Neoen Renewable Energy Projects

Economic Assessment Report

Neoen

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1 Executive Summary

Renewable energy projects are fundamental to Australia's transition away from fossil fuels to renewable energy sources. In addition to supplying clean energy into the National Electricity Grid, both the construction and operation phases of renewable energy facilities provide various socio-economic benefits to the surrounding communities and the corresponding states:

Economic activity: The construction and operation of the renewable energy projects will directly generate regional and state-wide economic activity that will contribute to growth or output, employment and income. The economic activity will generate direct benefits and secondary or indirect effects, like the production of goods and services such as accommodation, engineering, freight services, construction materials and equipment, local labour and technical contractors. The purchase of these goods and services will generate additional employment and income for members of the regional and state economies and, in turn, lead to further output and spending.

Electricity production: The renewable energy projects are expected to produce renewable energy that will provide value to the electricity supply chain and communities more broadly.

Employment and labour income: The construction and operational phases of the renewable energy projects will generate economic activity that will directly generate employment within the region and state where the projects are located including apprentices and trainees. The direct employment generated will, in turn, lead to secondary or indirect employment effects. As a hypothetical example, 20 full-time equivalent (FTE) staff may be required to operate one of the facilities, which may then require an additional person to be employed to accommodate the additional income and spending of the staff.

Network security: Battery storage provides network security to Australian customers allowing renewable energy to be stored and released to the grid when it is needed. Specifically, the projects assessed in this report will provide or expand battery storage in South Australia and Victoria.

Neoen owns and operates some of Australia's largest and most progressive renewable energy projects. Aurecon has assessed the socio-economic impacts of the construction and operation of eight of Neoen's renewable energy projects, three of which have already been constructed and five that are currently in the planning stage. A summary of the findings is outlined in Table 1 below.

2 Methodology

Neoen have commissioned Aurecon to prepare a series of socio-economic assessments for current and future renewable energy projects across Australia as outlined in Table 2:

Table 2: Renewable energy projects assessed in this report

Name	Location	Type
Current projects		
Bulgana Green Power Hub	Victoria	Wind
Hornsdale Power Reserve	South Australia	Battery
Numurkah Solar Farm	Victoria	Solar
Future/planned projects		
Crystal Brook Energy Park	South Australia	Wind/Solar/Battery
Goyder South Stage 1	South Australia	Wind/Solar/Battery
Culcairn Solar Farm	New South Wales	Solar
Goorambat East Solar Farm	Victoria	Solar
Western Downs Green Power Hub	Queensland	Solar

This Report aims to present the findings of the economic impact assessment of the Neoen projects highlighted above including the estimation of a number of socio-economic impacts from the construction and operation phases of the projects. The economic analysis provides details both at a state level and for relevant regional areas for each project. The approach to the socio-economic assessment is further outlined in Appendix C.

The direct and indirect economic output, electricity production and employment that will stem from the five ‘future renewable energy projects’ under investigation is inherently uncertain. In order to produce a robust set of forecasts of employment, output, and income benefits from these projects, a series of retrospective or ‘ex-post’ assessments of current Neoen renewable energy projects have been undertaken with the insights gleaned used to cross-check information obtained from construction and operational managers to understand the specific characteristics of the future renewable energy projects.

The economic forecasts outlined below have been benchmarked to actual outcomes recorded at comparable renewable energy facilities across Australia and are therefore more rigorous and robust than traditional forecasting techniques.

6 Future Assessment – Crystal Brook Energy Park

Crystal Brook Energy Park (CBEP) is a 324MW hybrid renewable energy project approximately 200km north of Adelaide with the ability to provide firm, reliable, 24-hour power to South Australia's grid and industrial customers. It will combine around 254MW of wind and solar generation with 70MW battery storage allowing for energy to be stored and dispatched when it is needed. In additional to helping reduce wholesale energy prices (refer Appendix A) and carbon emissions associated with traditional energy generation it is expected to provide a number of socio-economic benefits to the surrounding communities and South Australia.

