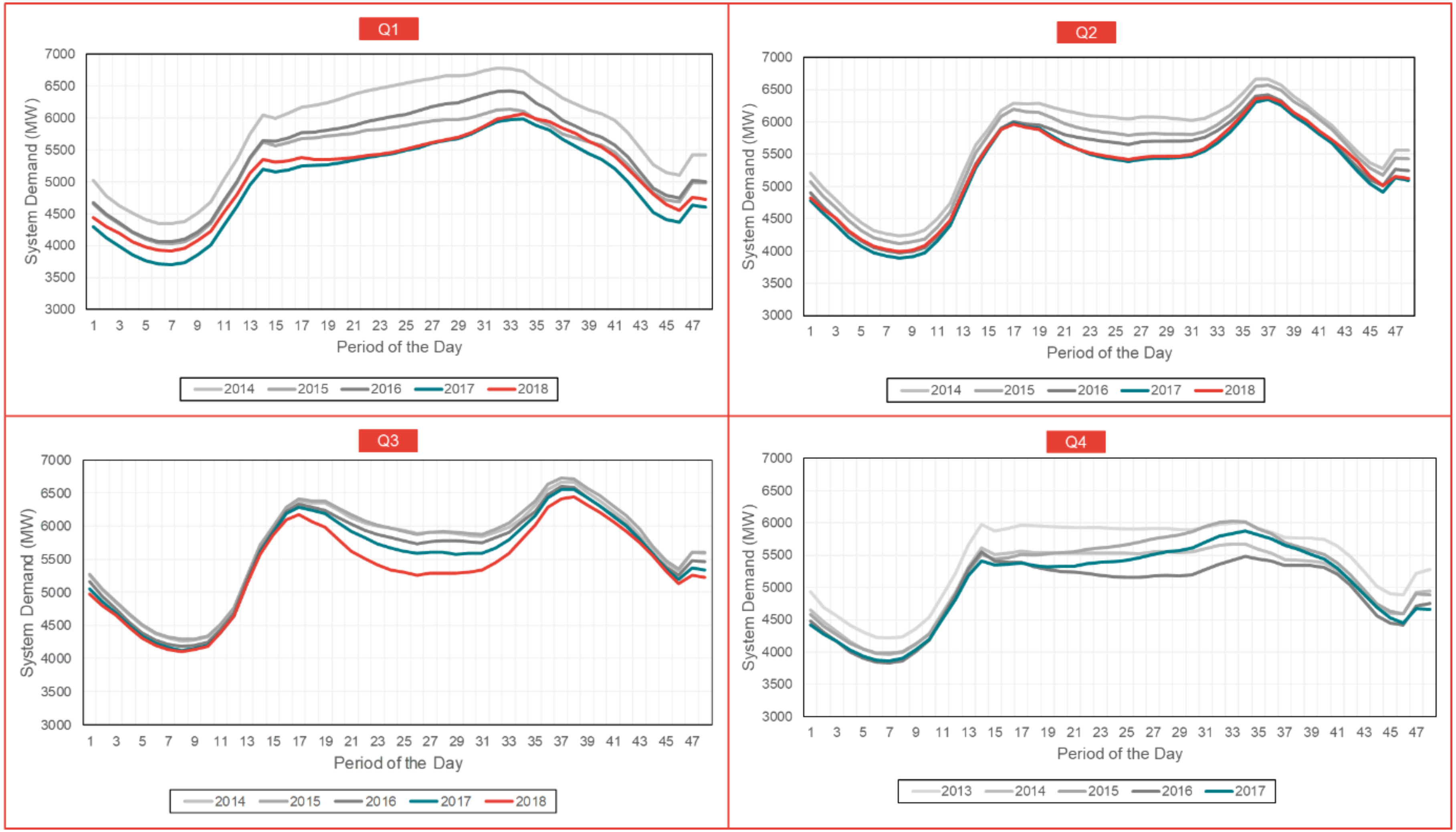
- the overall level of system demand
- the effects of embedded generation on the system demand profile.

We analysed half-hourly historical Victorian system demand data from Q1 2014 to Q3 2018. This data represents the total Victorian daily energy demand profile in megawatts (MW), less the embedded generation profile in MW (which is mostly solar generation).

