Shoalhaven Knowledge Sharing Report

Origin Energy & ARENA

28 February 2019

Executive Summary

On the 28th August 2018, Origin and ARENA executed a Funding Agreement for the provision of $2m of funding by ARENA to support Origin's Full Feasibility Study into the expansion of its existing Shoalhaven Pumped Hydro Scheme (**SPHS**). This Full Feasibility Study aimed to investigate the following:

- ✓ Geotechnical assessment
- ✓ Spoil Management planning
- ✓ Optimal asset design
- ✓ Technical feasibility
- ✓ Financial feasibility
- ✓ Planning & Environmental processes
- ✓ Impact on water users

The completion of these assessments will provide Origin with an understanding of the feasibility of an expansion of Shoalhaven Pumped Hydro Scheme and will ensure that an expansion is designed to a high technical, environmental and commercial standard in-line with expectations.

Under the terms of the Funding Agreement, Origin is required to deliver three Knowledge Sharing Reports; two for public release and one for ARENA's internal consideration.

This is the first Knowledge Sharing report and it details the market and commercial considerations required to support the development of a pumped hydro scheme in Australia.

As requested by ARENA, this report includes the following;

- ✓ Description of revenue streams considered and aggregated/summarised outputs on scenarios considered;
- ✓ Aggregated data and market modelling approach to provide market insight into future market participation (including scenario testing and potential impact of moving to a 5-minute settlement);
- ✓ Analysis as to how market conditions are developing such that they could benefit Pumped Hydro;
- ✓ Methodology for assessing the market under different scenarios; and
- ✓ Forward market outlook under the different scenarios.

This document also provides an update on the progress of the Full Feasibility Study.

Contents

1 Knowledge Sharing Objective for Report 1

As agreed with ARENA in our Shoalhaven Funding Agreement, Origin has investigated the following:

Item	Description	
1	✓ Description of revenue streams considered and aggregated/summarised outputs on scenarios considered.	Section 5-8
2	✓ Aggregated data and market modelling approach to provide market insight to future market participants (including scenario testing and potential impact of moving to 5-minute settlement).	Section 6-7
3	✓ Analysis as to how market conditions are developing such that they could benefit PHES.	Section 4
4	✓ Methodology for assessing market under different scenarios.	Section 7
5	✓ Forward market outlook under different scenarios	Section 8

2 Full Feasibility Study progress to date

Origin has made significant progress toward achieving the objectives of the Full Feasibility Study, including the following key milestones;

- ✓ undertaking a review of pre-feasibility studies to confirm findings;
- ✓ preparing a technical reference design for the scheme;
- ✓ procuring geotechnical data to develop a ground model;
- ✓ informing the Early Contractors Involvement (**ECI**) proposed design;
- ✓ overseeing the bore drilling program with respect to quality and conformance with specifications; and
- ✓ progress toward obtaining Environmental Impact Statement approvals from the NSW Government.

Origin have engaged TransGrid to undertake the electrical connection study that will inform the connection of the expanded assets to the NSW energy market, whilst ensuring the operation of the existing Shoalhaven assets are not impacted.

On the 18th December 2018 the proposed expansion of the SPHS was granted critical State Significant Infrastructure status by the Minister for Planning because of its importance to NSW's future energy security. The NSW Department of Planning and Energy stated that the project *"is essential to NSW for economic reasons and will have environmental and social benefits by facilitating the state's transition to a low emissions-based economy. It will also add increased competition in the electricity market, putting downward pressure on prices and creating around 350 jobs during construction".*

Following the grant of critical State Significant Infrastructure status, Origin is now able to move forward with the proposed program of geotechnical testing and has requested from the NSW Department of Planning and Energy the assessment requirements for the preparation of an Environmental Impact Statement for the exploratory works application, which will inform the preparation of a Development Application.

The Environmental Impact Statement for the Geotechnical Explorations has been lodged with the Department of Planning and Environment and has been publicly exhibited from 22 February 2019. Current indications show that approvals may be granted to undertake geotechnical drilling by late April.

Community consultation is integral to gaining community support for the proposed Shoalhaven Expansion Project, as it allows community members to raise issues and concerns to be addressed. Origin is committed to advising the Kangaroo Valley and surrounds of the proposed project through various means including utilising local newsletters, creation of a dedicated project website (which is updated as the feasibility study progresses) and face-to-face meetings.

Consultation to date has included meeting with direct neighbours of Shoalhaven's Kangaroo Valley Power Station, the local Kangaroo Valley Community Association, Shoalhaven City Council, Wingecarribee Shire Council and Kiama Municipal Council.

These meetings have given Origin an opportunity to identify and understand community and local government concerns with the aim of resolving them through the EIS process. Consultation with local community will be ongoing with community information sessions

proposed for Kangaroo Valley, which will enable the wider community to find out more about the project.

3 Operating regime of the existing Shoalhaven Scheme

Pumped hydro facilities are a form of energy storage that utilise water reserves. They use electricity to pump water uphill into a storage reservoir when electricity prices are low and discharge water through a turbine to generate electricity when electricity prices are high.

Historically, pumped hydro facilities operated as peaking plants which are used to generate electricity during high electricity market price periods. Figure 1 below illustrates the operating profile of Shoalhaven during Q2 2017 and shows that, currently, pumping is undertaken in the early morning when the low-price periods generally occur.