6.1 Economic activity from the construction and operation of CBEP

The construction of the CBEP will help to support businesses in the Yorke and Mid-North Region and across the State more broadly. In particular, the construction of the CBEP is expected to require $201.8 million in labour and resource inputs from within South Australia and lead to total economic growth with output value of $436.7 million for the Yorke and Mid-North Region (i.e. direct and indirect output) and $873.5 million for the State more broadly (Table 12). The operation of the facility will also help to support businesses in the Yorke and Mid-North Region and across the State more broadly. In particular, the operation of the CBEP is expected to cost $4.84 million per annum and lead to $16.34 million of total economic activity in the Yorke and Mid-North Region and $18.15 million for the State more broadly.

Table 12: Economic activity from the capex and opex requirements of the Crystal Brook Energy Park

Project phase	Regional impacts	Expenditure ($m)	Economic activity ($m)
Construction	CAPEX (South Australia)	201.8	
	Total activity (Yorke and Mid-North)		436.7
	Total activity (South Australia)		873.5
Operation	OPEX (South Australia)	4.8	
	Total activity (Yorke and Mid-North)		16.3
	Total activity (South Australia)		18.2

6.2 Impacts of the production of electricity from the CBEP

The CBEP is forecast to produce 817 952 MWh of clean energy per annum which would be sufficient to power 167 000 homes across the State.

The production of renewable energy at CBEP is expected to help to reduce wholesale spot prices. The literature review conducted by Aurecon regarding the impact of renewable energy production on wholesale spot prices (Appendix A) found strong and consistent evidence that the solar and wind energy generated by the CBEP will help to reduce wholesale spot prices in South Australia. Based on the expected volume of solar and wind energy generated, and the most recent estimates of the impact of renewable energy production on wholesale energy prices in South Australia (Appendix A), the cost saving associated with the volume of energy produced by CBEP is estimated to be $120,000 per year. In practice, reductions in the spot price due to renewable energy would apply not just to the volume of electricity produced by Neoen but to the volume of electricity produced in the market at a given point in time. We would therefore expect the potential cost savings across the market to be more significant, all else constant. Based on the forecast annual production level, and the monthly average spot price observed between May 2019 and April 2020 ($69.7), the CBEP is expected to generate $57 million in gross income in its first year of operation (Table 13).[9] Future revenues will be highly dependent on the market which is continuing to evolve.

Table 13: Electricity production from the operational phases of the Crystal Brook Energy Park, Year 1

Electricity production (MWh)	Estimated gross income generated ($m)
817,952	57.0

[9] The wholesale electricity spot price is one indicator of the value of renewable energy produced by CBEP per MWh for South Australia. MLF and other criteria like curtailment, availability etc are not factored into this calculation.

6.3 Employment and labour impacts

Construction phase

Our analysis based on the above CAPEX and OPEX expenditure specifies that the construction of the CBEP is forecast to require the initial employment of 244 FTE from the Yorke and Mid-North Region and 487 FTE more broadly from across the State. Of the direct number of staff employed to construct the CBEP, 66 employees are expected to be apprentices and trainees. The construction activity required to build the CBEP will help to stimulate additional economic activity within the supply chains that support the primary contractors, while the additional income and spending of construction workers will help support further activity and employment across the State. The overall direct and indirect labour resource requirement to support the construction of the CBEP is expected to be 6 million man hours and translate to total income of close to $241 million to be distributed to individuals and households across South Australia (Table 14).

Operational phase

The operation of the CBEP is expected to require the direct and indirect employment of 43 FTE staff from the Yorke and Mid-North Region and 48 FTE staff more broadly from across the State. Thus, most of the staff required for the operational phase of the project are expected to be sourced locally. The overall labour resource requirement to operate the CBEP is expected to be 103,000 man hours per annum and translate to total income of close to $4.1 million per annum to be distributed to individuals and households across South Australia. Over the next 30 years the wages and salaries paid to operating staff are expected to reach close to $100 million. This income would be circulated within the South Australian economy through the spending of employees on, for example, retail goods and services.