For each quarter, and for each of working days and non-working days (i.e. weekends and public holidays), we average the system demand for each half-hourly interval to derive an average daily profile (consisting of each of the 48 half-hours that make up a day). We did not average across quarters to ensure the different demand levels and characteristics between quarters, for example the summer and winter quarters, remain distinct. We also ensure that working days and non-working days are averaged separately for the same reason.

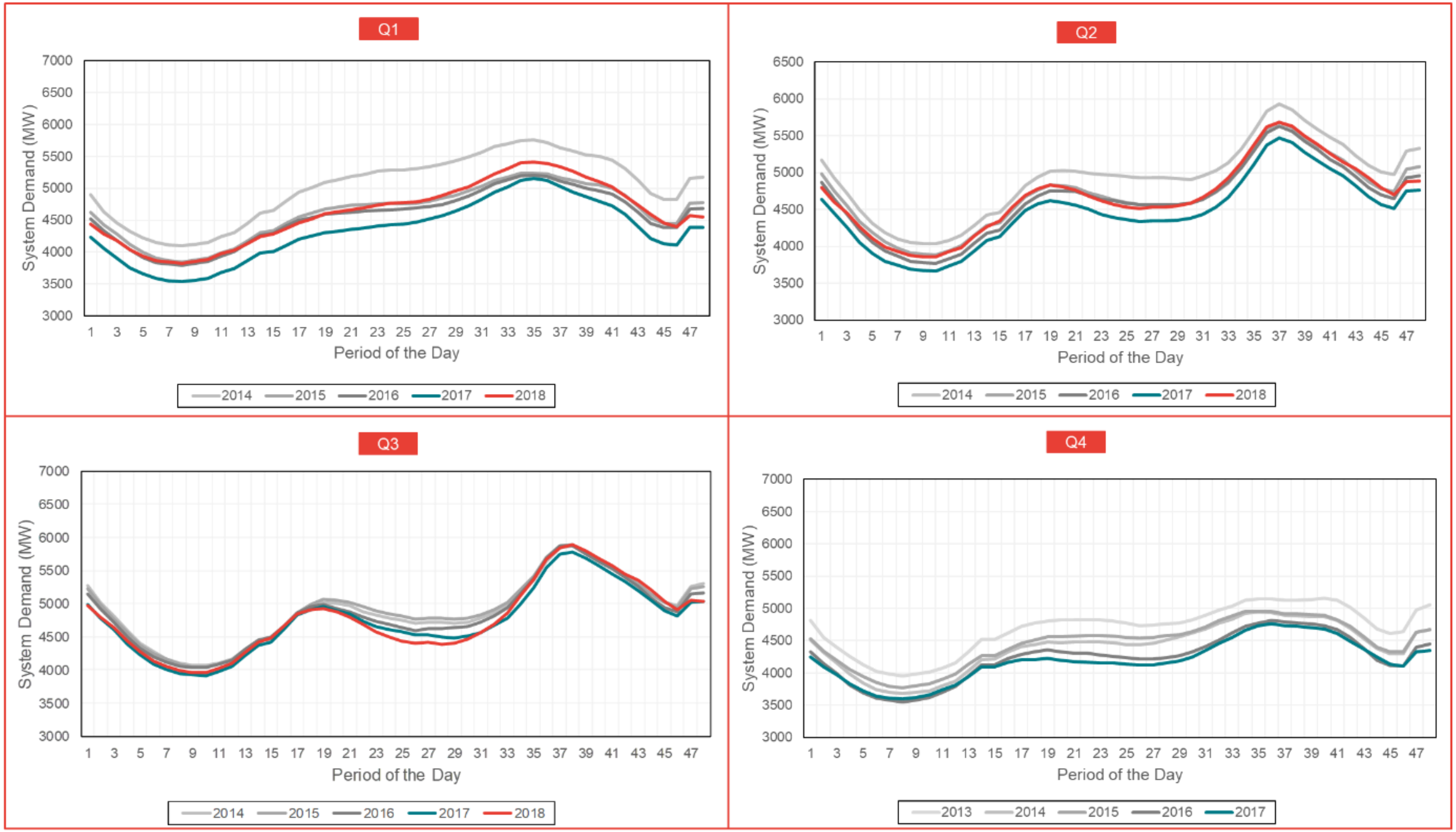
Figure 1 and **Figure 2** present the results for working days and non-working days respectively.