As the penetration of both large scale and residential solar increases in the NSW energy market, low priced periods are expected to shift to the middle of the day. This trend is starting to become evident. Figure 2 shows Shoalhaven's operating profile during Q2 2018 which has pumping in both the early morning and during the middle of the day.

Figure 1: Shoalhaven operating profile Q2 2017

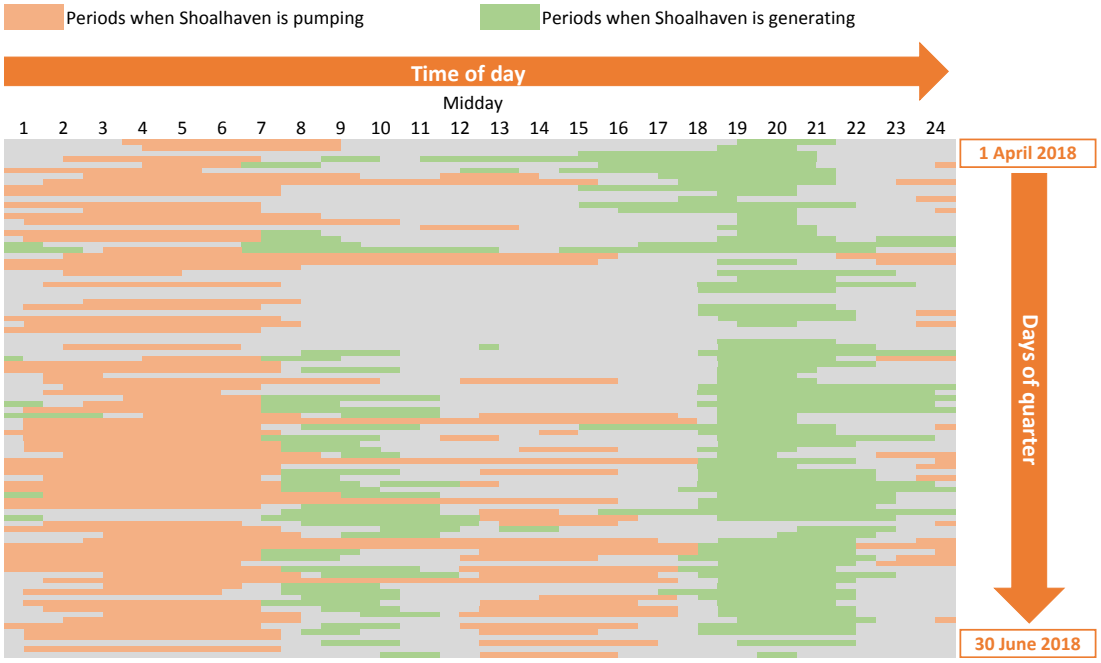

Figure 2: Shoalhaven operating profile Q2 2018

Figure 2 above shows more pumping and generating periods than the same quarter a year prior (Figure 1). This is caused by Q2 2018 having a greater intra-day pricing spread (difference between high price periods and low-price periods). Figure 3 below illustrates the intra-day pricing spread during Q2 2017 and Q2 2018.

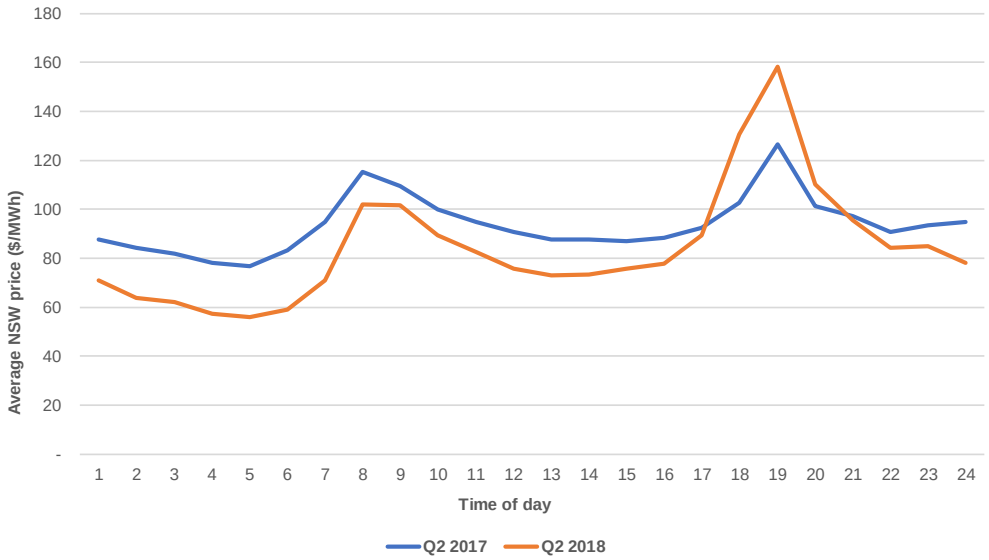

Figure *3*: Average daily price ($/MWh)

4 Current & future market conditions and their impact on PHES viability

Market conditions for, and the perceived future value of, pumped hydro as a provider of energy storage within the NEM have improved significantly over the last 2 years. This is evidenced through the announcement of various feasibility studies and investigations into new and expanded pumped hydro schemes. These have occurred through significant commitment in co-funding by ARENA, through the development of support frameworks such as the NSW Government's Pumped Hydro Roadmap and Handbooks, and the launch of WaterNSW's expressions of interest process that sought proposals from the private sector to develop energy and storage projects on 38 state-owned dams.