Table 14: Estimated employment from construction and operational phases of the Crystal Brook Energy Park

Project phase	Regional impacts	FTE staff (no.)		Apprentices (no.)	Man hours ('000 p.a.)	Wage Bill ($m p.a.)
		Direct	Indirect			
Construction	Yorke and Mid-North	244	1,257	62	3,017	120.7
	Rest of SA	243	1,256	4	3,018	120.7
	South Australia	**487**	**2,513**	**66**	**6,035**	**241.4**
Operation	Yorke and Mid-North	10	33	-	93	3.7
	Rest of SA	0	5	-	10	0.4
	South Australia	**10**	**38**	**-**	**103**	**4.1**

6.4 Social and environmental impacts

The construction and operation of Crystal Brook Energy Park is expected to realise several social and economic benefits for the Region and the State more broadly.

- Based on the number of apprentices (66), and the average improved future employment outcomes identified from the literature review (Appendix B), the overall benefit of the placements to the individuals involved is expected to be in the order of $33 million.[10]
- The increased volume of clean energy produced by CBEP is forecast to lead to close to 340 000 tonnes of CO2 being displaced per annum, which is equivalent to taking 140,000 cars off the road.
- The annual Community Benefit Fund contribution of $80,000 is forecast to provide up to $3.4 million worth of additional social and economic benefits to the local community and wider region.[11]

[10] The literature review conducted by Aurecon regarding the benefits of apprenticeship and trainee placements (Appendix B) found strong and consistent evidence that the provision of such opportunities during the construction phase of the CBEP will provide a benefit to the individuals involved by increasing their probability of employment, and their expected weekly wage rate in subsequent years. Based on the number of apprenticeship and trainee positions expected during the construction phase of CBEP, and the average improved future employment outcomes identified from the literature review, the overall benefit of the placements to the individuals involved is expected to be in the order of $500,000.

[11] Forecast value of Community Benefit Fund calculated as the future value of annual payments over a 30 year period, indexed at CPI.

Appendix A: The Impact of Crystal Brook Energy Park on Wholesale Spot Prices

The impact of renewable electricity generation on wholesale electricity prices is an empirical question that requires the review of academic studies that utilise complex econometric models to untangle and isolate the various factors that can affect wholesale electricity prices. A detailed international literature review has thus been conducted across a number of countries that have seen an increasing share of renewable energy production and that have similar institutional arrangements to the National Electricity Market (NEM) in Australia.[22]

International literature review

The literature review performed covered a number of academic studies on the impact of renewable energy production on wholesale electricity prices in electricity markets in Germany, Spain, Denmark, the Netherlands, Ireland, Israel, the UK, Austria, Italy and in the US wholesale markets.

All but one of these studies concluded that renewable electricity generation led to wholesale price reductions of varying size.

In Australia, two studies (the most recent using data to June 2013) suggested renewables had reduced prices in the National Electricity Market. Furthermore, those studies that did examine the net impact of renewables (i.e. the extent to which wholesale price reductions were offset by the charge for renewables subsidies), tended to conclude that the benefit of price reductions was more than offset by the recovery of subsidies from residential customers.

Table 37: Literature review of the impact of variable renewable energy (VRE) on wholesale electricity prices

Study	Region	Time Period	Average VRE penetration (% of demand)	Decrease in average wholesale price from average VRE (AUD)
United States				
Woo et al. 2011	ERCOT	2007-2010	Wind: 5.1%	Wind: $2.5/MWh (ERCOT North) $6.4/MWh (ERCOT West)
Woo et al. 2013	Pacific NW (Mid-C)	2006-2012	N/A	Wind: $3.9/MWh
Woo et al. 2014	CAISO (SP15)	2010-2012	Wind: 3.4% Solar: 0.6%	Wind: $9.5/MWh Solar: $1.3/MWh
Woo et al. 2016	CAISO (SP15)	2012-2015	Wind: 4.3% Solar: 2.6%	Wind: $9.9/MWh Solar: $2.7/MWh
Gill and Jin 2013	PJM	2010	Wind: 1.3%	Wind: $5.3/MWh
Wiser et al. 2016[a]	Various regions	2013	RPS energy: 0%-16% depending on the region	RPS energy: $0 to $5.9/MWh depending on the region
Jenkins 2017[b]	PJM	2008-2015	N/A	Wind: $1.2-3.1/MWh
Haratyk 2017[b]	Midwest Mid-Atlantic	2008-2015 2008-2015	N/A	Wind: $5.7/MWh Wind: $0MWh
Australia				
Mountain et al. 2018	South Australia	2018	N/A	Wind: $28/MWh Solar: $10/MWh
Forrest and MacGill 2013	South Australia Victoria	2009-2011 2009-2011	Wind: 29% Wind: 1.9%	Wind: $8.05/MWh Wind: $2.73/MWh
Cladius et al. 2014[a]	Australia	2011-2012 2012-2013	Wind: 4.3% Wind: 4.6%	Wind: $2.30/MWh Wind: $3.29/MWh
Europe				
Würzburg et al. (2013)	Europe	2010-2012	N/A	Non hydro: $0.7/MWh-$2.1/MWh

