MARKETS, PRICE TRENDS AND CLIMATE POLICY

TIM NELSON

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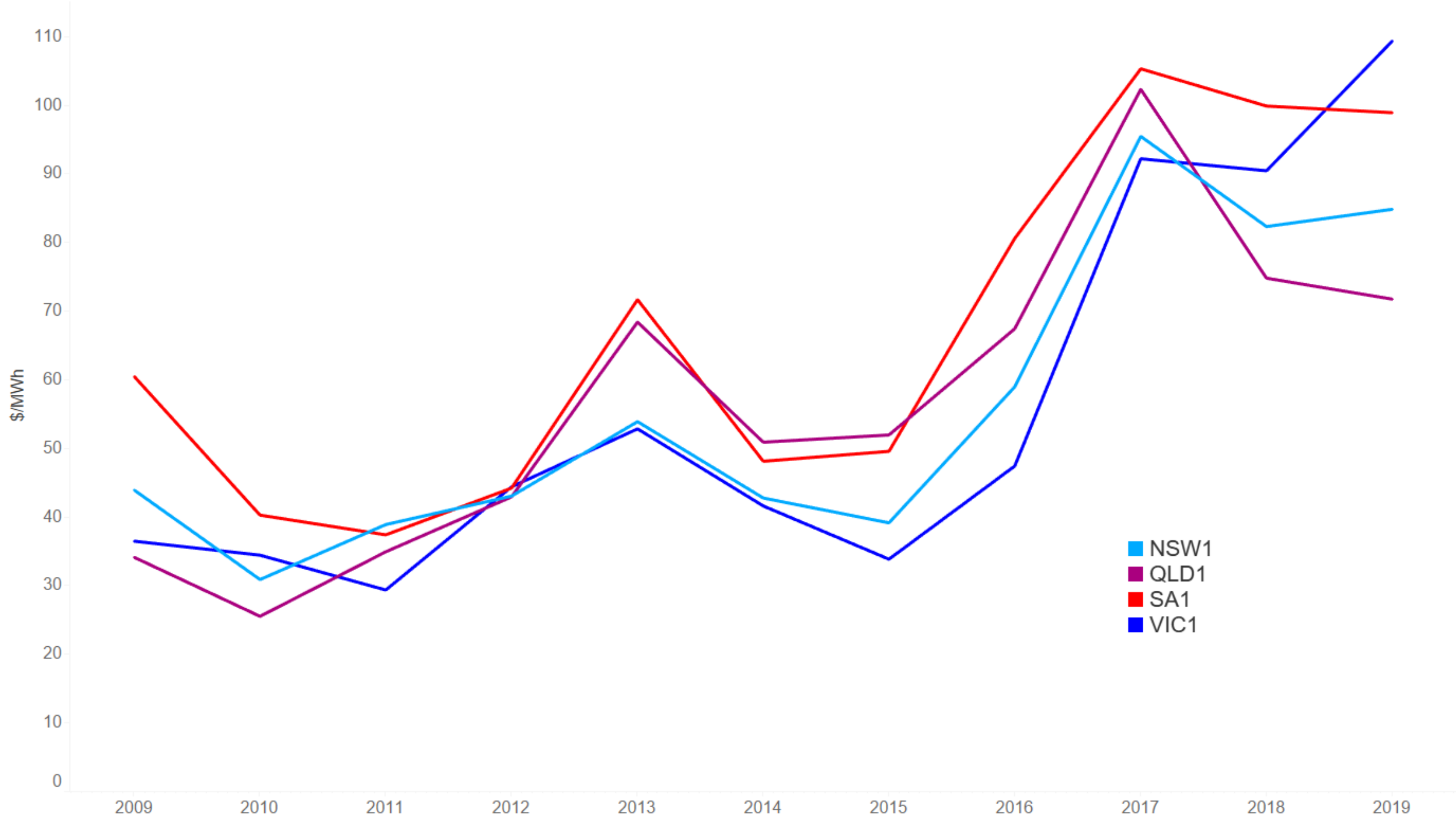
AEMC

CURRENT MARKETS

A FEW OBSERVATIONS

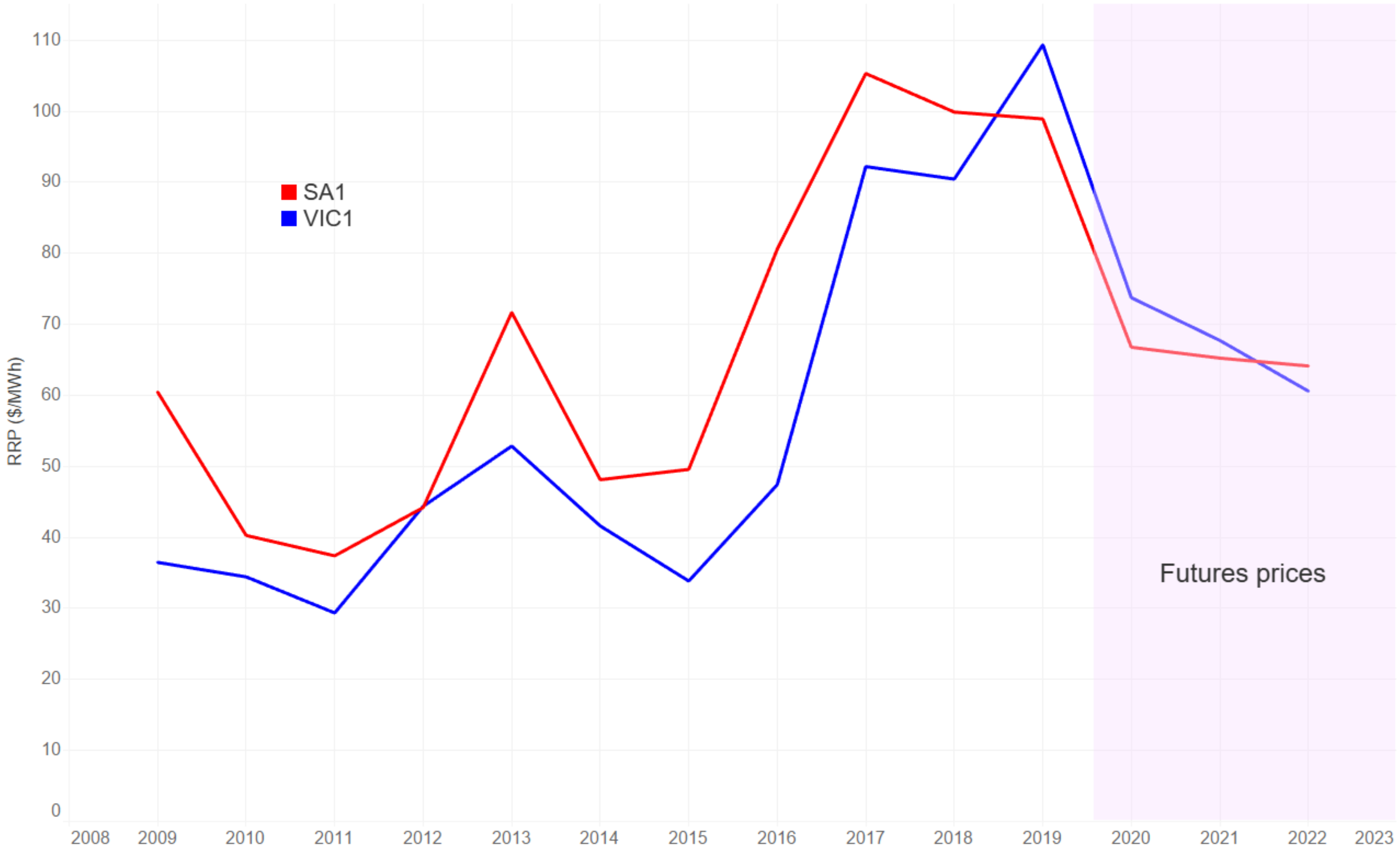
2019 saw relatively high prices across NEM regions