This renewed interest has been supported by several emerging and expected future market dynamics, outlined below;

Increased need for energy shifting services

The current, and forecast increase in penetration of small and large-scale variable renewable energy generation sources creates a significant opportunity for responsive energy storage technologies that can absorb energy at a time when rooftop PV, and other renewable technology generation levels are high, and subsequently dispatch stored energy at a time when renewable energy generation levels are low, as outlined in Figure 4 below;

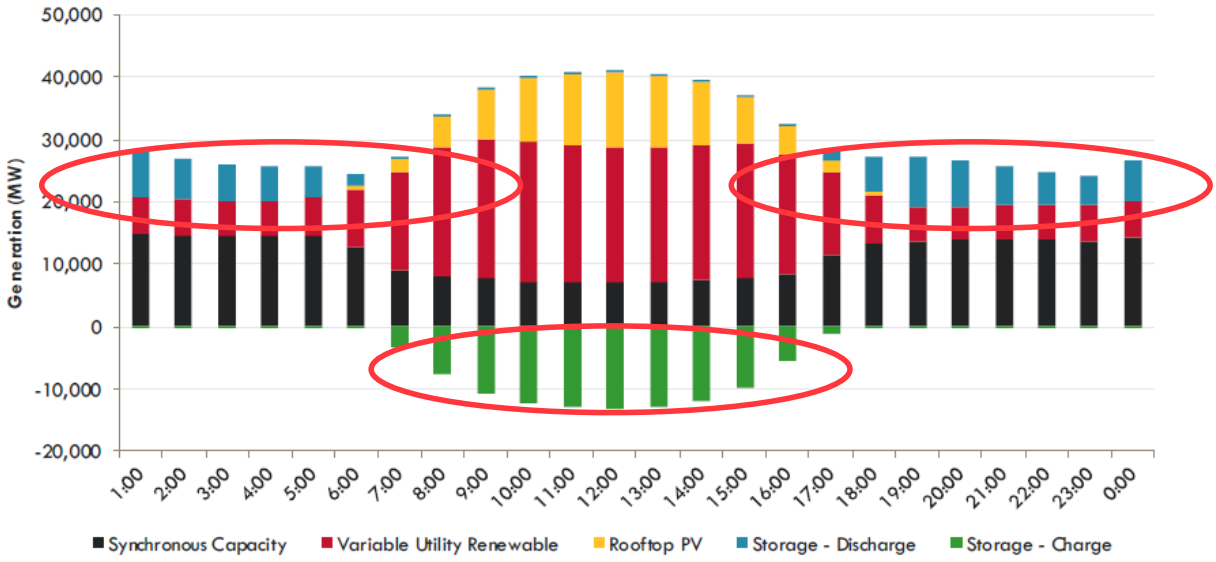

Figure 4: Role of storage in high renewable markets (Source: AEMO)

The scale of this opportunity will continue to increase as the penetration levels of both rooftop and large-scale variable renewable energy sources increase.

Longer term impact of 5-minute pricing

Whether five-minute settlement creates a change in value links to whether the price signal is sufficient to bring forward new investment and whether new renewable generation stretches the ramp capability of the generation fleet over a trading interval.

Historical analysis for NSW indicates that in the near term the difference between five and 30-minute settlement is insufficient to bring forward new technologies beyond when they would have otherwise occurred. However, in the longer term (post 2030), as black coal plant retires, the change provides a clearer signal for fast start plants or demand response as replacement capacity, potentially increasing the value available to fast start storage or pumped hydro assets.

Increased requirement for inertia and grid stability services

This represents a potential opportunity for proposed pumped hydro projects, which provide inertia in generating and pumping modes. PHES could also provide inertia when not pumping or generating if the plant has capability to operate as a synchronous condenser. These stability services will assist with the rapid integration of renewable energy sources in the state and should reduce the amount of intervention required by AEMO. However, despite this recognition, there is no current clear price signal or payment stream for these grid stability activities in the NEM. Should the provision of this service be recognised through the development of a price signal, this would provide an additional value stream available to pumped hydro assets developed within the NEM.

While there are areas of emerging support, there are still several challenges faced by the developer of pumped hydro projects as detailed below:

Energy Policy Uncertainty

When Origin first commenced discussions with ARENA into a joint investigation of the feasibility of an expansion of the SPHS, the Turnbull Government was proposing to implement a National Energy Guarantee (**NEG**), based on a recommendation from their independent panel of experts, the Energy Security Board. The NEG required retailers (such as Origin) to contract with generation, storage or demand response projects so that:

- ✓ there are contracts in place to support a minimum amount of dispatchable energy to meet consumer and system needs (reliability requirement), and
- ✓ the average emissions level of the electricity sold to consumers meets the electricity sector's share of Australia's international emissions reduction commitments of a 26 per cent reduction in carbon emissions by 2030 (emissions reduction requirement).

This policy was favourable for fast start, reliable generation sources like pumped hydro. However, 6 months into the Full Feasibility Study, the future energy and emissions policy framework faced by potential energy generation project in Australia has shifted entirely.

In September 2018 the Morrison Government introduced a new suite of proposed energy policies. The constant changes to the long-term energy policy landscape makes it challenging to commit to investment decisions for assets with long lifetimes and high upfront capital costs.