22 That is, electricity production from centrally dispatched generators in interconnected electricity markets.

Notes: a - Price effect is estimated impact of RPS energy relative to price without RPS energy in 2013 before making adjustments due to the decay effect discussed by the authors. b - Decrease in average wholesale prices is based on change in wind energy from 2008-2016 (Jenkins 2017) or 2008-2015 (Haratyk, 2017), rather than the decrease from average wind reported in other rows

Application of literature review to Crystal Brook Energy Park

The Crystal Brook Energy Park is earmarked to be located approximately 23 kilometres southeast of Port Pirie and 3 kilometres north of Crystal Brook in South Australia. The most relevant studies included in our literature review are therefore those recent studies that focus on the unique features of the South Australian market. In particular, wind and solar production in South Australia has the potential to:

- displace relatively expensive gas production compared to other countries, and in turn
- lead to relatively large reductions in wholesale electricity prices.

The Victoria Energy Policy Centre within Victoria University recently estimated the various drivers of change to the average South Australian spot price recorded in 2018 via a complex econometric model including gas prices, wind generation, solar generation, and demand.[23]

Consistent with the broader international literature review outlined above, the analysis conducted by Victoria University demonstrated that renewable energy production helped to reduce the average spot price per MWh in 2018.

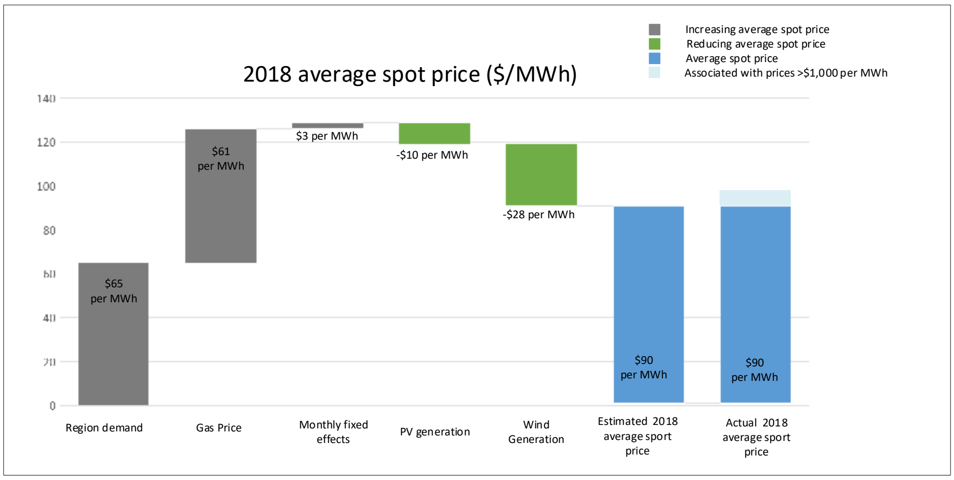
In particular,

- wind generation, which accounted for 5,500 GWh in South Australia in 2018, contributed to a reduction of $28/MWh, while
- solar generation, which accounted for 1,110 GWh in South Australia in 2018, contributed to a reduction of $10/MWh (Figure 1).

The relatively large impact that renewable energy was estimated to have had on wholesale prices in South Australia during 2018 compared to the results presented in other international studies reflects:

- the relatively high level of renewable energy generation in the State, and
- the relatively expensive gas production that was displaced by renewable energy in 2018.