NEM annual time-weighted prices – 2009 to 2019



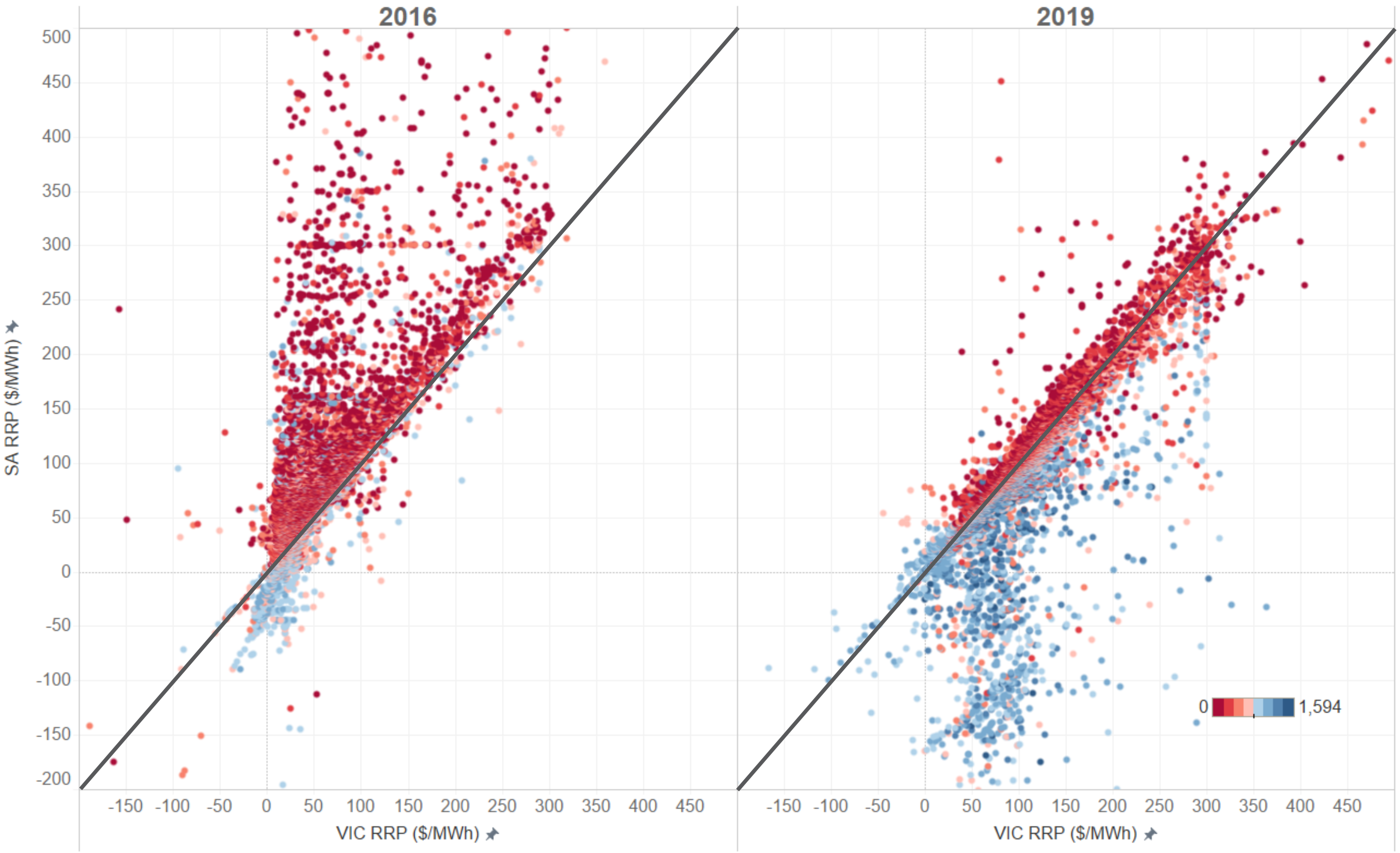
Futures prices suggest large falls in SA, VIC spot prices are imminent

SA, VIC actual and futures prices by year – 2009 to 2022



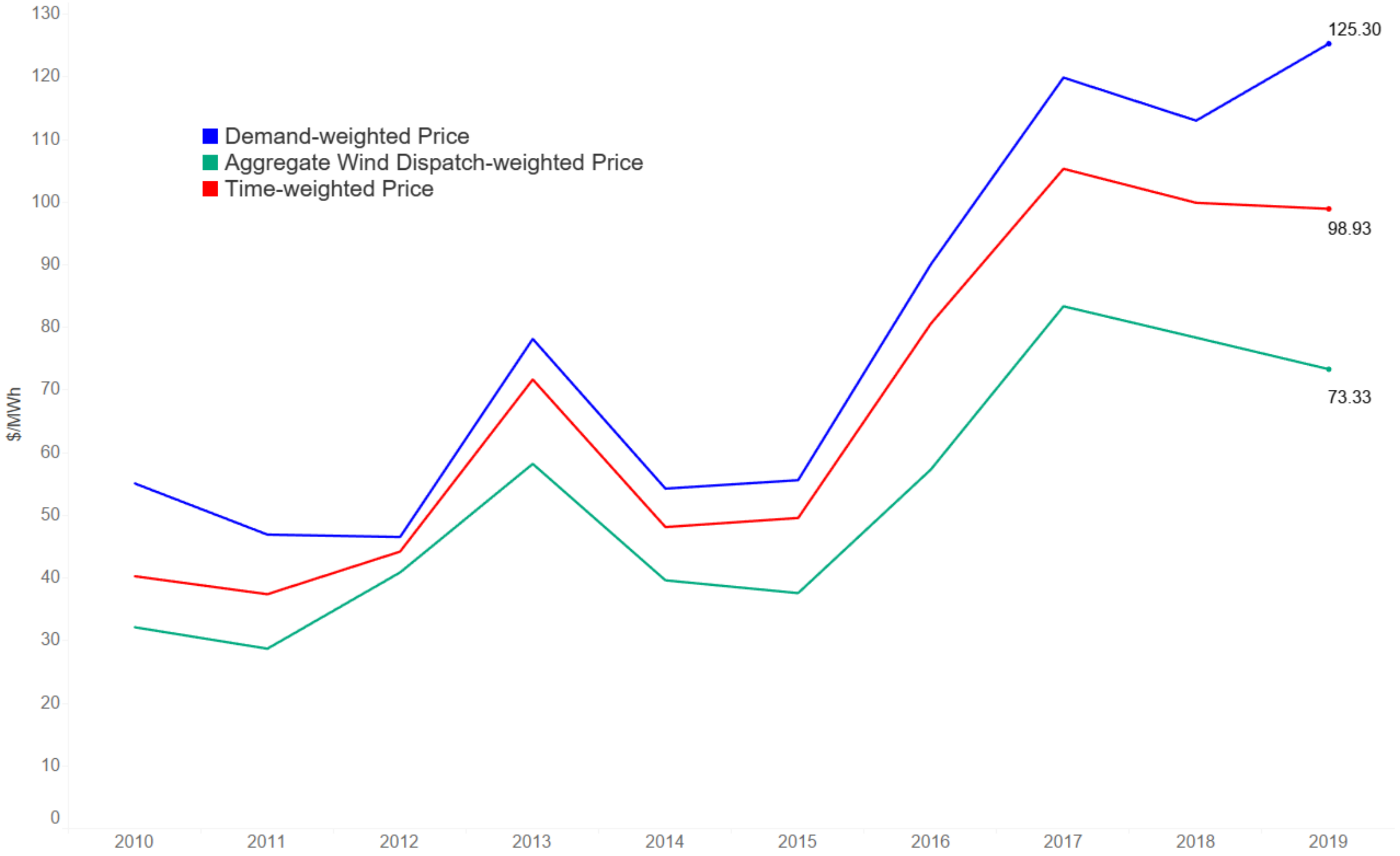
Profound change in joint distribution of SA, VIC prices