Development of Snowy 2.0

At a potential size of 2,000 MW (or nearly 10 times the size of the proposed 235 MW SPHS expansion) and with 350,000MWh of storage capacity, the Federal Government's proposed Snowy 2.0 represents a significant change in the generation mix for both the NSW and VIC electricity and ancillary markets.

Adding to this uncertainly is the political uncertainly relating to the ultimate approval for development, with the Federal Government having increased its ownership of Snowy Hydro to 100% in 2018. On the 26th February, the Prime Minister announced a commitment of up to $1.38billion in Snowy 2.0, allowing the project to progress to the early works stage, with the remainder of the project to be financed by Snowy Hydro Limited. Prior to the commencement of construction, the Project will need to secure various development and environmental approvals.

Any development of this size, particularly one that is subject to such unique development and political risks and challenges, creates significant uncertainly in determining future market dynamics.

Ancillary Service Market structure

Origin will undertake a detailed investigation into these markets, with the results provided as part of Origin's Knowledge Sharing Commitments due at the completion of the Full Feasibility Study.

Availability of Project Funding

It can prove challenging to secure competitive debt or equity for a proposed pumped hydro project which have very long lifetimes, high upfront capital requirements and revenue streams that are subject to considerable uncertainty.

This barrier is being addressed by the Clean Energy Finance Corporation (**CEFC**), who provide finance offerings to generation projects on potentially less onerous terms than traditional banks, and through the development of the Federal Government's underwriting new generation investment program, which aims to provide financial support to projects that increase firm electricity supply and improve wholesale market competition to reduce wholesale electricity prices.

5 Revenue Streams considered for an expanded SPHS

In considering any energy development opportunity, Origin will assess the project's ability to capture various revenue streams. Critical to identifying appropriate value streams is a consideration of the following:

- ✓ project location (NEM connected, state based);
- ✓ technology choice (peak, baseload, or intermittent generation, start time, location, cost);
- ✓ fuel availability;

- ✓ access to connection and transport infrastructure (electrical and fuel);
- ✓ the project's proposed operating regime; and
- ✓ the project's development timeframes

The following revenue streams are applicable when considering the value of developing a pumped hydro facility in the National Electricity Market:

- ✓ **Cap revenue***:* A pumped hydro project provides fast start generation capability that can be ramped up quickly to capture spikes in the wholesale spot price.

  Origin could utilise an expansion of SPHS to avoid cap purchase costs for its own customer retail demand, use it as insurance for other Origin or market plant outages or, alternatively, sell capacity contracts to other retailers or large-energy users. Cap revenue is included within the expanded SPHS financial modelling and various potential future capacity contract price scenarios are considered.

- ✓ **Pool revenue:** A pumped hydro project, such as the proposed SPHS expansion, dispatches into the energy market when the wholesale spot price is high to earn a pool revenue return. In turn, the pump storage hydro asset then pumps water when the wholesale spot price is low. The spot price at the time of pumping effectively sets the short run marginal cost of the asset.

- ✓ **Ancillary services***:* A pumped hydro facility could also offer capacity into the "Frequency Control Ancillary Services" markets or could seek to secure contracts with AEMO for non-market services such as System Restart Ancillary Services.

  These revenues are not considered in this report as Origin, with ARENA, is undertaking detailed modelling to better understand the potential value that a proposed pumped hydro scheme, such as the SPHS expansion, could extract from ancillary services. The findings of this will be outlined in Origin's final Knowledge Sharing Report.

The aggregated revenue streams as an output to our modelling can be found in Section 8.

6 Origin's approach to market modelling for a pumped hydro opportunity

6.1 Modelling Methodology

For the consideration and valuation of new energy generation opportunities, Origin has developed a scenario framework approach which represents a range of potential energy market outcomes. New opportunities under consideration are tested against several market scenarios, which are broad enough to capture the range of market dynamics expected to impact a proposed investment decision, such as the decision to expand the existing SPHS.

AEMO's 2018 Integrated System Plan (**ISP**) forms the foundational inputs of Origin's modelling assumptions. The AEMO ISP models a least cost solution to system reliability and security in the NEM over the long term. A summary of AEMO's modelling approach utilised for the development of the ISP is outlined below;