Figure 1: Decomposition of the average spot price in South Australia during 2018



In terms of the net impact of renewable energy production (i.e. the extent to which wholesale price reductions were offset by the charge for renewables subsidies), the reduction in the average spot price of $38/MWh in 2018 was estimated to have been associated with a subsidy of $11/MWh.[24]

The net impact of renewable energy production was therefore estimated to have been $27/MWh.

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23 Victoria University, *Does renewable electricity generation reduce electricity prices?* 2018

24 From 2013 to 2018, the Small-Scale Technology Percentage has averaged 12.6% and Renewable Power Percentage has averaged 12.9%. Assuming an average price of Small-Scale Technology Certificates of $40 and Large-Scale Technology Certificates of $45, this implies the average cost of renewable subsidies over this period has been $11/MWh.

Looking forward, assessing the future impact of renewable energy production from the Crystal Brook Energy Park on wholesale sport prices requires an estimation of the marginal benefits of wind and solar generation i.e. what is the change in the wholesale spot price in South Australia per MWh from an additional MWh of renewable energy production? Based on the approach and analysis outlined above, Victoria University estimated that expanding:

- wind generation will reduce wholesale prices at the rate of around $0.09/MWh, per one MWh of additional wind generation.
- solar generation, will reduce wholesale prices at the rate of around $0.26/MWh, per one MWh of additional solar production.

CBEP, which is expected to generate 450,000 MWh of wind and 320,000 MWh of solar per year, is therefore expected to reduce the cost of wholesale electricity it produces by more than $120,000 per year. As outline above, reductions in the spot price due to renewable energy would apply not just to the volume of electricity produced by Neoen but to the volume of electricity produced in the market at a given point in time. We would therefore expect the potential cost savings across the market to be more significant, based on current assumptions. Some of the annual savings in the cost of wholesale electricity would be expected to be passed onto final customers across the State, while additional savings are expected to be associated by the inclusion of battery storage at the Crystal Brook Energy Park.

The impact of battery storage at Crystal Brook Energy Park

Batteries are playing an increasingly important role in reducing electricity costs to consumers, while strengthening the national grid. For example, the Hornsdale Power Reserve, launched in August 2017, is the largest lithium-ion battery in the world, and provides network security services to South Australian electricity consumers in concert with the South Australian Government and the Australian Energy Market Operator (AEMO). Aurecon has publicly released two separate reports that have outlined how the battery technology has been used in its first two years of operation to achieve system security and reduce ancillary service prices. The reports found that since Neoen launched the Hornsdale Power Reserve (HPR) in August 2017, the facility:

- enabled $50 million of cost savings to electricity consumers in its first year of operation, and
- reduced costs in the NEM by $116 million through the provision of Contingency and Regulation Frequency Control Ancillary Services (FCAS). In particular, the average Regulation FCAS costs have been reduced by more than 90% due to HPR (from $470/MWh to $40/MWh). [25]

The additional 70 MW of battery storage at the Crystal Brook Energy Park points to further reductions in cost of ancillary services, which are typically fully recovered from market customers and generators.

Reliability of wholesale spot prices

It may be suggested that the analysis above ignores the reliability benefit associated with dispatchable coal generation rather than variable renewables. It is worth noting that the modelling results of the Victorian University report show the impact of coal closure and renewable expansion as expressed in the actual market prices. The argument that there is a reliability value that is not currently reflected in South Australia's prices therefore needs to establish that those prices have failed to reflect the value of reliability.

The Victorian University note that the evidence does not seem to support this:

> *Specifically, the volume-weighted average prices received by different production technologies does not suggest that dispatchable production has become more valuable in South Australia as the proportion of renewable production has increased.*

[25] Aurecon, *Year 1 Report – Technical and Market Study, Year 2 Report – Technical and Market Impact Case Study*, 2019,2020

Appendix B: Economic benefits from the Hiring of Apprenticeships

Overview

The construction of the renewable energy projects discussed in this report is expected to result in the hiring of a number of trainees and apprentices. Aurecon has undertaken a high-level literature review to determine the benefits of Neoen providing apprenticeships and trainee positions during the construction phase of the projects.

