Lessons Learned Report #2

Renewable Energy Hub

July 2020

Contents

This Project received funding from ARENA as part of ARENA's Advancing Renewables Program.

Glossary of Terms

AEMO	Australian Energy Market Operator
ARENA	Australian Renewable Energy Agency
Cap Contract	A cap contract provides electricity purchasers with insurance against high prices. The standard contract traded in the Australian market is a "$300 cap". The buyer pays a regular premium to the seller, and in exchange the seller of the cap is required to pay to the buyer the difference between the spot price and $300/MWh every time the spot price exceeds $300/MWh during the specified contract period.
DER	Distributed Energy Resources
Futures Contract (energy)	A futures contract is a legal agreement to buy or sell energy at a predetermined price at a specified time in the future.
Firming	Firming up supply means guaranteeing supply from other sources in the event of intermittency issues with solar and wind generation. Typical physical firming resources include battery or pumped hydro storage. Financial firming solutions include futures contracts and insurance products.
Hedge Contract (energy)	A hedge contract involves establishing a (contracted) position in the futures or options market that is equal and opposite to a position at risk in the physical energy market. It is intended to offset potential losses or gains that may be incurred by rising or falling energy prices.
Option Contract (energy)	An options contract offers the buyer the opportunity to buy or sell—depending on the type of contract they hold—the underlying energy. Unlike futures, the holder is not required to buy or sell the asset if they choose not to exercise their option.
Offtake Agreement	An offtake agreement is an arrangement between a producer and a buyer to purchase or sell portions of the producer's energy generation.
PPA	Power Purchasing Agreement – an example of an offtake agreement
Pumped Hydro	A type of hydroelectric energy storage used by electric power systems for load balancing. The method stores energy in the form of gravitational potential energy of water, pumped from a lower elevation reservoir to a higher elevation
Swap Contract (energy)	A swap is an agreement whereby the floating spot (or market) price in a particular NEM region is exchanged, or 'swapped', for a fixed price, over a specified period(s) of time. If the spot price is above the agreed strike price the seller pays the buyer the difference. If the spot is lower than the strike then the buyer pays the seller the difference. Energy consumers and retailers utilise swaps in order to fix or lock in their energy costs, while energy generators utilise swaps in order to lock in or fix their revenues.
VRE	Variable Renewable Energy

Executive Summary

Project Summary

Renewable Energy Hub has commenced an 18-month project with support from the Australian Renewable Energy Agency (ARENA). The Project will work with market participants to develop specifications for a suite of innovative, standardised hedge contracts that are suited to both variable renewable energy (VRE) generators and new sources of clean dispatchable capacity (e.g. battery storage, pumped hydro storage and demand response), as well as the changing needs of energy retailers and large customers.

The Project also involves the development of a digital platform that will enable prospective counterparties to access live market pricing, assess the value of the new hedge contracts, evaluate the risks of different contract positions under a range of scenarios and provide a point of market access for new and emerging clean energy providers (the Project).

Project Rationale

The rationale for this Project is as follows:

- The rapid transformation of the Australian electricity system towards higher penetration of VRE requires commensurate innovation in financial markets. These two components – the physical and financial elements of the electricity system, must both evolve as the system transitions towards a renewable energy future.
- The current suite of products (swaps, caps and options) used in the financial market were designed several decades ago and have not changed materially to accommodate the transforming supply/demand and price dynamics created by the rapid deployment of wind and solar (both utility scale and behind the meter).
- Traditional hedge contracts allow electricity retailers and large electricity users manage price risk associated with the electricity that they buy. Generators also rely on hedge contracts to manage risk of volatile wholesale electricity prices, smooth revenue flows and underpin financing for new projects.
- The electricity supply mix is changing due to rapid and sustained growth in VRE generation and this is changing the hedging needs of parties with electricity price exposure, requiring new hedge contracts for those parties to use to cover their exposure.
- At the same time, the traditional suppliers of existing hedge contracts are withdrawing from the market (in the case of coal generators), are exposed to high fuel prices (peaking gas generators) or constrained by drought (in the case of hydro plants) creating scarcity and high prices in the existing hedge market.