Figure 1: Working day profiles for Victorian system demand for the past five years (by quarters)



Source: National Electricity Market data from AEMO, analysis by Frontier Economics

Figure 2: Non-working day profiles for Victorian system demand for the past five years (by quarters)



Source: National Electricity Market data from AEMO, analysis by Frontier Economics

Our analysis of historical Victorian system demand, net of solar exports, highlighted a number of observations:

- Across the system demand profiles the effects of embedded generation on system demand in Victoria are characterised by a reduction in demand in trading intervals that occur when solar PV is generating. In more recent years this effect has been more apparent, with demand during the middle of the day in 2017 and 2018 tending to be relatively lower (compared with demand overnight and during the morning and evening) than it was in earlier years.
- System demand peaks occur at the same trading interval (or in adjacent trading intervals) over the period. The reason is that even in 2014 system demand peaks were occurring sufficiently late in the afternoon (or in the evening) that increased solar PV has not shifted the time of peak demand later.

Overall, there is some evidence that solar PV has continued to change the shape of the system demand profile, although the time of absolute peak demand has not been significantly affected.

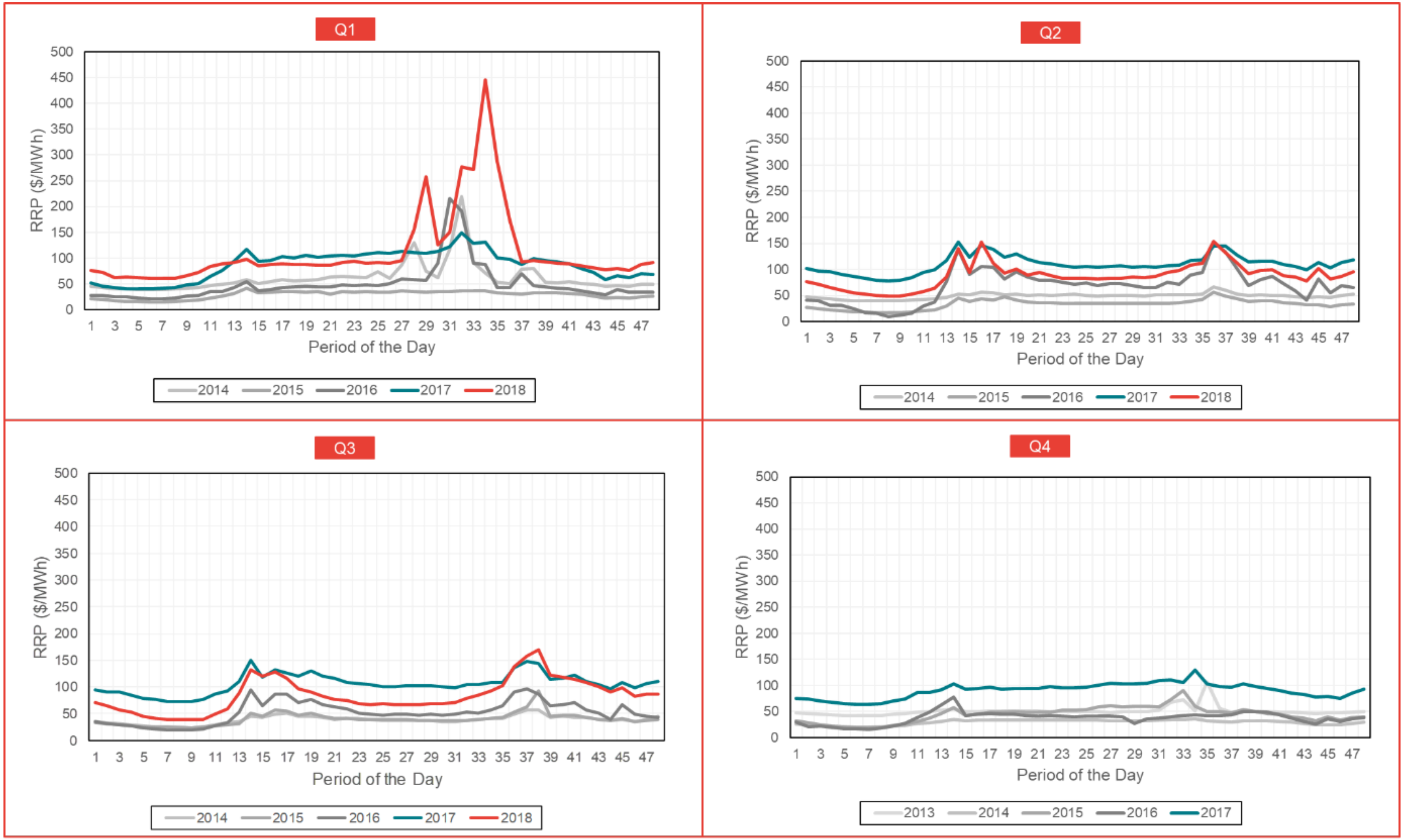
2.2 Historical Victorian prices

Like the analysis of historical Victorian system demand, we considered historical Victorian prices across the past five years in terms of:

- the overall price level
- the effects of embedded generation on the behaviour of peak prices.