SA versus VIC RPP by half-hour, coloured by SA wind output, 2019

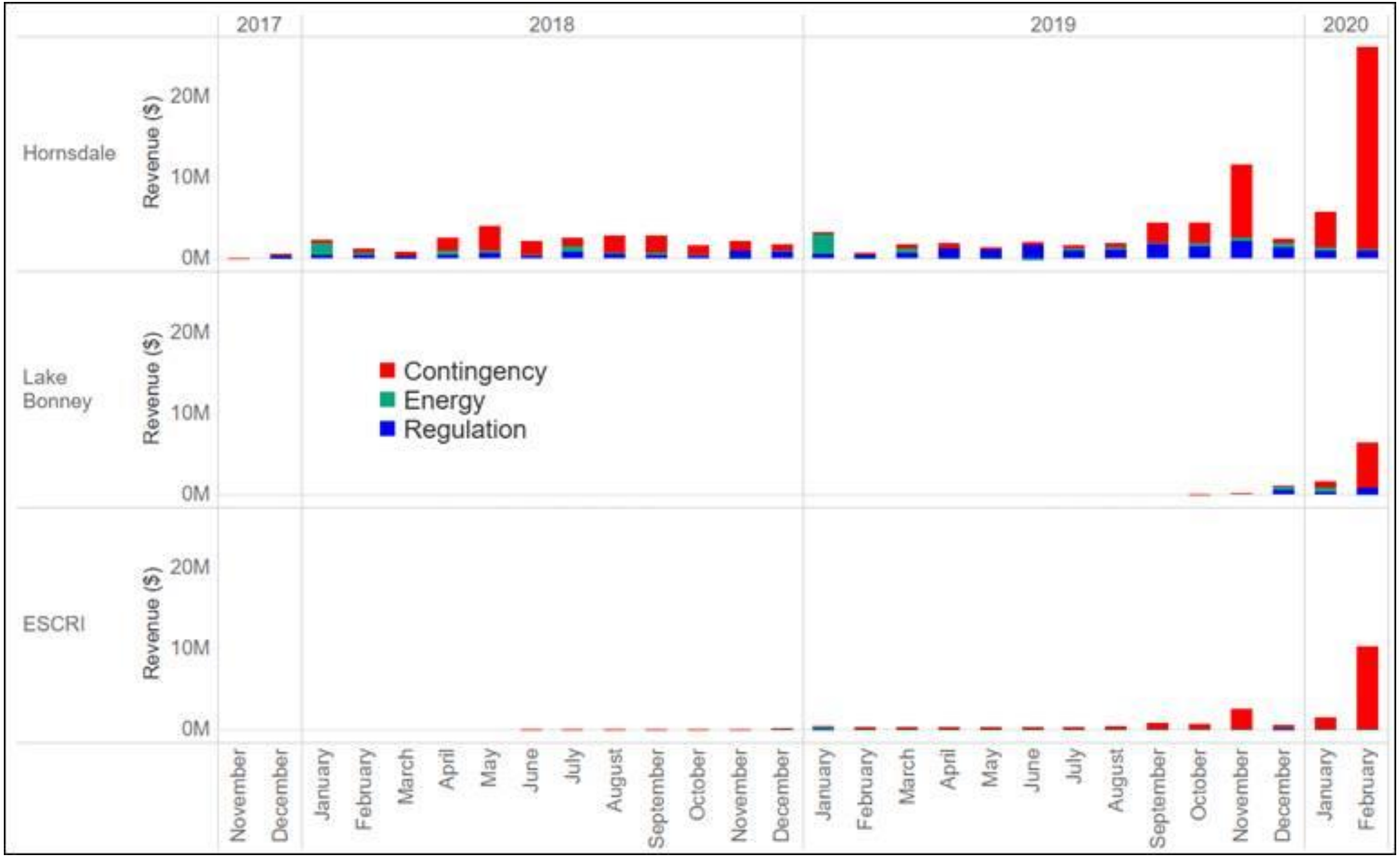


Wind farms earned a substantial discount to SA average price in 2019

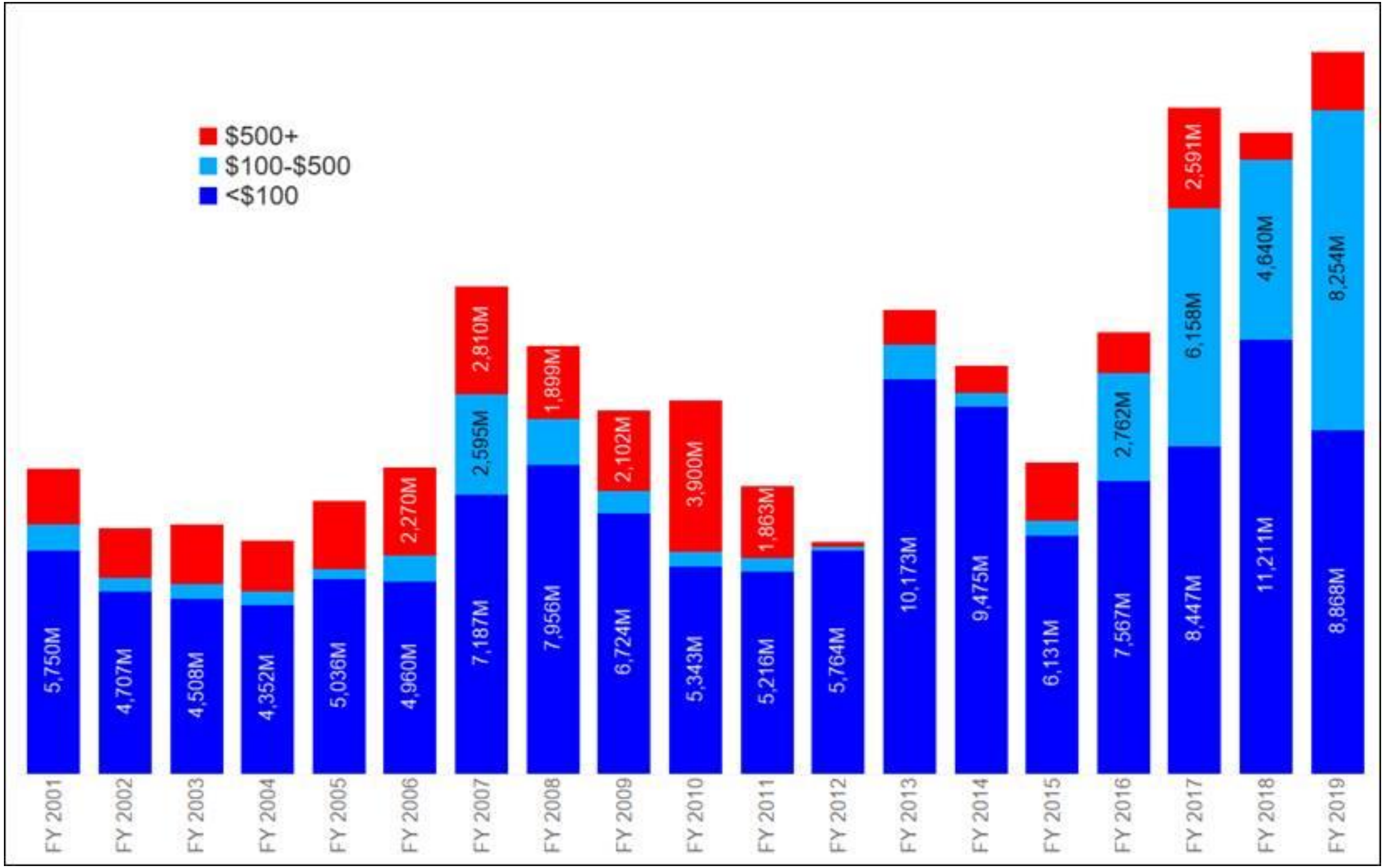
DWP, TWP, and WFTWP in SA, 2010 to 2019



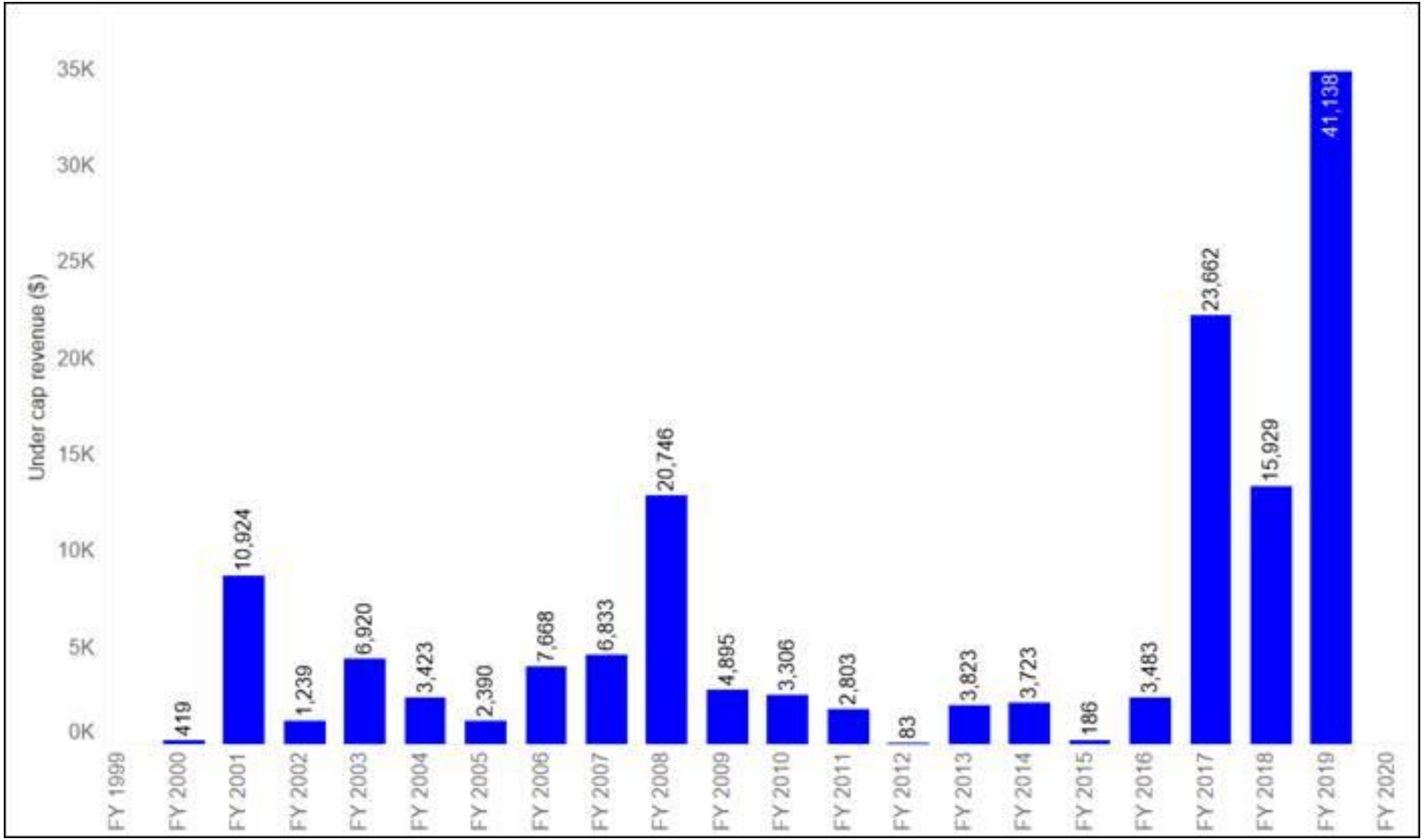
But what a time to own a battery!
Battery revenue by project over time