- New providers of clean dispatchable capacity such as batteries, pumped hydro and demand response are not able to physically defend their financial exposure under existing hedge contracts due to the duration of their exposure. For example, current "peak" swap contracts traded on the ASX cover the period from 7am to 10pm; batteries and demand response with 1 or 2 hours of output capability, or even pumped hydro with up to 6 hours of output, expose themselves to significant risk taking on these longer duration contracts, and so are largely absent from the contract market.
- Creating new hedge contracts, tailored to the physical characteristics of both VRE and clean dispatchable capacity assets creates a point of access for VRE and dispatchable capacity projects to the contracts market. Creating a liquid forward market in firm hedge contracts opens up new sources of revenue for clean energy providers, and most importantly has the potential to unlock finance for these new assets.
- Likewise, creating new hedge contracts that more efficiently manage the risk and volatility of the changing supply/demand and price dynamics in the system will enable retailers (and by implication, their customers) to more cost effectively hedge the price of electricity in a high renewables system.

Report Overview

The purpose of this 'lessons learned' report is to outline the key insights generated over the last quarter of activity by the Project with a focus on recent trading activity in our new hedge contracts.

In this lessons learned report, the following elements will be covered:

1. **Market Insights.** Insights into the current suite of products that are being traded or under development by Renewable Energy Hub. We discuss the successful launch of our Super Peak contract, diving into some of the trade data as we begin to understand how the market is valuing this new contract.
2. **New Product Development.** We detail our new Virtual Storage contract which will enter the market in Q3 2020, in both its short and long duration incarnations.
3. **Software development.** Provide a brief update on the software development of the 'Hub' and how it has progressed; and
4. **Broader external market reflections.** A view on the external energy industry landscape, particularly the impact of Covid 19 and how the pandemic might influence the development roadmap for the Renewable Energy Hub.

Renewable Energy Hub is delighted by the level of industry support exhibited for the project to date and looks forward to further progressing this ARENA-funded project.

1. Market Insights

Super Peak contract – successful launch

Over the last quarter Renewable Energy Hub has successfully launched a new hedge contract into the wholesale electricity market – the Super Peak. The contract was launched in March 2020 with an inaugural trade between Snowy Hydro and a confidential buyer announced on 31st March.

The 'Super Peak' swap contract targets intra-day and seasonal peaks offering a new hedging option for participants with exposure during emerging 'super peak' shoulder periods. The product seller is likely to be suited to dispatchable, peaking generators (e.g. hydro) and energy storage operators (eg pumped hydro and batteries).

The shaded areas in the figure below show the half hourly profile of the contract; an evening super peak in Q1 and Q4, and both a morning and evening peak in Q2 and Q3.

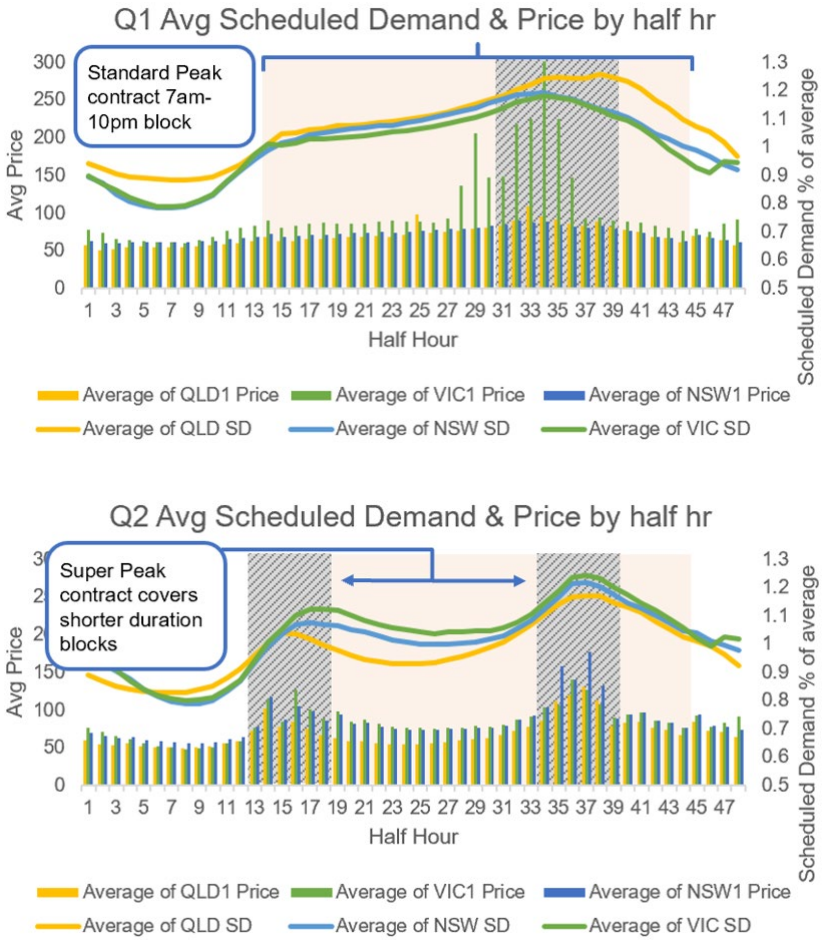

Figure 1: SUPER PEAK PRODUCT Q1 and Q2 DAILY PROFILE (grey shaded area) & STANDARD PEAK CONTRACT (light orange shaded area) COMPARED TO AVERAGE DAILY SCHEDULED DEMAND AND SPOT PRICE (RRP) IN VIC, NSW and QLD (2018 AEMO price and demand data).