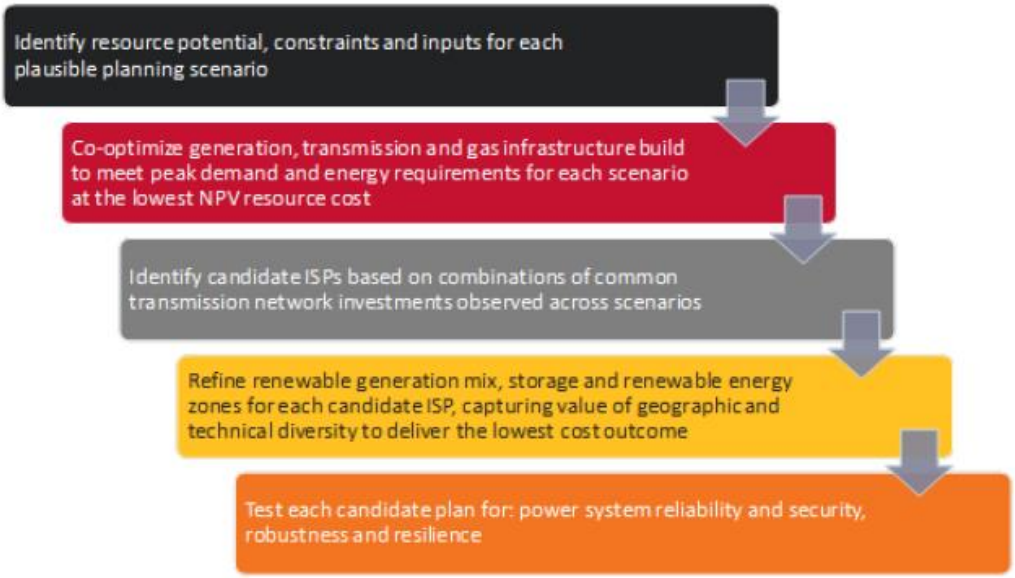

Figure 5: Summary of AEMO's ISP modelling approach

The 2018 ISP is described by AEMO as *"a holistic and technology-neutral approach, integrating existing and new resources on both the supply and demand side, at utility-scale and distributed at consumers' premises, at the lowest overall consumer expense. It takes into consideration a broad set of thermal and renewable generation, transmission, and storage investment opportunities across the NEM in assessing the requisite transmission development to deliver the 'least resource cost' future energy mix. Capital and operating costs for all technologies are provided for reference in the 2018 ISP Assumptions Workbook. The same weighted average cost of capital was applied for all technologies to convert capital costs into an equivalent annual cost stream for assessment".*

For the purposes of valuing the Shoalhaven expansion, Origin has maintained consistency with the inputs of the 2018 AEMO ISP database, unless an assumption leads to an unsustainable market outcome, such as pricing outcomes consistently above new entrant pricing or below operating costs of existing plants. Origin has elected to utilise its own internal viewpoint in determining inputs relating to asset operational behaviours and retirement of existing generation assets.

These scenarios also utilise inputs derived from market announcements (such as transmission planning reports, commitments to development of new assets, closure or retirement announcements) and Origin's internal expertise developed through the long-term operation and management of a ~6,000MW portfolio of generation assets across the NEM. Assessing the future market conditions in which a generation asset will operate requires consideration of:

- ✓ Forecast market prices for fuel supply (primarily gas and coal)
- ✓ Forecast energy demand, including uptake of distributed PV and storage
- ✓ Current and potential energy and emissions reduction policy
- ✓ Forecast new build (including uptake of distributed energy, storage and demand response technologies)
- ✓ Forecast technology cost curves
- ✓ Forecast retirement of existing generation fleet
- ✓ Forecast operational performance of existing generation fleet

- ✓ Implementation of demand response technologies
- ✓ The internal consistency between the input assumptions themselves

To understand the breadth of possible economic outcomes for a proposed energy generation project, several potential future wholesale electricity price scenarios are utilised for valuation purposes. These scenarios will include a variety of differing assumptions around several key market dynamics that are likely to impact the project. The scenarios assessed for the Shoalhaven expansion are discussed in Section 7.

Origin's scenarios, and specific modelling inputs, are developed through consultation with a wide range of subject matter experts across the Origin business and public information, including:

- ✓ Load forecasting experts
- ✓ Regulatory and Government Relations teams
- ✓ Third party sourced weather forecasts
- ✓ Economic forecasters (including expertise in fuel price forecasting)
- ✓ Portfolio managers, electricity, gas and financial product trading teams

This scenario testing approach to financial modelling provides a potential range of investment returns for an expansion of SPHS. As the Full Feasibility Study progresses, and the project is de-risked and the market dynamics for the development and operational periods are better understood, the number and range of scenarios may be refined.

To value a potential pumped hydro opportunity such as the expanded SHPS, Origin has focussed on three market price scenarios to capture the key risks and opportunities to the project. Each scenario has a multitude of variables, with the key variables (and the variances between scenarios) outlined in detail in Section 7 of this report.

To develop the price forecasts arising from these scenarios, Origin utilises a third-party software 'PLEXOS', which is widely utilised by market participants within the Australian energy market. PLEXOS is an energy market simulation tool that allows for multiple inputs (including load, fuel prices, market dynamics, operational and physical constraints) to be considered simultaneously, generating expected half hourly electricity dispatch volumes and half hourly price forecasts across the National Electricity Market to apply to a project valuation.

For the proposed SPHS expansion, the run profile is solved within the model to maximise profit subject to given operating constraints. PLEXOS accounts for the physical hydrology of the water ways including the connection pathways between the storages, the water utilisation rate of each hydro unit and the limitation on water usage under its total water license. The model incorporates a one day 'look ahead' to ensure that there is some discretion around when hydro utilisation occurs. An example of the selectiveness of the dispatch / pumping profile from the modelling is provided in Figure 6.