Significant uplift in value traded through the pool – particularly in $100-$500 price bands



Significant growth in undercap revenue for fast-start flexible plant (e.g. gas-fired OCGT)



PRICE TRENDS

A FEW OBSERVATIONS

Committed projects**

595 MW

- Maryborough – 35 MW
- Haughton – 133 MW
- Kennedy Energy Park – 15 MW
- Lilyvale – 100 MW
- Oakey – 25 MW
- Oakey 2 – 56 MW
- Rugby Run – 65 MW
- Yarranlea – 103 MW
- Warwick – 64 MW

496 MW

- Coopers Gap – 453 MW
- Kennedy Energy Park – 43 MW

210 MW

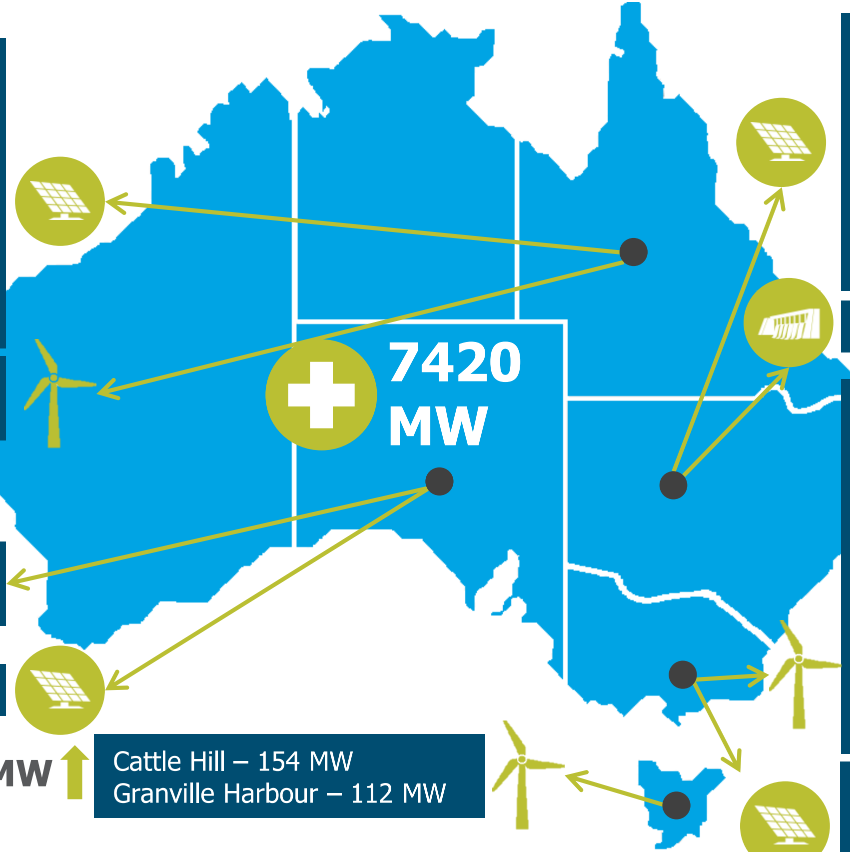
- Barker Inlet Power Station – 210 MW

135 MW

- Bungala Two – 135 MW

266 MW

- Cattle Hill – 154 MW
- Granville Harbour – 112 MW



1171 MW

- Bomen – 121 MW
- Darlington Point – 275 MW
- Molong – 30 MW
- Nevertire – 105 MW
- Sunraysia – 229 MW
- Finley – 162 MW
- Limondale 1 – 220 MW
- Limondale 2 – 29 MW

2040 MW

- Snowy 2.0* – 2040 MW

2070 MW

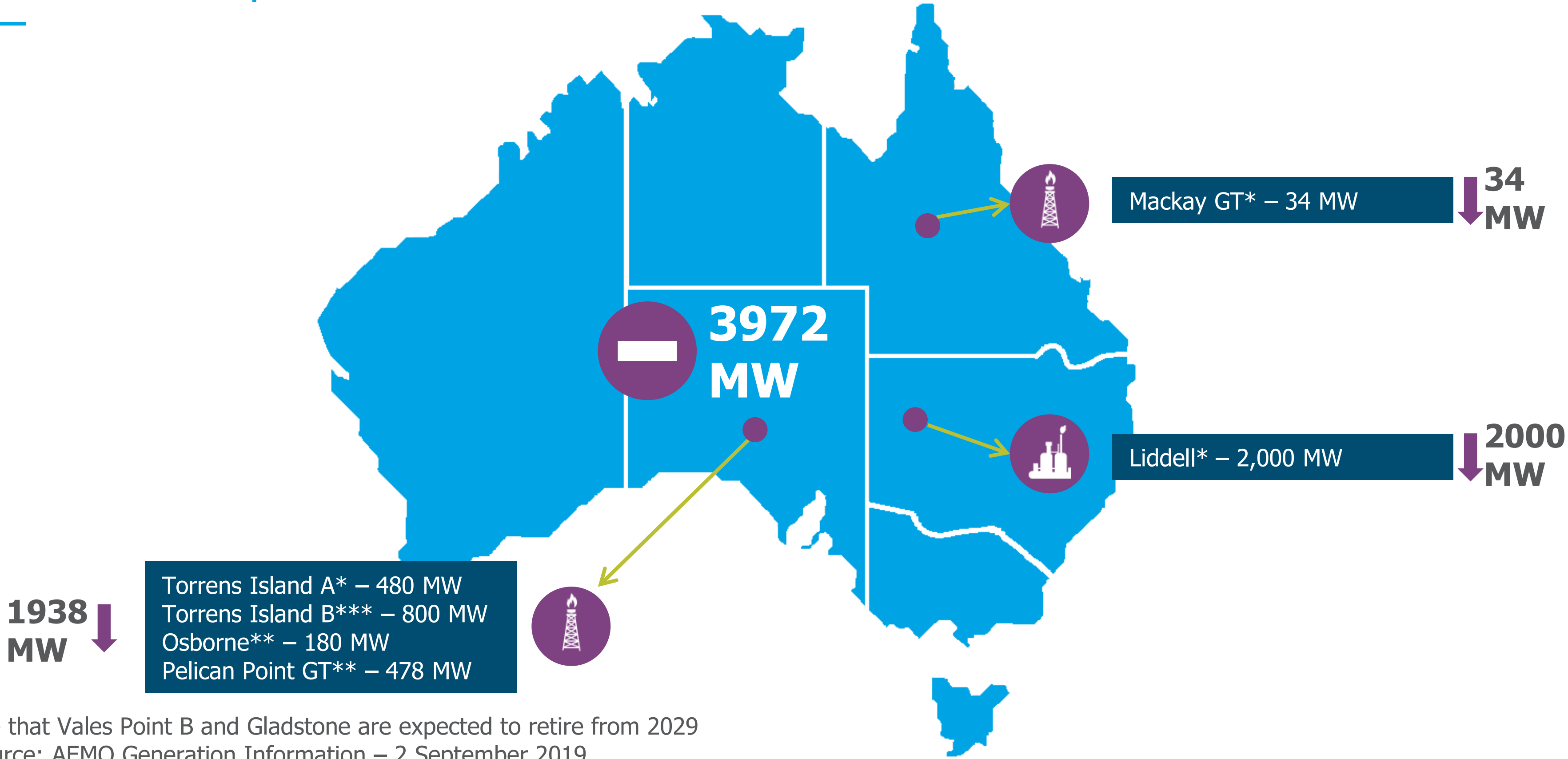
- Crowlands – 80 MW
- Bulgana – 204 MW
- Cherry Tree – 58 MW
- Dundonnell – 336 MW
- Lal Lal Elaine – 84 MW
- Lal Lal Yendon – 144 MW
- Lincoln Gap Stage 2 – 86 MW
- Moorabool – 320 MW
- Murra Warra Stage 1 – 226 MW
- Stockyard Hill – 532 MW

437 MW

- Kiamal Stage 1 – 200 MW
- Numurkah – 112 MW
- Yatpool – 94 MW
- Cohuna – 31 MW

*Snowy 2.0 is assumed to be in commercial use from April 2025 (ESOO 2019).
**Source: ESOO 2019