Since this first trade, Renewable Energy Hub has successfully supported a number of transactions in the new contract. Table 1 below provides details of the publicly reported trades brokered by Renewable Energy Hub.

As well as providing trade prices, Table 1 also indicates the relative value to the equivalent baseload (or "flat") and peak futures contracts on the same date as the trades occurred. As discussed in the previous lessons learned report, one approach to evaluating the new Renewable Energy Hub contracts is to understand their value relative to well established futures contracts.

Based on the trades to date, the average difference in value to the baseload contract is 169% and to the peak contract 132%. Note that these averages are based on all regions and all tenors traded to date, and from a relatively small sample of 17 reported trades, however, they do provide market participants with an indication for pricing levels.

While the face value of the Super Peak contract is higher than the standard Peak or Baseload contract this does not mean that the buyer is paying more for energy across their total portfolio. Because of the lower number of Trading Intervals (and hence MWhs) covered by this new contract, they potentially represent a more cost effective and efficient hedging tool for retailers. Given the new intra-day pricing dynamics in the Spot market, buyers of Peak and Baseload contracts are potentially over-hedged (ie. overpaying for energy) in the middle of the day when prices are lower. With the product innovation introduced by the Project, natural buyers such as retailers have additional hedging options to help them manage Spot market volatility.

					EOD Price		Relativities	
Trade date	Region	Term	Vol (MW)	Trade Price	Peak	Flat	SP-Flat	SP-Peak
11/03/2020	NSW	Cal21	25	$ 107.00	$ 78.41	$ 62.83	170%	136%
11/03/2020	NSW	Cal22	25	$ 107.00	$ 74.42	$ 61.87	173%	144%
23/03/2020	NSW	FY21	25	$ 102.00	$ 79.33	$ 62.17	164%	129%
30/04/2020	QLD	FY21	25	$ 71.25	$ 56.62	$ 47.12	151%	126%
30/04/2020	QLD	FY21	10	$ 72.75	$ 56.62	$ 47.12	154%	128%
1/05/2020	QLD	FY21	15	$ 73.50	$ 56.62	$ 45.96	160%	130%
12/05/2020	QLD	Cal21	50	$ 71.50	$ 54.88	$ 43.86	163%	130%
19/05/2020	QLD	Q420	10	$ 60.50	$ 49.00	$ 39.50	153%	123%
27/05/2020	QLD	FY21	10	$ 73.50	$ 55.72	$ 47.51	155%	132%
4/06/2020	QLD	FY21	10	$ 74.50	$ 55.28	$ 45.44	164%	135%
11/06/2020	QLD	Q122	10	$ 103.50	$ 78.00	$ 63.25	164%	133%
16/07/2020	QLD	Cal22	10	$ 72.00	$ 59.65	$ 39.30	183%	121%
17/07/2020	QLD	Cal22	10	$ 73.00	$ 59.65	$ 39.20	186%	122%
17/07/2020	QLD	Cal22	10	$ 73.00	$ 59.65	$ 39.20	186%	122%
17/07/2020	VIC	Cal21	5	$ 121.00	$ 83.73	$ 59.38	204%	145%
22/07/2020	NSW	Cal21	25	$ 100.00	$ 72.63	$ 55.82	179%	138%
23/07/2020	QLD	Q420	10	$ 66.50	$ 45.00	$ 36.00	185%	148%

TABLE 1: SUPER PEAK CONTRACT TRADES MARCH TO JULY 2020 (EOD = End of Day, prices provided by TFS Australia). Noting that settlements are calculated bilaterally by counterparties not by Renewable Energy Hub.

The relatively small transaction sizes are standard for the contract trading market and are in alignment to the standard parcel sizes on ASX. The PPA market is very different where transactions might be for a whole project (100s MW) with tenors lasting over a decade. The contract market operates very differently, offering liquidity in standardised products that are a firm volume, and are not subject to project related risks such as construction or connection delays.