Table 38 below outlines the studies that were examined and their key findings. The key findings from the literature review showed that there is an overall consensus that apprenticeships bring value to enterprises, individuals and society. While it is difficult to accurately capture and quantify the variety of costs and benefits associated with apprenticeship training, case studies from countries with established apprenticeships programs such as the UK, Switzerland, Germany and also Australia show that apprenticeships bring many monetary and non-monetary benefits, but that the amount varies between sectors and also for men and women.

While the concept of apprenticeships may have a bad reputation or is perceived as inferior to higher education, individuals have many things to gain from completing apprenticeship training. Apprenticeships are generally linked to higher chances of finding employment and higher wage premiums, though apprentices may need to accept lower incomes at the beginning or during the training period as compared to unskilled workers. The earnings gap becomes positive soon after completion of training and if lifetime earnings are taken into account, the returns are considerable.

For firms and enterprises an upfront investment is often required, which might be a deterrent to providing apprenticeship places. How quickly firms reap benefits from training apprentices depends on the sector, company size, the wages being paid and the level of government support. In the long term, benefits to firms and enterprises include higher productivity and quality of work, gaining a pipeline of skilled workers and associated savings in recruitment if apprentices stay at the firm beyond their training period. Additional non-monetary benefits such as positive work attitudes, reduced turnover, knowledge transfer to other employees and lower injury rates are also evident.

The benefits of apprenticeships to society include lower unemployment (particularly youth unemployment), higher productivity, better quality work, increases in tax revenue and lower social expenditure such as unemployment benefits. The returns on investment are generally high with NPV estimates for the UK of £16 to £21 per pound of government funding (McIntosh, 2007) and £21:1 (Cebr, 2014).

Key assumptions applied to the socio-economic assessment

For the purpose of this study we have assumed that provision of apprenticeships and trainee positions during the construction phase of the renewable energy projects will provide a benefit to the individual recipients by:

- Increasing the probability of employment in subsequent years by 5 percentage points,
  - i.e. the probability of employment for the individual in a given year subsequent to the completion of the apprenticeship is expected to be 5 percentage points higher than what would have been the case if an apprenticeship position was not available.
- Increasing the hourly weekly wage rate by $180 in subsequent years,
  - i.e. the average weekly wage for the individual in a given year subsequent to the completion of the apprenticeship is expected to be $180 more than what would have been the case if an apprenticeship position was not available.

Table 38: Key findings from literature review to investigate benefits from apprenticeships

Name of study	Author	Date	Key findings	Comments
Wage Transitions of Apprentices	Yin King Fok; Yi-Ping Tseng (University of Melbourne)	2009	▪ Apprentices have higher employment rates and lower unemployment rates compared to non-participants. ▪ Self-employment rate of apprentices exceeds that of non-participants soon after completion of training. ▪ Apprentices start with lower earnings but the earnings gap becomes positive (higher for apprentices) three years after training commencement. ▪ Weekly earnings gap after completion of training lower between apprentices and trainees than between apprentices and the non-training group. ▪ Positive returns to apprenticeships, which are considerable if life-time earnings are taken into account.	Study compares labour market outcomes for apprentices to individuals who entered a traineeship program and those who had not entered either of the programs. Observation period is up to 6 years after training commenced.
Estimating economic benefits from apprenticeships – Technical paper	Department for Business, Innovation and Skills (UK); Skills Funding Agency; National Apprenticeship Service	2012	▪ Possession of apprenticeship associated with higher wages compared to individuals with Level 2 qualifications (General Certificate of Secondary Education (GCSE) equivalent). ▪ Large variations in wage premiums between male and female, and by sector with apprenticeships in 'energy and water' having some of the highest premiums. ▪ Overall economic benefits include higher productivity due to skills gained by individuals with apprenticeships, higher lifetime employment and spillover effects on productivity. ▪ Spillover effects include knowledge transfer to other employees, increased profits and positive signalling associated with successful completion of apprenticeship. ▪ Benefits from apprenticeship will occur for the rest of an individual's working life. ▪ Cost to the economy consist of cost of provision (public funding and fees paid by employer) and indirect cost of foregone output while learning. ▪ Cost-benefit analysis (CBA) indicates that economic return to apprenticeships is £16 to £21 per pound of government funding with cost-benefit ratio (CBR) of 4.3:1 to 5.3:1.	Analysis based on data from UK Labour Force Surveys from 2004-09. Insufficient data/evidence to quantify the value of spillover effects of apprenticeships.