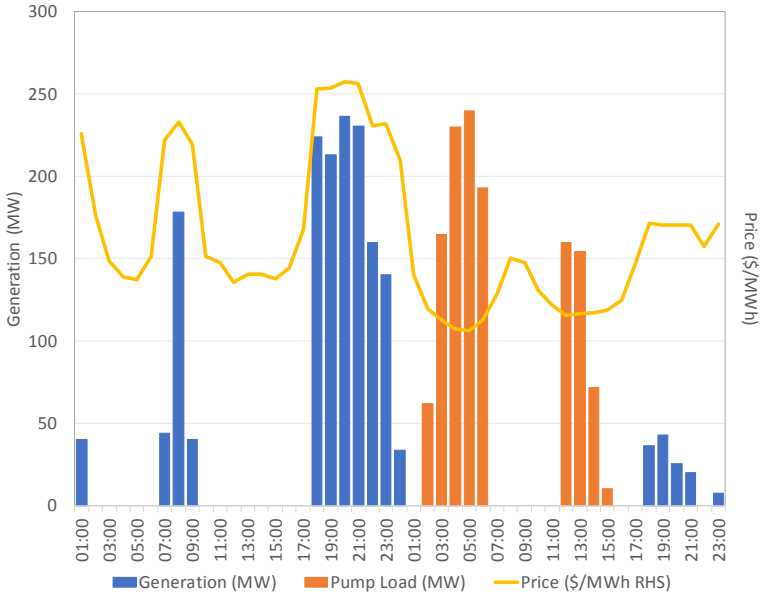

Figure 6: Example pumping and dispatch regime for a pumped hydro asset

Once simulated, the outputs of the PLEXOS market analyses are then input into Origin's in-house financial model to assess the valuation impact to the project.

6.2 Five Minute Settlement Impacts

In November 2017, the Australian Energy Market Commission (**AEMC**) made a rule change to align operational dispatch and financial settlement at five minutes, which is scheduled to take effect from July 2021. The change will see generator revenue settled on the supply demand outcome for each five-minute period rather than the current approach of averaging these five-minute periods over a half hour.

This rule change does not result in any significant changes to Origin's approach to market modelling, however this rule change will result in a potential change to the inputs required, and a greater granularity of price forecast outputs.

Over time, as the mix of generation sources with the NEM changes to more variable, less reliable sources, there may be additional value available for capture by assets able to respond to price signals within a 5-minute period (such as batteries and pumped hydro assets), as this rule change will provide a clear price signal for fast response players such as batteries, demand response technologies or pumped hydro to enter the market.

7 Development of scenarios for a pumped hydro development

For the purposes of understanding the range of potential economic outcomes for a potential pumped hydro project such as the proposed SPHS expansion, Origin has developed and applied three market scenarios.

The three market scenarios developed by Origin and the key inputs underpinning them, are outlined in further detail below;

1. **Reference Case** – Based on AEMO's 2018 ISP Neutral Case and consistent with a 28% reduction in emissions from the NEM by 2030.

The Neutral case assumed a range of central, or mid-point projections of economic growth, future demand growth and fuel costs. This includes:

Key Assumptions – Neutral Case 2018 ISP		
Inputs	**Setting**	**Rationale**
Demand (Economic Growth)	Neutral	Neutral growth outlook for consumption and demand from AEMO's March 2018 electricity demand forecasts.
Demand (DER Uptake)	Neutral	✓ Moderate Distributed Energy Technology (DER) uptake, including; ✓ Rooftop PV growth continues, providing 12% of underlying consumption by 2030. ✓ Battery systems provide up to 10% of operational maximum demand by 2030, and 45% of battery systems are coordinated by 2030. ✓ Electric vehicle update is moderate, with 10% of the vehicle fleet electrified by 2030.
Renewable energy / emissions reductions settings	Renewable energy targets, emission reduction trajectories	✓ All existing announced policies are included, as described by various Governments (LRET, VRET, and QRET). ✓ The NEM is assumed to achieve at least a proportionate share of the Commonwealth Government's emission reduction commitment by 2030, and for emissions to continue a similar path to 2050.
Supply Settings	Retirements	✓ The modelling approach for the ISP is one of least cost generation expansion to meet consumer needs within the confines of policy, demand and market settings.
Supply Settings	Technology Costs	✓ Technology costs have been selected from current, reputable public forecasts. CSIRO's December 2017 projections[1] provide a primary reference.

[1] CSIRO, Electricity generation technology cost projections (2017-2050), December 2017, available at https://publications.csiro.au/rpr/download?pid=csiro:EP178771&dsid=DS2.

Note that our Reference Case diverts from the ISP's neutral case assumptions in the areas of expected asset operational behaviour and retirements, instead utilising Origin's internal viewpoint.

The Origin view taken for retirements and operational behaviour incorporates an iterative approach, benchmarked against economic outcomes with the aim of achieving recovery of fixed and operating costs, if these are not recovered the plant is retired.

2. **Snowy 2.0 Case**: Based on Reference Case with inclusion of the Snowy 2.0 project included from FY2025.

Snowy 2.0 scenario adopts all assumptions of the Reference Case with the inclusion of the proposed Snowy Hydro expansion – a 2,000MW pumped hydro project with up to 350GWh of storage potential. Snowy 2.0 would be in direct competition with the SPHS expansion and so is a key risk to the project. The objective of the sensitivity is to examine the potential impact on SPHS operation and revenue stream if the large storage project gets developed.

Snowy 2.0 scheme is modelled in a time sequential model with its hydrology configurations such as waterway and reservoir capacities incorporated. It is assumed to run to maximise profits from the wholesale market. The pumped hydro is operated opportunistically based on the forward view of daily price differentials while considering the round-trip efficiency of the unit. Furthermore, to better capture the arbitrage opportunity between days, the model also incorporates a look ahead function to ensure sufficient storage is available to perform arbitrage across a longer time horizon. Origin has also considered operational limitations such as intra/inter- regional constraints to best mimic the behaviour of Snowy 2.0.