Queensland dominates early markets

As can be seen from Table 1, the Super Peak contract has been actively trading in Queensland. One possible driver for this activity is the growing 'duck curve' demand profile and associated spot price outcomes that are being witnessed in the Queensland market. The duck curve demand profile and associated morning and evening price spikes is providing a clear driver for utilisation of alternative hedging contracts such as the Super Peak.

Figure 2 below provides the average spot price and operational demand outcomes in Queensland for FY20. The chart shows the demand and price peaks occurring in the morning and early evening shoulder periods overlaid (grey blocks) with the periods covered by the Super Peak contract. The impact of the massive deployment of solar PV on spot prices in Queensland is further illustrated by comparing the average spot price at midday ($26.97) to 6:30pm ($109.41) over the last financial year.

Hedging this volatility is a key driver for retailers with customer load in Queensland, as well as providing a strong price signal for peaking generation and energy storage in the state.

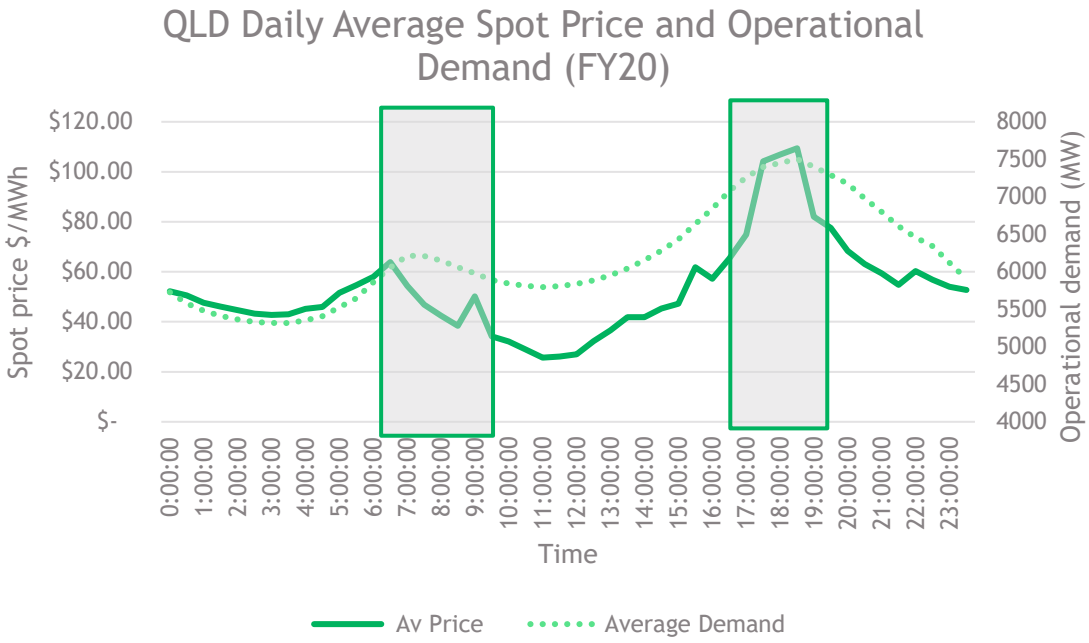

Figure 2: AVERAGE DAILY SPOT PRICE AND OPERATIONAL DEMAND IN QUEENSLAND ACROSS FY20 (Source: AEMO data, accessed via the Hub market platform). SUPER PEAK CONTRACT PERIODS SHOWN IN GREY.

Solar Shape markets

The Solar Shape product is a sculpted volume swap, covering only those hours relevant to a generic solar generation profile, unlike a standard baseload or "flat" contract which cover buyers and sellers for a fixed MW volume, 24 hours/day. The figure below provides an illustration of the Solar Shape product monthly profiles (the volume profile changes monthly to account for changes in seasonal irradiance experienced by solar generators).