Retirement – map



Note that Vales Point B and Gladstone are expected to retire from 2029

*Source: AEMO Generation Information – 2 September 2019

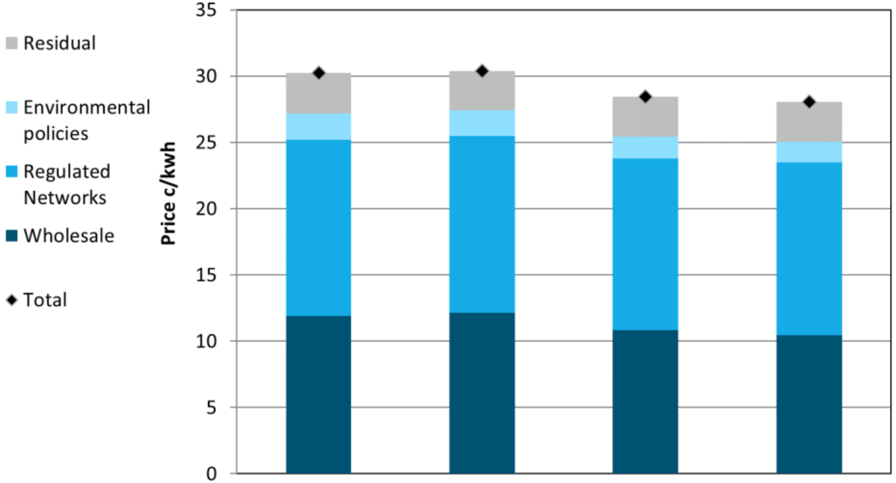
**Source: ESOO ISP 2018 – PLEXOS Model (These plants will retire when EnergyConnect (New interconnector between NSW and SA) comes online.

***Source: SA Energy Transformation RIT-T – Project Assessment Conclusions Report – 13 February 2019

National annual residential bill expects to go down over the reporting period*.

$97

Annual nominal residential bill (weighted by customer numbers) is expected to decrease by 7.1 per cent over the **whole** reporting period.



	2018/19 Base Year		2019/20 Current Year		2020/21		2021/22	
	c/kwh	$/year	c/kwh	$/year	c/kwh	$/year	c/kwh	$/year
Environmental policies	**1.98**	**$90**	**1.94**	**$89**	**1.67**	**$76**	**1.51**	**$68**
LRET	0.77	$35	0.64	$30	0.40	$19	0.27	$13
SRES	0.68	$31	0.74	$34	0.67	$31	0.62	$29
Jurisdictional Schemes	0.35	$16	0.39	$18	0.39	$18	0.41	$18
Efficiency Schemes	0.18	$8	0.18	$8	0.20	$8	0.20	$8
Regulated Networks	**13.28**	**$601**	**13.36**	**$604**	**12.94**	**$584**	**13.06**	**$590**
Transmission	2.22	$101	2.09	$95	2.18	$100	2.28	$105
Distribution	10.05	$456	10.34	$468	9.88	$446	9.90	$448
Metering	1.01	$44	0.93	$41	0.88	$38	0.87	$38
Wholesale	**11.90**	**$540**	**12.14**	**$550**	**10.84**	**$496**	**10.45**	**$477**
Residual	**3.05**	**$140**	**2.92**	**$132**	**2.97**	**$134**	**3.04**	**$137**
Total	**30.21**	**$1,370**	**30.35**	**$1,375**	**28.42**	**$1,290**	**28.06**	**$1,273**

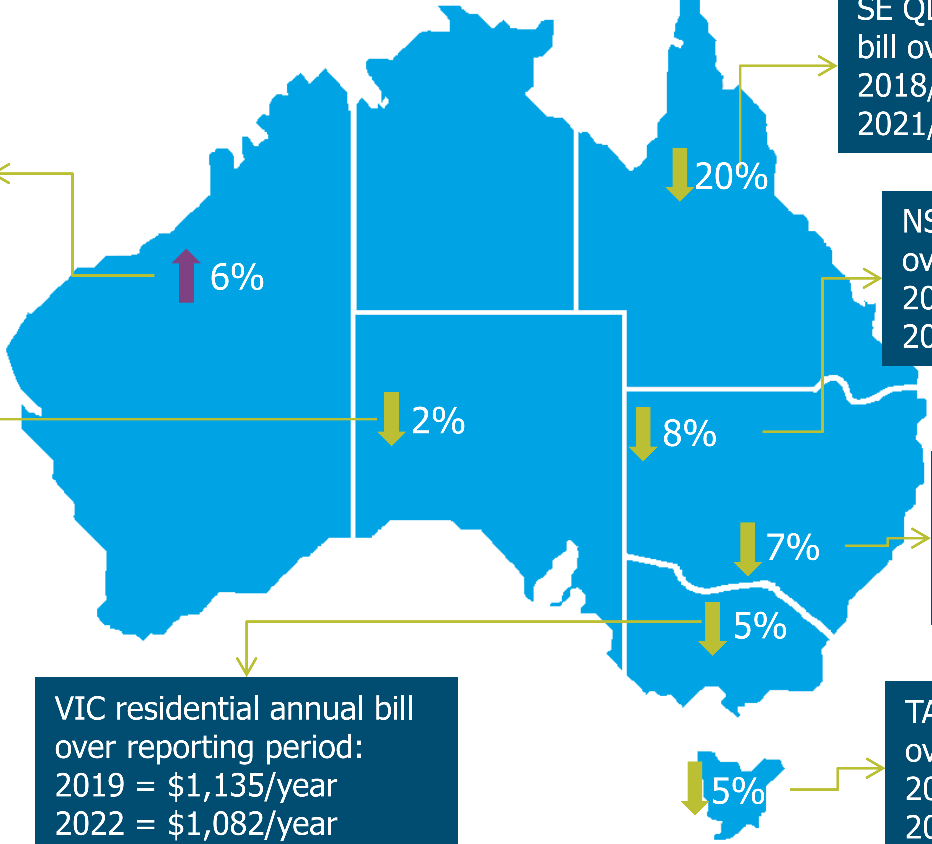
*Note that this figure excludes Northern Territory – see slide 3 for explanation.

Trends in residential bills by jurisdiction over 3-year period

WA residential annual bill over reporting period*:
2018/19 = $1,600/year
2021/22 = $1,702/year

SE QLD residential annual bill over reporting period:
2018/19 = $1,425/year
2021/22 = $1,147/year

NSW residential annual bill over reporting period:
2018/19 = $1,294/year
2021/22 = $1,187/year



ACT residential annual bill over reporting period:
2018/19 = $1,937/year
2021/22 = $1,803/year

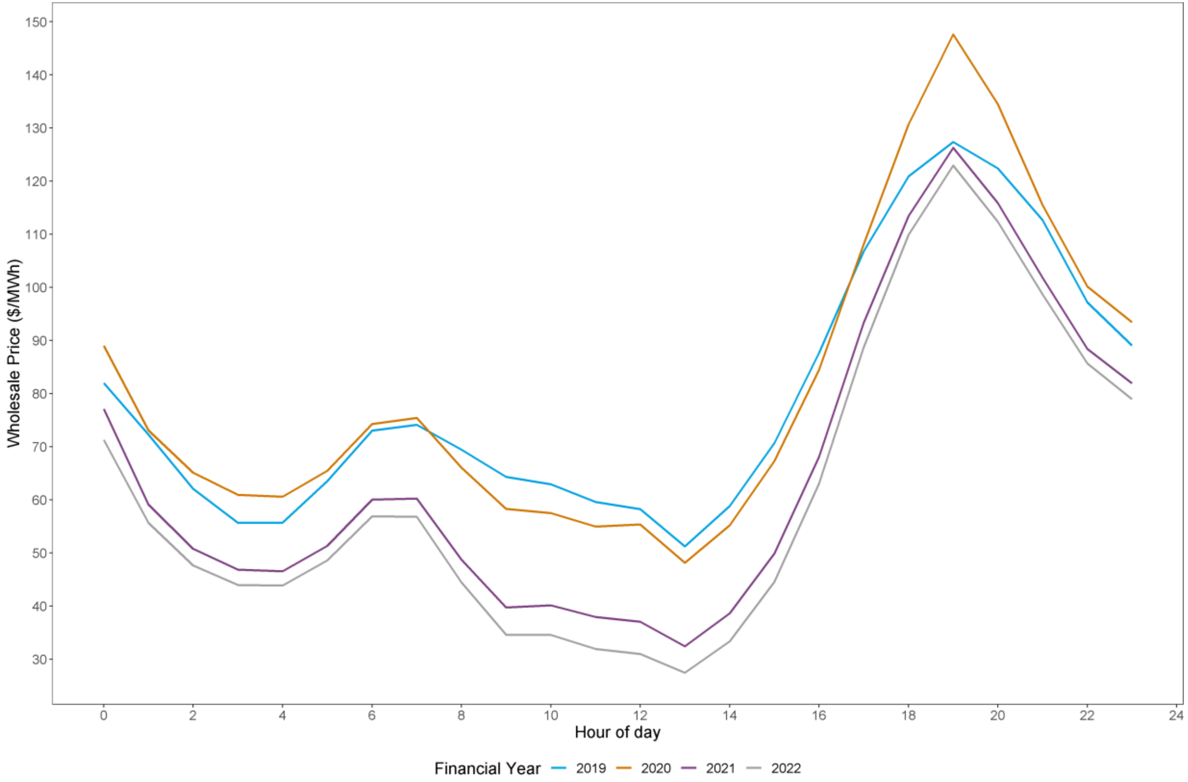
SA residential annual bill over reporting period:
2018/19 = $1,854/year
2021/22 = $1,826/year

VIC residential annual bill over reporting period:
2019 = $1,135/year
2022 = $1,082/year

TAS residential annual bill over reporting period:
2018/19 = $1,906/year
2021/22 = $1,813/year

* A different methodology has been used for WA allowing the AEMC to estimate both electricity cost of supply and residential price. Our results for WA should be treated with caution given the different methodology that has been used to establish these prices. Residential prices are set by WA Government.