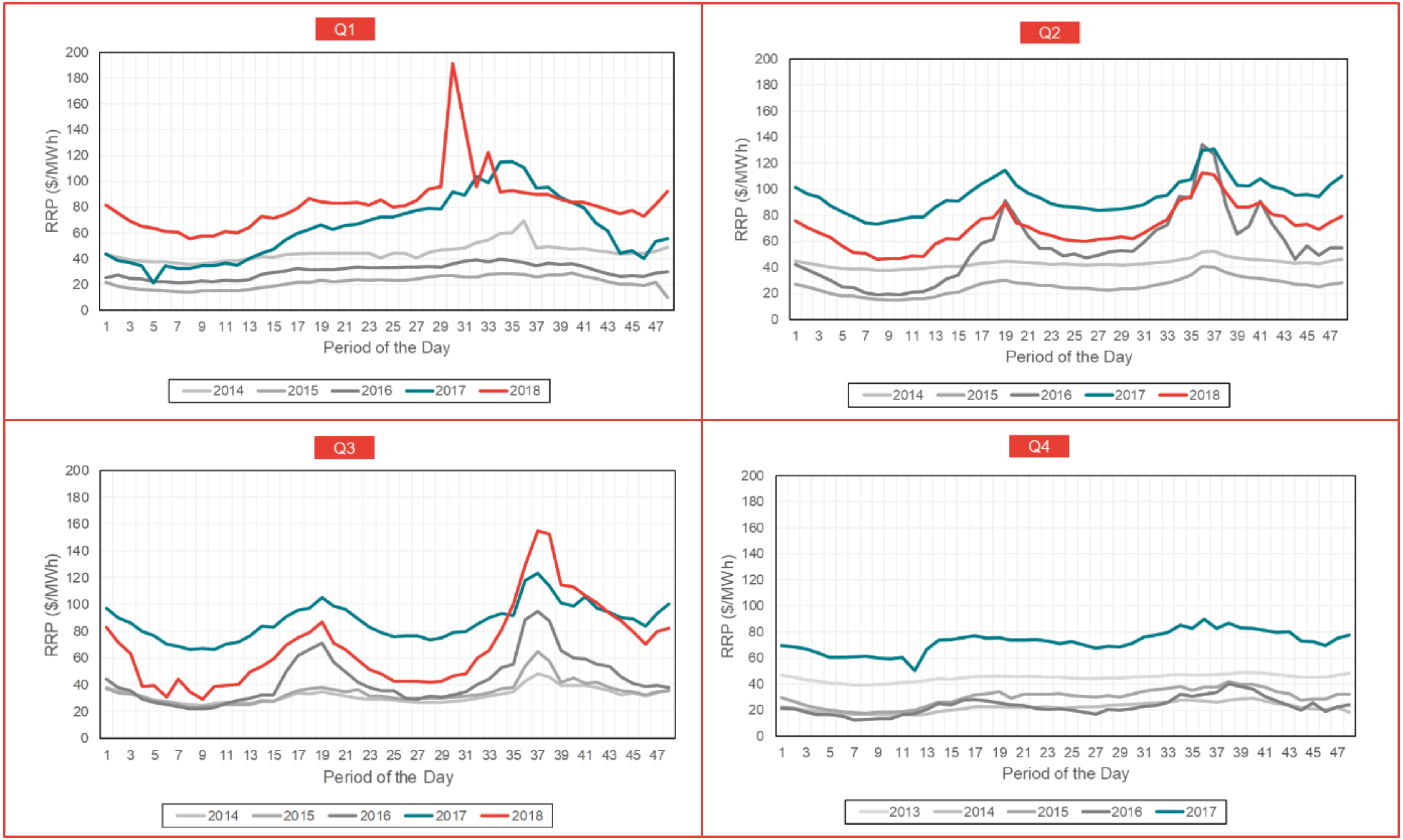
We analysed the historical Victorian half-hourly price data in the same manner as the historical system demand data and plotted the average Victorian price day profile. **Figure 3** and **Figure 4** present the corresponding charts for prices in working days and non-working days respectively.