Aggregated output of these scenarios as they pertain to the development of a pumped hydro asset such as the proposed SPHS expansion is in Part 8.

3. **High Renewables Case**: In the Reference Case, the modelling outcome suggests that the AEMO ISP's 28% emission abatement target could be achieved through current renewable schemes such as LRET, VRET and QRET.

This scenario is consistent with delivering a carbon abatement scenario that limits a rise in emissions to maintain temperatures at less than 2 degrees C above pre-industrial levels. This scenario excludes the development of Snowy 2.0. Relative to the Reference Case, the High Renewable scenario considers a future market with higher levels of renewable and utility scale battery penetration. The amount of renewable uptake is consistent with the AEMO ISP Fast change scenario, achieving a 52% emission reduction trajectory by 2030. Transmission network upgrades are also considered to adapt to the faster power system transformation. The purpose of this scenario is to examine the impact on investment requirement and market benefits of SHPS when the NEM undertakes a faster transition pace with more renewable energy resources available.

Key changes from the Reference Case used in High Renewables case are:

- ✓ Greater uptake of utility scale renewable capacity.
- ✓ Faster overall cost reductions in utility-scale storage technologies.

8 Origin's forward market outlook

The three scenarios presented reflect a plausible range of outcomes of how the NEM may develop over the life of the proposed SPHS project. The main drivers of the range of outcomes relate to the development (or not) of Snowy 2.0, the timing and level of abatement targets and coal retirements.

Interconnection plays a significant role in the supply demand dynamics by allowing capacity sharing between regions. This can be both a risk and an opportunity for the project depending on the coincidence of tight market supply conditions in NSW with interconnected regions. The 2018 ISP projects that there will be an increase in NSW's import capability of 3.6 GW by 2040. The assumption is consistent across the scenarios.

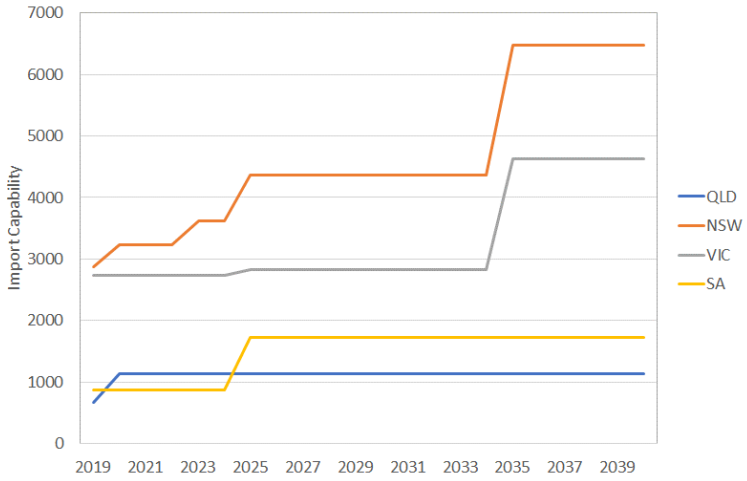

Figure 7: Interconnector Capability

Figure 8 illustrates the projected generation mix in NSW across the three scenarios. All scenarios capture that in the long term there is a significant change in the generation mix, characterised by coal retirement and its' replacement with renewable generation and storage (both battery and pump hydro). Predominantly this occurs post 2030 which coincides with AEMO's assumption of coal plant having a 50-year life.

The ***Reference*** case is relatively unchanged until the retirement of Eraring (2032, as announced by Origin), increased import capability into NSW (an additional 1.5 GW by 2034 and 3.6GW by 2040) and increasing renewables, which also displace energy from the remaining coal fleet. Storage (including a potential expansion of the SPHS) shifts significant amounts of solar PV from the middle of the day to the peak demand periods.

The ***Snowy 2.0*** case has a similar generation mix to the Reference case, although with increased storage capacity, additional solar generation can occur due to higher midday loads. Coal generation is reduced as a result. Being in direct competition with SPHS and with similar supply-demand outcomes to the Reference case represents a downside risk to the project.

The ***High Renewables*** case sees renewable generation come online earlier than the other cases and provides an opportunity for SPHS to capitalise on the resulting price swings, until

other storage enters the market. In this scenario the increased renewables are predominantly from solar, meaning there is a greater role for storage to play in balancing.