Name of study	Author	Date	Key findings	Comments
A Cost-Benefit Analysis of Apprenticeships and Other Vocational Qualifications	Steven McIntosh (University of Sheffield)	2007	■ 16-18% wage returns in 2004/05 for individuals with modern apprenticeships compared to those with Level 2 qualifications (year 10 equivalent). ■ Demand for modern apprenticeship places exceeds supply, so employers may be able to choose the best applicants. ■ Estimated wage returns for individuals with apprenticeships are rising (period under investigation: 1996-2005). ■ Significant variation in wage return between sectors. 32% wage return in construction compared with no observed wage return in the retail sector. ■ Wage returns to apprenticeships considerably higher than for other vocational qualifications. ■ Apprenticeships and other vocational qualifications are positively linked to the probability of an individual being in employment. ■ Positive economic return to apprenticeships and vocational qualifications in general. Net present values (NPVs) for modern apprenticeships of £16 to £17 per pound of state funding. ■ Wide variation in CBA per sector, but clear positive benefits for the five sectors considered.	Analysis based on data from UK Labour Force Surveys from 2004-05. Report focuses on government funded apprenticeships ('modern apprenticeships'). Sectors considered are construction, engineering, business administration, retail and customer service, and hospitality.
Apprenticeship training in England – a cost effective model for firms?	Prof. Dr. Stefan C. Wolter; Eva Joho	2018	■ Chances for firms to break even at the end of apprenticeship training period highest for three-year programs assuming that the apprentices are younger than 19 years, because minimum wages increase substantially afterwards. ■ Apprentices that start at an early age, even at very low pay, tend to generate the highest private rates of return, compared to apprentices that start at a later age. ■ Big firms tend to have the highest net benefits, whereas micro-companies (<10 employees) may face net costs in scenarios where average firm can expect net benefits. ■ In most occupations, at least one or two simulated scenarios produce net benefits. However, cooks, retail cashiers, and waiters produce simulation outcomes that show difficulties for firms to break even. ■ In all occupations except for waiters, the savings in hiring costs have the potential to cover the net costs, provided firms are able to retain their apprentices after training. ■ Incorporating potential benefits to the firms after the training has ended would make the training models viable in most cases and for most occupations.	The paper investigates whether an average English firm could expect a net benefit when training apprentices in a similar manner to Swiss firms. The study uses data from Switzerland to simulate the costs and benefits for English firms that would train apprentices in one of ten different occupations.

Name of study	Author	Date	Key findings	Comments
Economic impact of apprenticeships	Centre for Economics and Business Research (Cebr)	2014	■ Recent renaissance in apprenticeships, as government has expanded the scale of the apprenticeship programme partly in response to high youth unemployment. ■ Apprenticeships linked to higher chance of finding employment ("employment premiums") and higher wage once employed ("wage premiums") than similar groups without apprenticeships. ■ There is a net gain to the employer while apprentices train, and a higher output once employed. ■ Economic impact of apprenticeships is already large (£34 billion per year), and is likely to continue to rise to reach £101 billion by 2050. ■ Economic return estimated at £21 for each £1 of public spending (2010 data), in line with Feb 2012 paper published by Department for Business, Innovation and Skills. ■ Apprenticeship starts are most concentrated in health and social care. Most apprentices train in service industries, some in manufacturing and a smaller number in construction.	The principal data source used was the UK Department for Business, Innovation and Skills (BIS) further education data library.
Do apprenticeships pay? Evidence for England	Chiara Cavaglia; Sandra McNally; Guglielmo Ventura	2018	■ Results suggest positive earnings differential on average (at least up to age 28). ■ Large variability in the estimated earnings differential between sectors and between men and women. ■ Higher hrs of work by men seem to be important driver of this difference, though this does not account for gender pay gap amongst those educated to a more advanced level. ■ Very high concentration of men in sectors where the return to an apprenticeship is high (such as Engineering) whereas women specialise in areas where the returns to having an apprenticeship are much lower such as Child Development. ■ Exposure to information about apprenticeships will influence the probability of starting an apprenticeship between the age of 16 and 22.	Data obtained from National Pupil Database (NPD), the Individualised Learner Record (ILR), and the Higher Education Statistics Agency (HESA).
The future of Australian apprenticeships	Margo Couldrey; Phil Loveder	2017	■ Apprenticeship model is highly relevant in today's modern economy, but the system, including funding and regulatory arrangements, is complex, inconsistent and confusing. ■ Without apprenticeships, there were concerns that skill shortages in key occupations could occur, particularly for small and medium enterprises. ■ Investigate and consider international models which extend the apprenticeship model to new industries and higher qualification levels, including degrees. ■ Concept of apprenticeships, is often poorly perceived - challenge for the whole of the VET sector to change this view. ■ Need to increase understanding of what works and what doesn't, and then apply the learnings throughout the life cycle of an apprenticeship.	Paper is a summary of key findings from 'The future of Australian apprenticeships' stakeholder forum that was held on 25 Oct 2016 in Canberra.