Figure 3: Working day profiles for Victorian wholesale prices for the past five years (by quarters)



Source: National Electricity Market data from AEMO, analysis by Frontier Economics

Figure 4: Non-working day profiles for Victorian wholesale prices for the past five years (by quarters)



Source: National Electricity Market data from AEMO, analysis by Frontier Economics

Our analysis of historical Victorian prices highlighted several observations:

- Generally, across the years, we found the price profiles adopting similar shapes albeit at differing levels reflecting market dynamics, including the supply-demand balance.
- For three out of four quarters (except for Q1), prices have been peaking in the same or relatively close trading intervals. In the summer, peak prices occur in the evening (between trading intervals 33 – 37, save for an anomaly in Q1 non-working day). In winter, prices peak once in the morning (trading intervals 13 – 15 on working days and trading intervals 17 – 19 on non-working days) and once in the evening (between trading intervals 36 – 38). This indicates that embedded generation no longer has a time-shifting effect on peak prices (i.e. it is no longer pushing peak prices later into the evening). Even though the peak intervals for Q1 do not consistently fall in the same trading interval across the years, no time-shifting trend was observed.

Overall, we conclude there is no observable peak shifting as a result of embedded solar generation in recent years. This means that we can use any recent historical price data from 2014 to 2018 for the purposes of projecting the set of characteristic wholesale prices for 2019/20 (subject to the availability of export data, which we will discuss in our recommendation below).

2.3 Our recommendation

Based on our conclusion above, we recommend using recent historical prices as the starting points for us to project prices for 2019/20 by adjusting the price levels to mirror that of the 2019/20 base swaps (adjusted by an assumed contract premium). The analysis suggests all calendar quarters from recent years can be used interchangeably as the starting points for price projection (i.e. Q1 2017 prices would work just as well as Q1 2018 as the starting point for projecting Q1 2020).

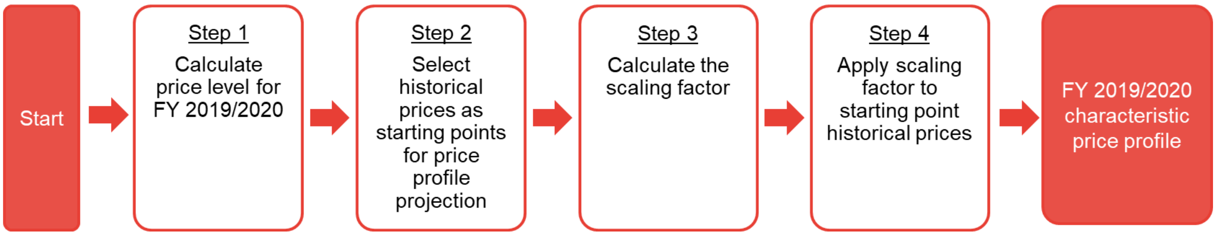
We understand that the ESC has requested solar export data from the regional distributors for Q3 2016 to Q3 2018. Given the importance of ensuring the consistency between export profiles and solar prices this therefore determines the range of reference quarters that could be used to project 2019/20 prices. We strongly recommend against taking prices from time periods outside this range, because doing so would break the correlation between price and export data which will result in inaccurate estimates for the weighted-average FiT. Considering this principle, we also emphasise that in the calculation of the weighted-average FiT, prices in a given calendar quarter are linked to the export data for that same quarter. Quarters without an adequate set of corresponding export data should not be chosen.

We recommend using historical prices in the most recent four quarters for which both historical prices and solar export data are available. In other words, if solar export data is available up to Q3 2018, we recommend using historical data for Q4 2017 – Q3 2018 to project future wholesale prices. Supposing that the full set of solar export data for Q3 2018 is not available, the next best combination would be Q3 2017 – Q2 2018. Notwithstanding our conclusion there is limited evidence of continued peak shifting, the most recent price forecasts are likely to provide the best facsimile for future outcomes.

3 METHODOLOGY

In this section, we set out our methodology for estimating the wholesale price profile for 2019/20, which is summarised in **Figure 5**:

Figure 5: Summary of methodology



Source: Frontier Economics

- **Step 1: Calculate price level for 2019/20**

  The price level for 2019/20 is represented by the average prices of 2019/20 quarterly base swaps (after adjusting for an assumed contract premium). In our calculations, we assumed a contract premium of 5 per cent.