What is driving a decrease in wholesale costs in QLD?

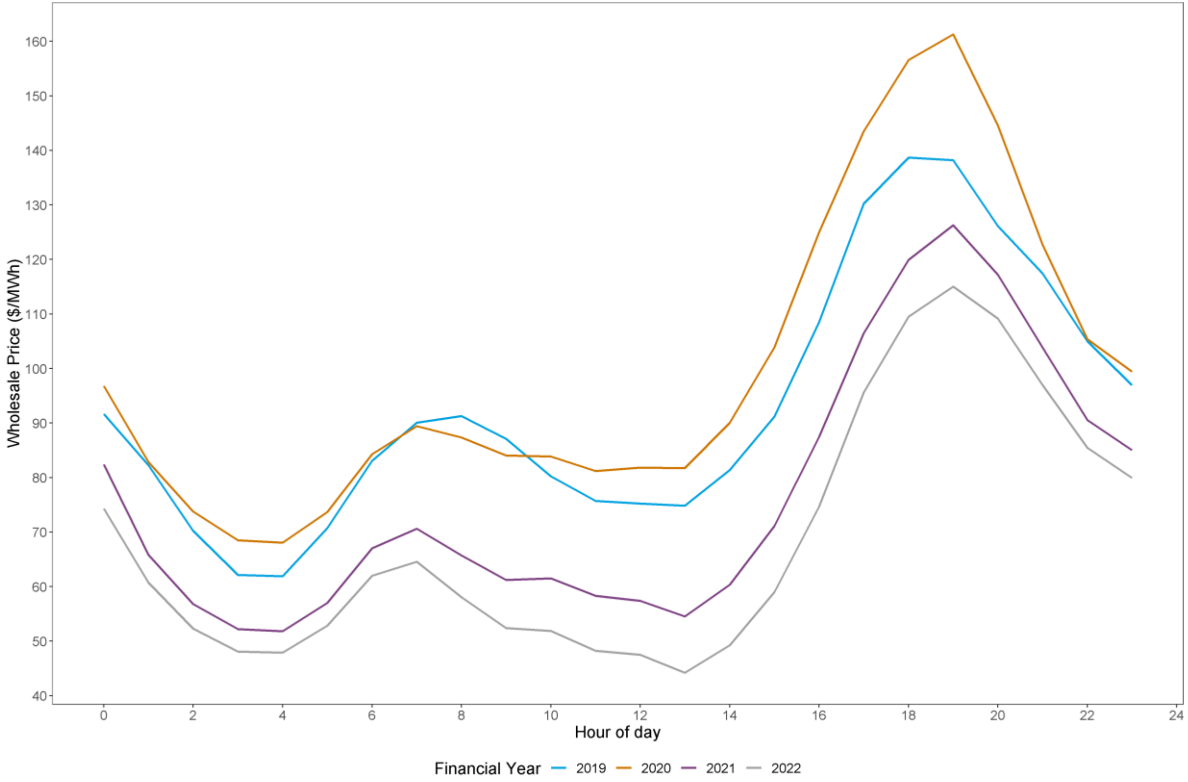


TYPE OF TECHNOLOGY	TOTAL CAPACITY OF COMMITTED BUILD (MW) IN 2022
Solar Farm	595
Wind Farm	496

By the end of 2022, total capacity of committed projects is 1,091 MW. This helps drive down the wholesale costs in QLD.

Total committed generation is only that category of generation sourced from AEMO that had reached financial close before the modelling was undertaken. Other new capacity may have been included as new generation within the modelling period. Since the modelling was undertaken, additional projects have been committed to across the NEM which would impact these results.

What is driving a decrease in wholesale costs in NSW?

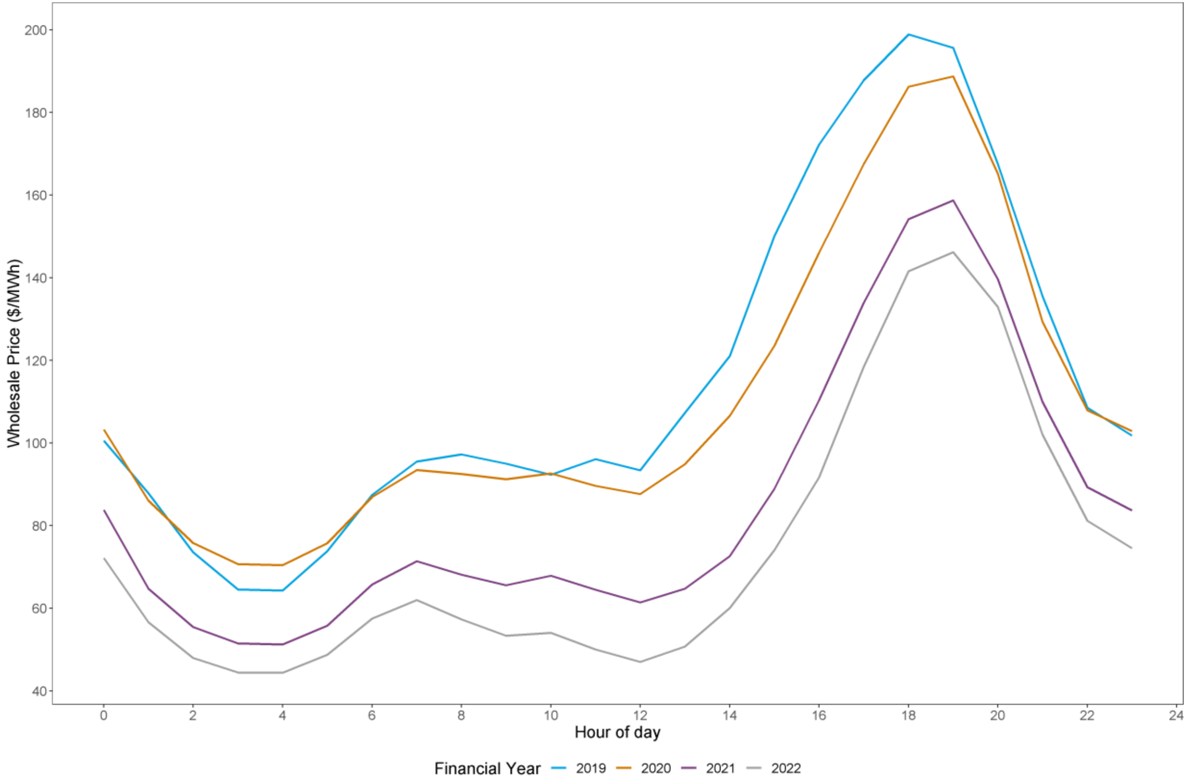


TYPE OF TECHNOLOGY	TOTAL CAPACITY OF COMMITTED BUILD (MW) IN 2022
Solar Farm	1,171

By the end of 2022, total capacity of committed projects is 1,171 MW. This helps drive down the wholesale costs in NSW.

Total committed generation is only that category of generation sourced from AEMO that had reached financial close before the modelling was undertaken. Other new capacity may have been included as new generation within the modelling period. Since the modelling was undertaken, additional projects have been committed to across the NEM which would impact these results.

What is driving a decrease in wholesale costs in VIC?