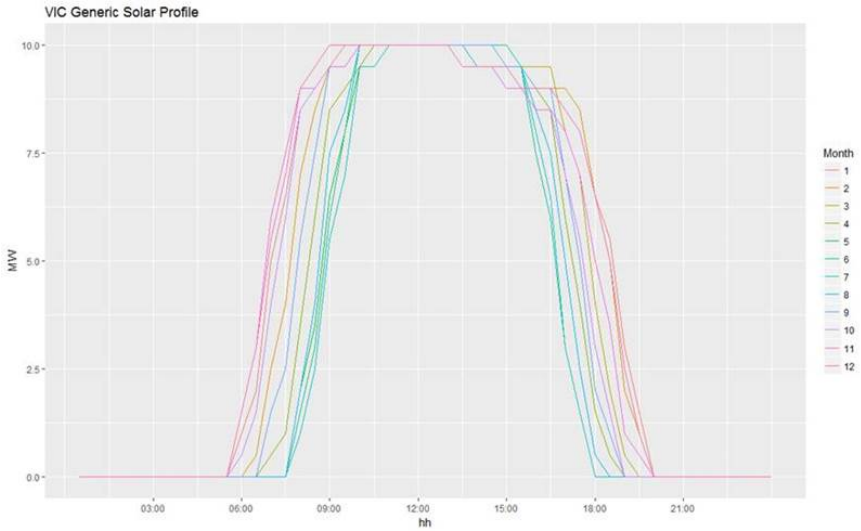

Figure 3: RENEWABLE ENERGY HUB SOLAR SHAPE SWAP CONTRACT, MONTHLY VOLUME PROFILES BASED ON 10MW CONTRACT

Markets in the Solar Shape contract have remained subdued over Q2 of 2020. The decline in spot prices during the day, driven by the ongoing record deployment of solar (both utility scale and rooftop) and resulting price cannibalisation has dampened interest in hedging forward this contract shape for many participants. An interesting lesson from the Project has been the shift in market interest from the Solar Shape to the Super Peak contract, perhaps reflecting the growing value of balancing or firming resources alongside the ongoing deployment of solar PV.

In our last lessons learned report we discussed the relative value of the Solar Shape contract to the equivalent baseload futures contract. Our most recent trade in the Solar Shape (15/07/2020) was for the Q420 NSW contract at $47.75. This trade price was 98% of the value of the equivalent (Q420 NSW) baseload contract on the same day (see Figure 4).

Trades at this level are supported by historical analysis of the seasonal variations in prices captured by the Solar Shape contract. Figure 5 below provides a historical view of the average quarterly value of the Solar Shape contract based on spot price outcomes, using a 'volume weighted average price' calculation. We observe that in Q4 2019 the Solar Shape in NSW (orange line) was valued at approximately 95% of all spot prices.

Given that the baseload contract captures all Spot price outcomes we would expect to see a similar procie difference between the Solar Shape and the baseload contract. Returning to the recent trade in the NSW Q420 Solar Shape, the relative value to the baseload contract of 98% shows that market participants expect similar Spot price outcomes in Q4 2020 as occurred in Q4 2019.

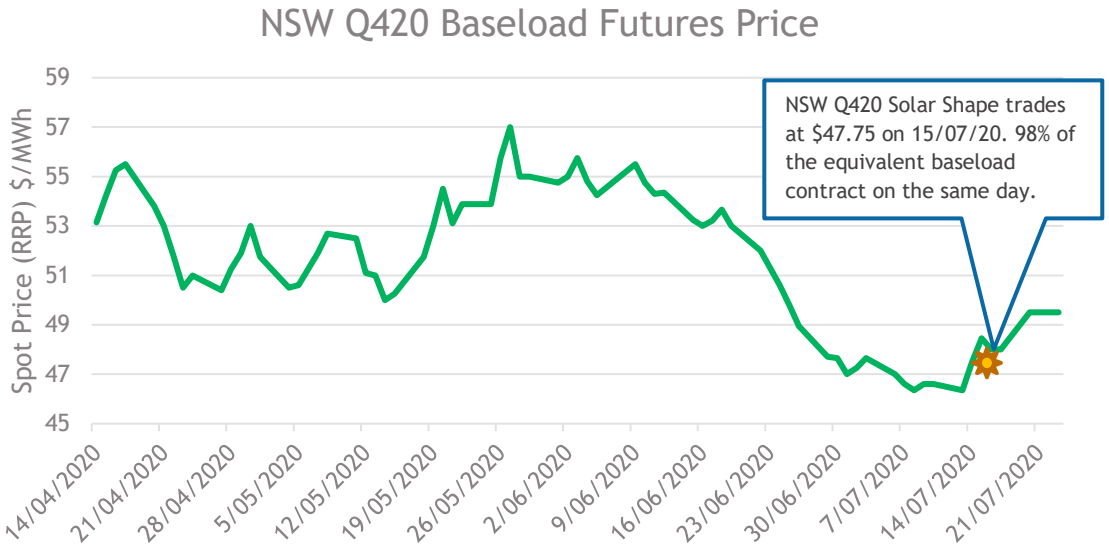

Figure 4: Q4 2020 NSW BASELOAD FUTURES CONTRACT SETTLE PRICES VS SOLAR SHAPE (Sources: ASX Energy, TFS Australia, Renewable Energy Hub)