  Quarterly base swaps trade for a number of years in advance of maturity, meaning there is a time series of prices for these contracts. We calculate the average prices of quarterly base swaps across 40-day, 12-month and 24-month window periods. We also calculate average prices based on a time-weighted approach (giving equal weight to each daily price) and using a trade-weighted approach (weighting the daily prices according to the number of trades on the day).

  Our view is that the 40-day average price provides the best indicator of the market's view of prices for 2019/20. Averaging prices over a longer period would mean giving weight to views of prices for 2019/20 that have since changed, likely as a result of updated information about likely market conditions in 2019/20. In the context of retail tariff regulation, retailers have argued in the past, and some regulators have accepted, that average prices over a longer period should be used. The justification given for this is that retailers will actually buy contracts over a longer period when hedging a retail load. While we do not dispute that retailers will likely buy contracts over a number of years leading up to the commencement of 2019/20 to hedge their retail load, we would still view the current market price as the best reflection of the economic value of those contracts and consider that decisions should be made on the basis of that economic value. The rationale for take a 40-day average price is to avoid the possibility of gaming the regulatory arrangement. The 40-day average approach is consistent with the approach that a number of regulators take to setting cost of capital parameters.

  Our view is that a time-weighted approach would generally provide the best indicator of prices for 2019/20. A trade-weighted approach will give greater weight to a daily price on a day with many trades, but we don't think this necessarily provides a better measure of the average price over, for instance, a 40-day period. However, one advantage of a trade-weighted approach is that it will naturally exclude prices on those days on which no trade occurred, and on those days the published price is a less reliable indicator of the market's view of prices.

  We have provided trade-weighted average quarterly base swap prices (as requested by ESC) in **Table 1**, and the results presented in Section 4 are based on these trade-weighted prices. For reference we have also presented time-weighted average quarterly base swap prices, and results based on these time-weighted prices, in Appendix A.

Table 1: Trade-weighted average price levels for 2019/20 (after removing 5 per cent contract premium)

CALENDAR QUARTER	40 DAY AVERAGE	12 MONTH AVERAGE	24 MONTH AVERAGE
Q3 2019	77.66	69.72	71.98
Q4 2019	68.34	61.26	63.72
Q1 2020	94.47	86.53	86.12
Q2 2020	65.31	60.38	61.37

Source: Base swap price data from ASX Energy and Analysis from Frontier Economics

- **Step 2: Select historical prices as starting points for price profile projection**

  Given our understanding that the ESC has requested solar export data from the regional distributors for Q3 2016 to Q3 2018, historical prices should also be selected from within this period. As discussed, we recommend using historical prices in the most recent four quarters for which both historical prices and solar export data are available. In other words, if solar export data is available up to Q3 2018, we recommend using historical data for Q4 2017 – Q3 2018.

- **Step 3: Calculate the scaling factor**

  For each 'starting point' historical quarter, we calculate the average price for that quarter by taking a time-weighted average across all half-hourly prices. We then calculate the scaling factor for that quarter by dividing the relevant ASXEnergy price for the equivalent quarter by that time-weighted average price.

  For example, assuming that the average price for the historical quarter Q3 2018 was $80/MWh and that the ASXEnergy price for Q3 2019 was $100/MWh, the scaling factor for Q3 would be 1.25.

- **Step 4: Apply scaling factor to starting point historical prices**

  To each half-hourly price data in the 'starting point' historical quarters, we multiply each half-hourly price by the relevant scaling factor for that quarter. This provides the resulting half-hourly prices for 2019/20. We also performed checks to confirm that these half-hourly prices would not exceed the NEM Market Price Cap[1] (MPC) and Market Floor Price[2] (MFP). We have also checked that the prices have not exceeded the Cumulative Price Threshold[3] (CPT).

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[1] We used the latest available MPC of $14,500/MWh (for 2018/19) - https://www.aemc.gov.au/news-centre/media-releases/aemc-publishes-schedule-reliability-settings-2018-19

[2] We used the MFP of -$1,000/MWh as prescribed in Chapter 3 of the National Electricity Rules Version 113 - https://www.aemc.gov.au/sites/default/files/2018-04/Reliability%20Panel%20Final%20Report.pdf

[3] Where the sum of the spot prices 36 consecutive trading intervals exceeds the CPT, the Administered Price Cap (APC)of $300/MWh will be applied for all trading intervals. The CPT for 2018/19 is $216,900 - https://www.aemc.gov.au/news-centre/media-releases/aemc-publishes-schedule-reliability-settings-2018-19

4 RESULTS

Based on the approach described in Section 3 this section summarises the results of our wholesale price analysis.