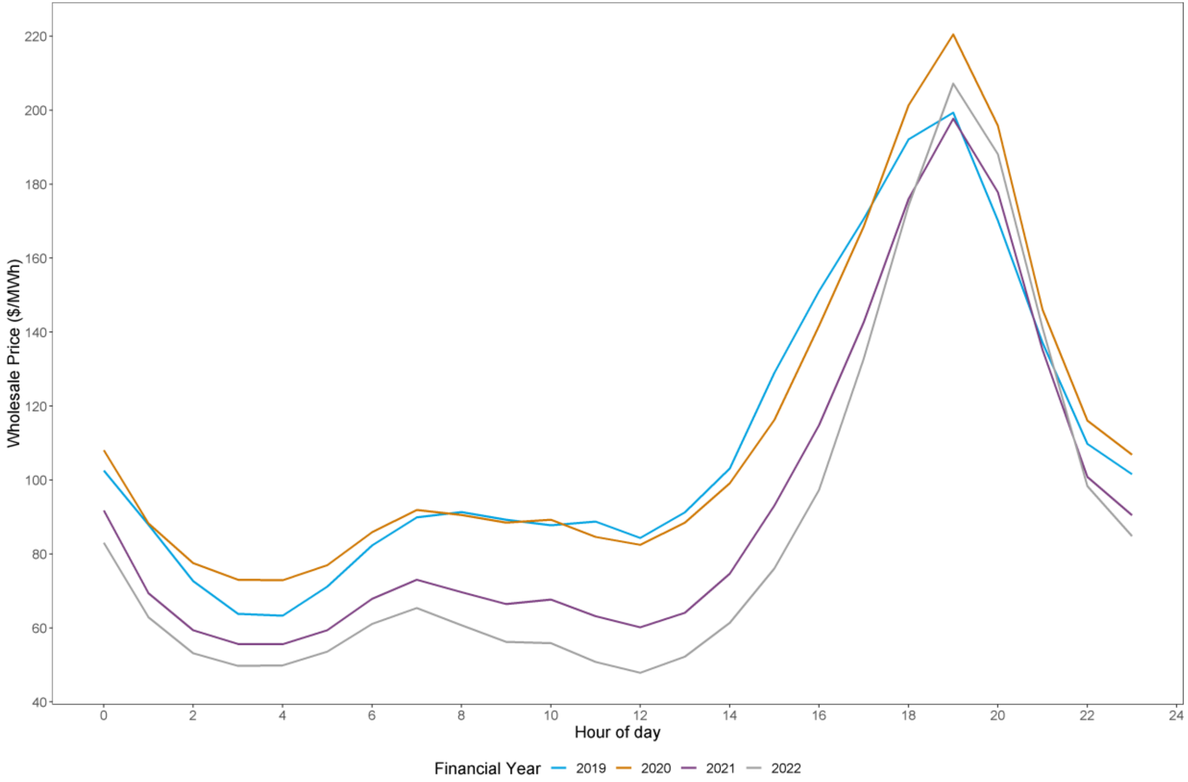


TYPE OF TECHNOLOGY	TOTAL CAPACITY OF COMMITTED BUILD (MW) IN 2022
Wind Farm	1,984
Solar Farm	437

By the end of 2022, total capacity of committed projects is 2,421 MW. This helps drive down the wholesale costs in VIC.

Total committed generation is only that category of generation sourced from AEMO that had reached financial close before the modelling was undertaken. Other new capacity may have been included as new generation within the modelling period. Since the modelling was undertaken, additional projects have been committed to across the NEM which would impact these results.

What is driving a decrease in wholesale costs in SA?



TYPE OF TECHNOLOGY	TOTAL CAPACITY OF COMMITTED BUILD (MW) IN 2022
Wind Farm	86
Solar Farm	135

By the end of 2022, total capacity of committed projects is 221 MW. A decrease in wholesale costs in SA is partly driven by the interconnection between SA and VIC.

Total committed generation is only that category of generation sourced from AEMO that had reached financial close before the modelling was undertaken. Other new capacity may have been included as new generation within the modelling period. Since the modelling was undertaken, additional projects have been committed to across the NEM which would impact these results.

PFITS

A NEW SPLIT INCENTIVE PROBLEM

Batteries – a new ‘split-incentive’ problem

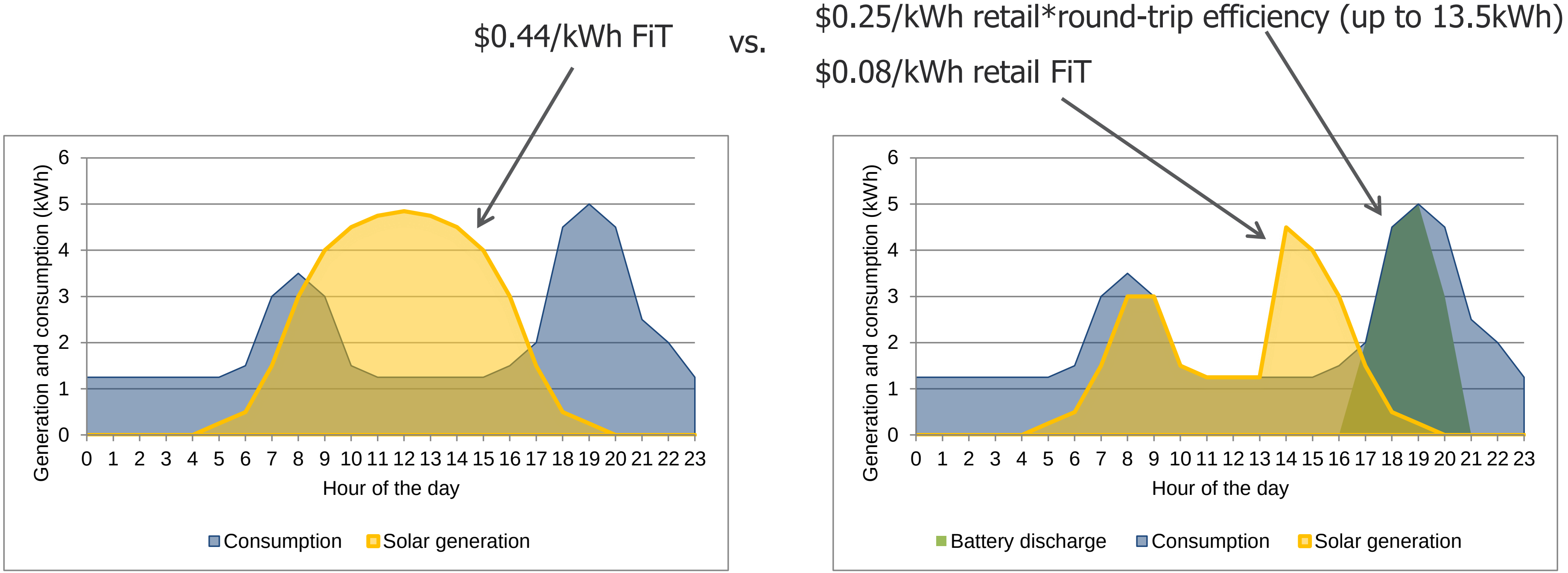
- Battery business case relies upon pricing arbitrage
  - Charge when prices are low
  - Discharge when prices are high

- ‘Average cost’ flat tariffs discourage battery uptake
  - System benefits not part of the economic decision
  - Split incentive between society and the householder

- Solar PV feed-in tariffs are ‘locked-in’ for nearly a decade

- These PFiT policies lead to an enhanced ‘split incentive problem’

The trade off is between the SBS FiT and an avoided retail tariff

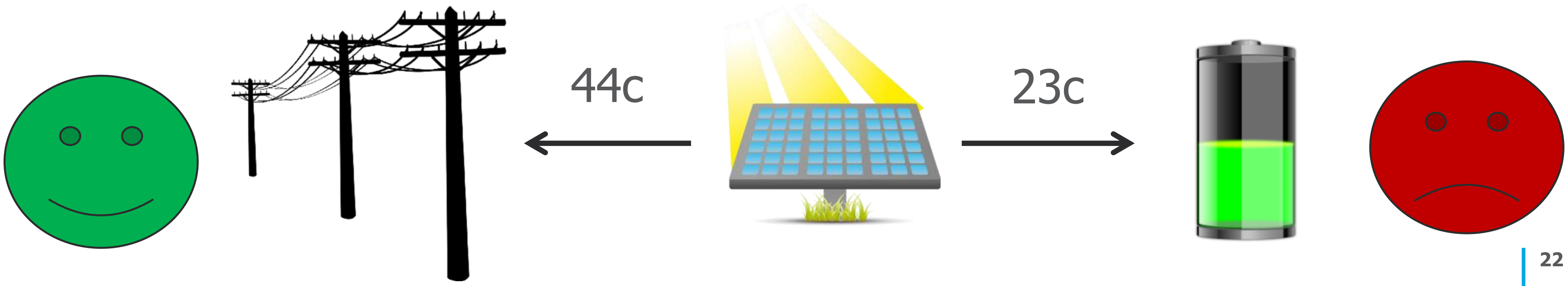


- The customer is effectively choosing between a $0.44/kWh FiT and a $0.25/kWh avoided retail tariff
- As the existing scheme is so generous and retail tariffs are flat it is likely that uptake of the battery option would be very low

The consumer's decision – weighing costs and benefits

- A rational consumer will not give up their FiT to take up the battery option.
    - Consider: a customer currently exporting 10 kWh per day would be giving up 10*0.44 = $4.40/day in order to save 10*0.9*0.25 = $2.25/day off their retail bill

- From the customer's perspective the battery option is effectively a machine for turning 44c into 23c



But significant system benefits from avoiding localised peak demand growth

Table 2: Calculated LRMC for 2020-21

DISTRIBUTION AREA	LRMC
Energex	$135/kW
Ergon East	$312/kW
Ergon West	$781/kW

Source: Ergon Information guide for SCS, Energex Annual Pricing Proposal 2019-20
Note: Values inflated to 2020-21 by 2% p.a.