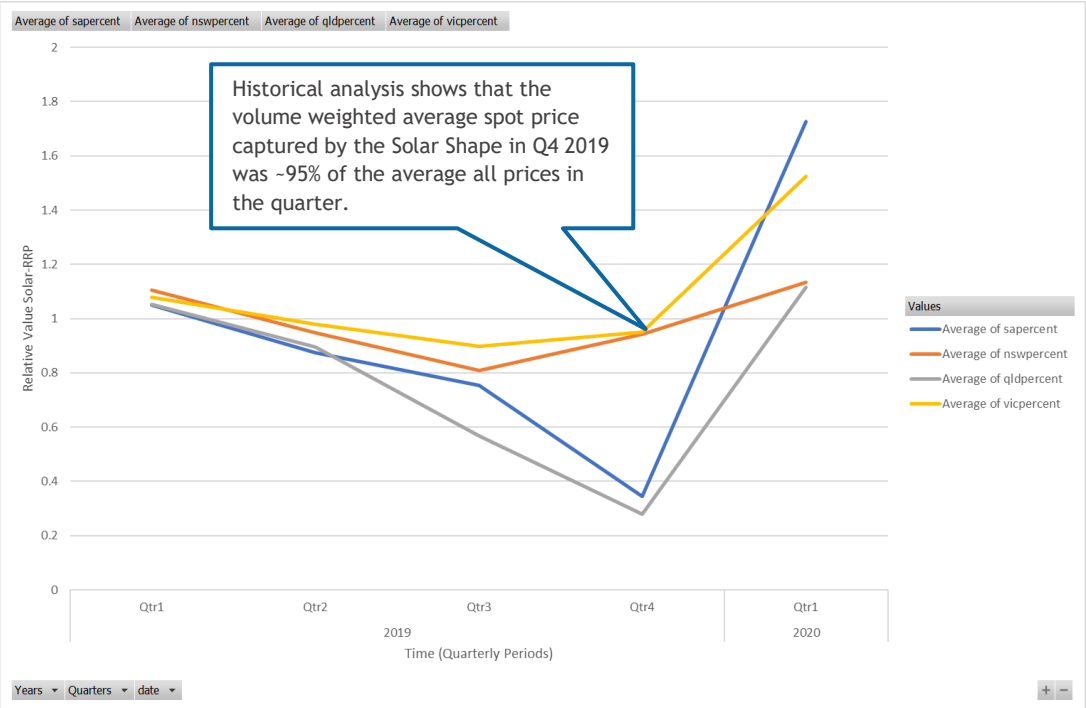

Figure 5: RELATIVE VALUE OF SOLAR SHAPE VS SPOT PRICE – based on quarterly average relative value of the daily volume weighted average price of solar shape vs all spot prices (RRP) across all NEM regions (ex-Tas)

2. New Product Development

Virtual Storage Contract

The development of a new hedge contract for storage technologies has progressed well, to the point where we have commenced initial discussions with potential counterparties for pilot transaction opportunities. The objective of this product is for participants to agree upon a set spread between the 'charge' and 'discharge' (the buy and sell of power) price for battery operators enabling merchant battery operators to de-risk their energy arbitrage revenue.

The Virtual Storage swap contract is proposed to operate as follows:

- Buyer of the Virtual Storage simultaneously sells a fixed MW block of low-priced energy "charge" and buys a block of higher priced energy "discharge".
- The product is energy-neutral (charge/discharge legs are the same MWh's), and the transaction price is the agreed price spread between bought and sold legs (ie. the energy arbitrage value).
- Settlement is calculated daily.

Based on feedback from the Market Advisory Group and more broadly across the market the product has evolved since our last update. In particular:

- Name changed from Virtual Battery to Virtual Storage contract to ensure the product is sufficiently attractive to all forms of energy storage technology.
- Creation of two versions, with both short (2 hours) and long (8 hours) under consideration by the market.
- Settlement calculations use a "heads and tails" methodology, described below.

Settlement calculation – Heads & Tails.

The Heads & Tails settlement methodology for the Virtual Storage contract is set out below using the short duration (2 hour) contract as an example:

- The seller of the Virtual Storage contract buys energy at the lowest four 30min Trading Interval prices of the day and sells energy back at the highest four Trading Interval prices of the day (note these do not have to be contiguous).
- The seller of the contract does not know ahead of time which hours to charge/discharge their storage technology to physically defend the contract. In this way these contracts carry greater uncertainty (which may be priced-in to the transaction price) but will ensure the greatest arbitrage spread is captured each day for the purposes of contract settlement.