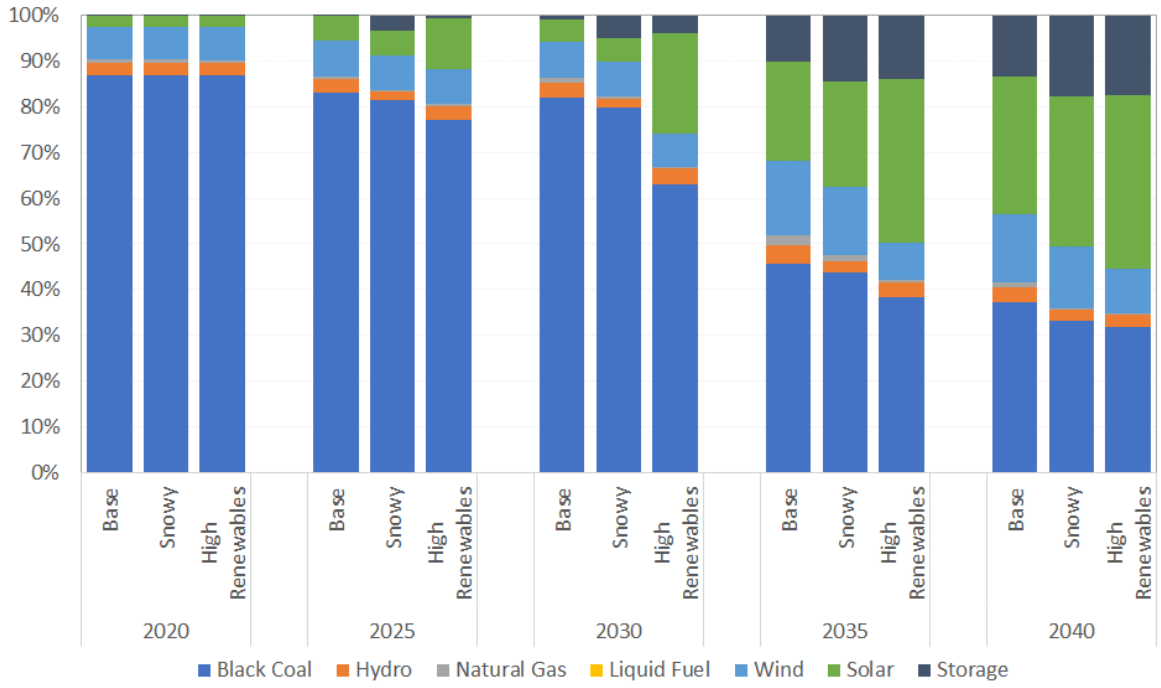

Figure 8: Forecast NSW generation mix

Figure 9 below presents the forecast aggregated revenue for the SPHS expansion on a thousand of dollars per megawatt of capacity ($ '000/MW), and Table 1 represents the average forecast capacity factor for the proposed SPHS project for the period FY23 to FY33).

Aggregated revenue includes forecast capacity contract revenue and the revenue received from the National Electricity Market, less the cost of purchasing electricity from the National Electricity Market for pumping purposes. Whilst the capacity factors under the Reference and High Renewables cases both indicate a significant role for storage, the net revenue under the High Renewables case is lower than that of the Reference Case. Under the High Renewables case the earlier entry of renewable generation also encourages increased entry of storage around the NEM, reducing revenue captured by the project.

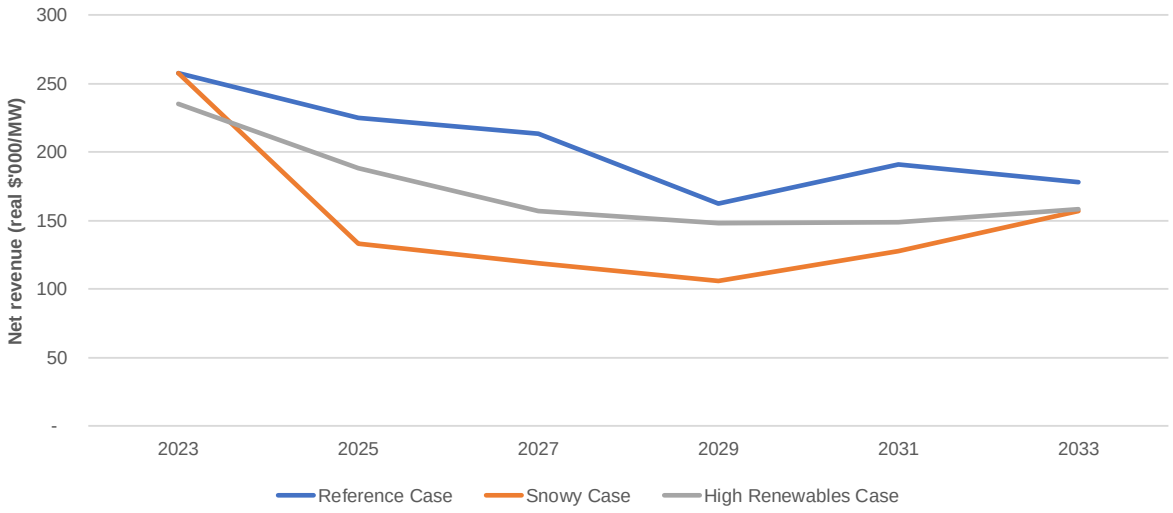

Figure 9: Net revenue per MW installed (real $'000/MW)

Scenario	Forecast Capacity Factor
Reference Case	20%-25%
Snowy Case	12%-17%
High Renewables Case	20%-25%

Table 1: Average Capacity Factor (FY23-FY33)

9 Conclusion

As the Full Feasibility Study progresses, Origin will continue to consider and refine the scenarios against which the proposed SPHS expansion opportunity is measured. This will include consideration of a variety of external and internal factors that impact the project's feasibility.

External drivers in the near term, and prior to completion of the final Knowledge Sharing Plan, will be the (current and opposition) Government's approach to Snowy 2.0, the results of the upcoming Federal Election and the level of uptake of renewable energy and battery storage, both large scale and behind the meter.

Origin continues to undertake detailed technical, commercial, planning and environmental assessments as proposed under the Funding Agreement. These factors will all contribute to Origin being able to determine the feasibility of the proposed SPHS expansion opportunity.