Additional benefits for the customer and the system

Customer benefits

- Battery typically has 10 year warranty so will provide benefits beyond the 8-year FiT horizon
- May be additional charge/discharge benefits if there is a move to cost-reflective pricing
- May also reduce PV curtailment in areas of high PV penetration

System benefits

- In addition to avoided network requirements batteries provide local network service and ancillary service benefits – for e.g. voltage and frequency services
- Wholesale market benefits by shifting PV generation to smooth evening peak

CLIMATE AND ENERGY

OVERCOMING PRODUCTION SUBSIDY LIMITATIONS

Observed experience

1. Tax and trading schemes
    i. GGAS
    ii. Clean Energy Future
2. Direct regulation
    i. Emission Reduction Fund
3. Subsidy schemes
    i. QLD 18% Gas
    ii. LRET
    iii. CfDs
    iv. SRES, PFiT

Different policy instruments – an assessment framework

		Cost effectiveness - lowest cost abatement						Environmental effectiveness			Efficacy of implementation			
Policy		CE1	CE2	CE3	CE4	CE5	CE6	EE1	EE2	EE3	EI1	EI2	EI3	EI4
Tax and trading schemes	ETS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Neutral	Yes
	EIS	Yes	Yes	Yes	Yes	Neutral	Neutral	Neutral	Yes	Yes	Yes	Yes	Yes	Yes
	Carbon tax	Yes	Yes	Yes	Yes	Yes	Neutral	Neutral	Yes	Yes	No	Yes	Yes	Yes
	Baseline and credit	Yes	Neutral	Yes	Yes	Neutral	Yes	Neutral	No	Neutral	Neutral	Neutral	Neutral	Yes
Subsidy schemes	ERF	Yes	Yes	Neutral	Yes	Neutral	No	No	No	No	Yes	No	Neutral	Neutral
	RET/ CET	Yes	No	Neutral	No	No	No	No	Neutral	Neutral	Yes	No	No	No
	CFD	Yes	No	Yes	No	No	No	No	Neutral	Neutral	Yes	No	No	No
Direct regulation	Coal closure	No	Yes	No	No	Yes	No	Neutral	Neutral	Neutral	Yes	No	No	No

So where to from here? Overcoming the limitations of production subsidies

- Economics suggests a well-designed price to internalise the externality of producing emissions is the optimal policy response

- Real-world political economy indicates this may not be possible

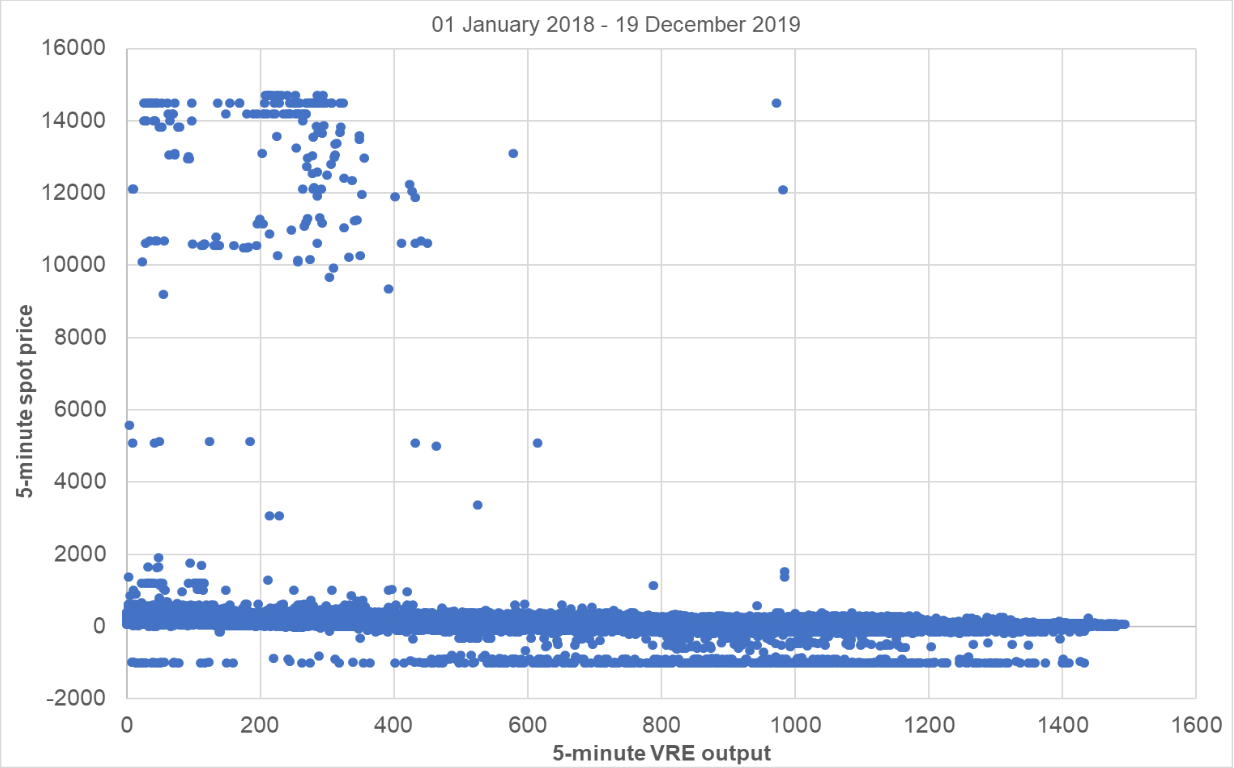
- Production subsidies are generally regarded as better than taxes

- Can production subsidies be designed to overcome the two main limitations
  - Co-incident production and accentuated merit-order effect
  - Disincentive to participate in hedge markets due to long dated PPAs

Limitation 1 – Accentuated merit-order effects

- Option 1 - Link the quantity of subsidy to the spot price – 3 possible functions below:
  - $Q_{i,credit}^{t,x} = f\left(Price_{SPOT}^{t,x}, Q_{i,MWh}^{t,x}\right)$
  - $Q_{i,credit}^{t,x} = \begin{cases} Q_{i,MWh}^{t,x}\ when\ Price_{SPOT}^{t,x} \geq X \\ 0\ otherwise \end{cases}$
  - $Q_{i,credit}^{t,x} = \begin{cases} Q_{i,MWh}^{t,x}\ when\ Price_{SPOT}^{t,x} > X_4 \\ 0.8 * Q_{i,MWh}^{t,x}\ when\ Price_{SPOT}^{t,x} \in (X_3, X_4] \\ 0.6 * Q_{i,MWh}^{t,x}\ when\ Price_{SPOT}^{t,x} \in (X_2, X_3] \\ 0.4 * Q_{i,MWh}^{t,x}\ when\ Price_{SPOT}^{t,x} \in (X_1, X_2] \\ 0.2 * Q_{i,MWh}^{t,x}\ when\ Price_{SPOT}^{t,x} \in [X_0, X_1] \\ 0\ when\ Price_{SPOT}^{t,x} < X_0 \end{cases}$

Limitation 1 – Accentuated merit-order effects



Limitation 1 – Accentuated merit-order effects

- Option 2 - Link the quantity of subsidy to the emissions intensity of the market:
  - $Q_{i,credit}^{t,x} = f\left(EI_{tonnes}^{t,x}, Q_{i,MWh}^{t,x}\right)$

- Average intensity of the market at any point in time determines quantity of subsidy
  - High EI, higher quantum of subsidy
  - Lower EI, lower quantum of subsidy

- Marginal intensity could be used for a more accurate outcome – administratively difficult to determine

Limitation 2 - Restoring contract market liquidity – firm capacity credit

- The continued use of existing production subsidies is likely to disincentivise producers of new variable renewable energy from entering into financial derivative contracts as PPAs blunt the important inter-temporal pricing signals from the spot market. There is therefore still a potential gap on the *supply-side* of the financial derivative market, despite the RRO being in place.

- This supply-side gap is relatively easy to address. As part of the architecture of any production subsidy-style policy, policy makers could require generators to demonstrate to the regulator that they have entered into, or supported the development of, financial derivative contracts for a proportion of the nameplate capacity of the new renewable project. Following verification by the regulator, the proponent would be allocated a 'firm capacity credit certificate' which would be required to register to receive any form of production subsidy.

Important to consider optimal plant mix and impact of ageing plant