Over Q3 and Q4 of 2020 we will continue to progress and refine the product design as well as initiate our first transactions in the product. Stakeholders interested in participating in trades or with feedback on the product itself can contact us: hello@renewableenergyhub.com.au

3. Software Development

Renewable Energy Hub is also progressing the development of the digital market platform and expects to complete its public launch of the platform in Q3 2020, in line with the revised Project timeline and milestones.

The Hub is a digital renewable energy market platform providing access to a variety of transaction types and products, as well as evaluation of risk and portfolio management tools. The Hub platform will facilitate price discovery, evaluation of market opportunities and ultimately help to build liquidity in the new hedge contracts developed during the Project.

The target market for the platform is wholesale market contract traders (existing 'gentailers', retailers, banks & funds), renewable energy project developers and asset owners, and large energy users.

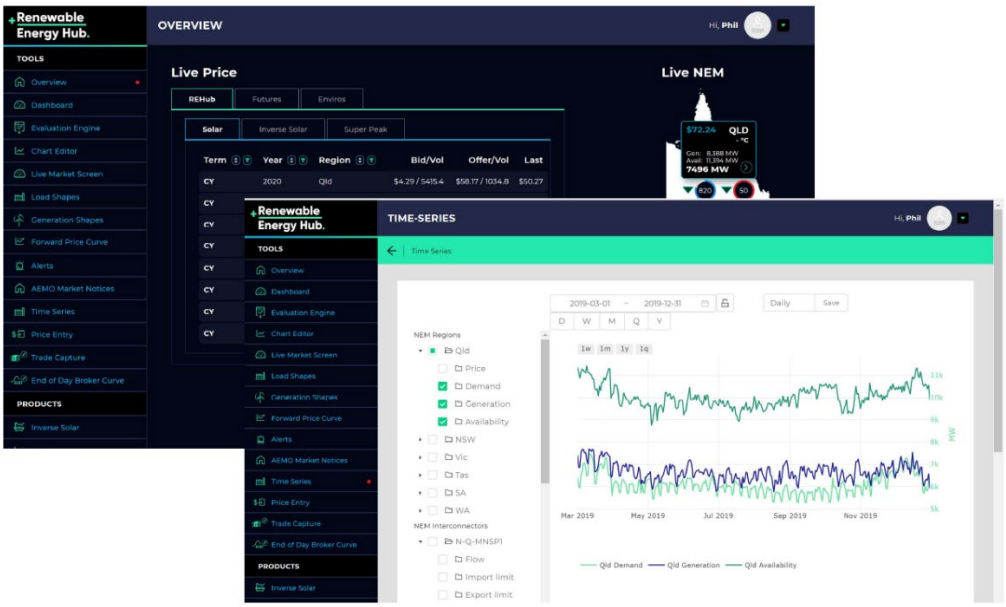

Figure 6: SCREENSHOTS OF THE 'HUB' DIGITAL MARKET PLATFORM

Prior to the public launch of the Hub, we are continuing to engage with market participants - energy retailers, project developers, large customers, and government agencies - to provide product demonstrations. These sessions continue to provide the Project team with the ongoing opportunity to refine our product roadmap and ensure core features and functionality are well aligned with market requirements.

The public release of the Hub was delayed from July to later in Q3 due to the disruption to working arrangements caused by Covid-19. Despite these disruptions, our software team continues to build features in line with our roadmap.

Stakeholders interested in a demonstration of the Hub platform should contract us at: hello@renewableenergyhub.com.au

4. Broader External Market Reflections

Renewable Energy Hub has also identified the following external market trends which are being considered and may influence the outputs of this ARENA-funded project. This lessons learned report covers the period – April to June 2020 – and aligns to the initial stages of the Covid 19 pandemic, thus we are watching how the market manages the resultant uncertainty.