Table 2 presents averages of the half-hourly price forecasts for 2019/20, both for a flat annual average and for peak, shoulder and off-peak periods of the year. Results in **Table 2** are presented:

- for trade-weighted ASXEnergy prices for 2019/20
- based on a 40 day average of ASXEnergy prices
- based on the starting point for the analysis being historical quarters Q4 2017 to Q3 2018.

These half-hourly price forecasts in **Table 2** are not weighted in any way. However, we have also provided the full set of half-hourly price forecasts to the ESC, and these half-hourly price forecasts can be weighted, for instance to reflect the time of solar PV exports. Based on data provided by the ESC, export weighting the half-hourly price forecasts in **Table 2** by typical solar PV exports would provide export-weighted average prices as shown in **Table 3**.

The time periods for peak, shoulder and off-peak periods are based on the existing classification used by the ESC,[4] as summarised in **Table 4**.

Table 2: Summary of draft half-hourly spot prices for 2019/20 (based on historical quarters Q4 2017 to Q3 2018)

RATE TYPE		AVERAGE SPOT PRICE (C/KWH)
Single-flat rate		7.64
Time-varying rate	Peak	10.88
	Shoulder	7.71
	Off-peak	6.01

4 See https://www.esc.vic.gov.au/electricity-and-gas/electricity-and-gas-tariffs-and-benchmarks/minimum-feed-tariff

Table 3: Summary of draft export-weighted half-hourly spot prices for 2019/20 (based on historical quarters Q4 2017 to Q3 2018)

RATE TYPE		EXPORT-WEIGHTED AVERAGE SPOT PRICE (C/KWH)
Single-flat rate		8.00
Time-varying rate	Peak	12.80
	Shoulder	7.48
	Off-peak	7.52

Table 4: Existing classification entered in the model

PERIOD	WEEKDAY	WEEKEND
Peak	3pm – 9pm	N.A.
Shoulder	7am – 3pm; 9pm – 10pm	7am – 10pm
Off-peak	10pm – 7am	10pm – 7am

Source: Essential Services Commission

A APPENDIX A – TIME-WEIGHTED PRICES

This Appendix presents results for time-weighted average prices, in the same form as the results for trade-weighted average prices that are presented in Section 3 and Section 4.

Table 5 provides time-weighted average quarterly base swap prices from ASXEnergy. It is the equivalent of **Table 1**, although using time-weighted average prices rather than trade-weighted average prices.

Table 6 presents averages of the half-hourly price forecasts for 2019/20, both for a flat annual average and for peak, shoulder and off-peak periods of the year. It is the equivalent of **Table 2**, although using time-weighted average prices rather than trade-weighted average prices.

Table 7 presents export-weighted average prices based on typical solar PV exports. It is the equivalent of **Table 3**, although using time-weighted average prices rather than trade-weighted average prices.

Table 5: Time-weighted average price levels for 2019/20 (after removing 5 per cent contract premium)

CALENDAR QUARTER	40 DAY AVERAGE	12 MONTH AVERAGE	24 MONTH AVERAGE
Q3 2019	76.90	72.91	73.75
Q4 2019	67.74	63.71	65.13
Q1 2020	94.78	84.48	78.93
Q2 2020	64.32	66.15	66.97

Source: Base swap price data from ASX Energy and Analysis from Frontier Economics

Table 6: Summary of draft half-hourly spot prices for 2019/20 (based on historical quarters Q4 2017 to Q3 2018)

RATE TYPE		AVERAGE SPOT PRICE (C/KWH)
Single-flat rate		7.59
Time-varying rate	Peak	10.82
	Shoulder	7.66
	Off-peak	5.97

Table 7: Summary of draft export-weighted half-hourly spot prices for 2019/20 (based on historical quarters Q4 2017 to Q3 2018)

RATE TYPE		EXPORT-WEIGHTED AVERAGE SPOT PRICE (C/KWH)
Single-flat rate		7.96
Time-varying rate	Peak	12.78
	Shoulder	7.44
	Off-peak	7.48

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