- **Demand down but not by much -** Across the NEM, the impact of Covid 19 on electricity demand was muted with demand slightly down but that was probably more to do with a cooler Autumn season. Commercial load was down, while residential consumption increased in line with 'stay at home rules' across the states. Data through to the end of Q1 2020 shows continued strength in rooftop solar PV installation rates[1], further impacting total electricity demand.
- **Price Volatility -** Renewable Energy Hub notes there has been much volatility in fuel prices. Brent Crude oil prices reached a low of A$30.76/barrel towards the end of April (the lowest levels since 1999). Japan Korea Marker (JKM) liquified natural gas (LNG) prices fell to reach a record low of A$2.77/gigajoule (GJ) towards the end of Q2 2020. Newcastle thermal coal prices declined from A$113/tonne at the end of March to finish the quarter at A$73/tonne (-35%). Prices are rebounding but the fear of a second wave of the pandemic may dampen any pickup.
- **Crisis only beginning -** As the crisis continues the chance of the global economy and national economy tumbling into a prolonged severe recession is increasing. It will be interesting to see if energy prices can continue to recover, or if the economic environment continues to stagnate. There is also much uncertainty on when a recovery will occur and what type of recovery it will be – ie. will it be a quick V shaped recovery or more a slower U shaped economic improvement.

What it means for Renewable Energy Hub's market:

- Falling spot prices (see Figure 7) can be attributed to factors beyond Covid 19. Mild weather conditions and the continued increase of rooftop solar PV is leading to reduced operational demand across the NEM. Moreover, generators have increased 'low price offers' due factors such as low wholesale gas prices, easing of coal constraints and increased renewables capacity.
- FY21 forward prices have dropped significantly lower than previously forecast. This is due to a combination of low spot electricity and gas prices, increased penetration of renewables and to a lesser extent concerns surrounding Covid

[1] Source: SunWiz data quoted in RenewEconomy - https://reneweconomy.com.au/rooftop-solar-installs-at-record-high-during-covid-19-but-what-about-leads-and-sales-15160/

19. Subdued prices may lead merchant operators to contract revenue forecasts, in expectation of earnings headwinds.

- Well publicised challenges with system strength and congestion in parts of the grid may cause a slowdown in renewable energy project connections post 2021. This could result in a halt to the current decline of electricity prices.

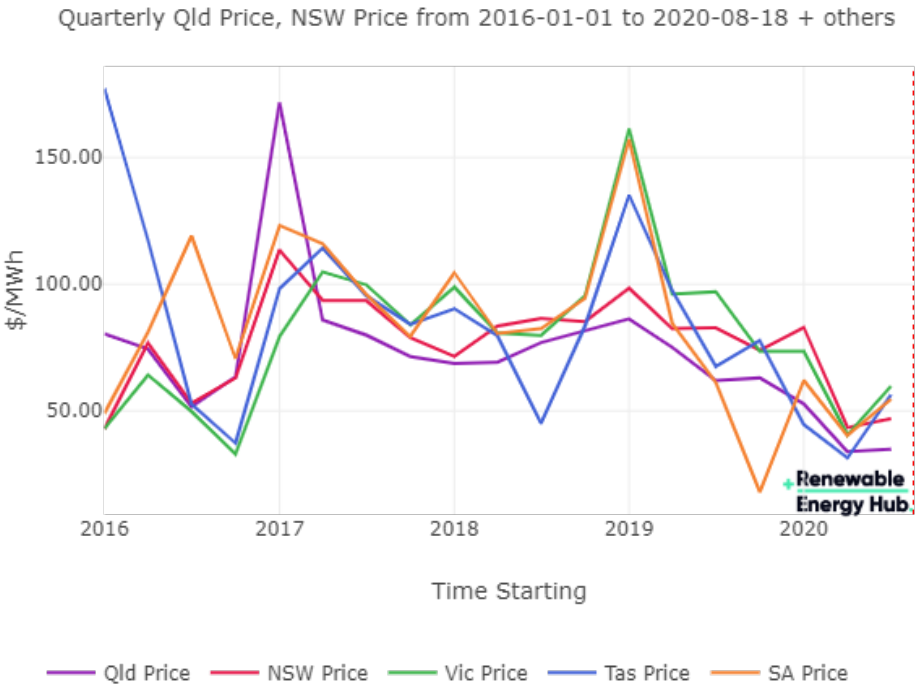

Figure 7: Spot Prices are at their lowest levels since early 2016. (Source: Source: AEMO data, accessed via the Hub market platform)

5. Next Steps

Over the coming months, we plan to finish the build of the Hub digital market platform and onboard our first group of users. This will be a major milestone for the Project, and we are excited to welcome market participants onto the platform to test features, engage in transactions and inform future software developments.

In addition, we will be conducting a review of the performance of several Renewable Energy Hub contracts, particularly the new Virtual Storage contract. This review will be released as our next major Knowledge Sharing deliverable in October 2020.

We continue to watch with interest and curiosity the impact of Covid 19 on the electricity market, and on the volumes and types of trades undertaken by counterparties involved in the Project.