Name of study	Author	Date	Key findings	Comments
Measuring the costs and benefits of apprenticeship training	International Labour Office	2019	▪ Non-monetary benefits for enterprises include reduced turnover, improved recruitment, gaining pipeline of skilled workers, lower injury rates and improved employee engagement. ▪ Benefits to individuals include better school-to-work transitions, shorter unemployment between training and getting a first job and higher wage premiums. ▪ Better soft skills as well as a positive work attitude make apprenticeship graduates often more attractive to hire. ▪ Benefits to society include low youth unemployment, better-quality work, increases in tax revenue and lower social insurance expenditure. ▪ How quickly net benefits are generated depends on company size, sector, duration of training, the extent to which apprentices are engaged in real work/production processes and whether apprenticeships are subsidized.	The paper highlights that there are challenges to obtaining evidence-based data to measure costs and benefits of apprenticeships and particularly long-term benefits are difficult to quantify accurately.

Appendix C: Approach to the socio-economic assessment

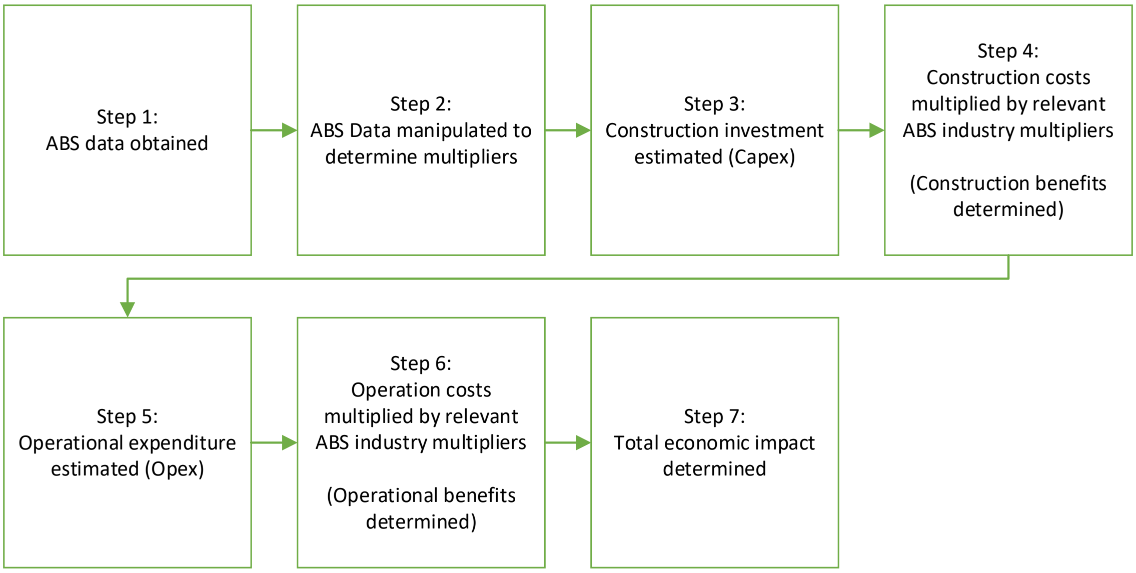
Input-Output Modelling

Input Output Modelling is defined as a top down approach to estimating economic impacts of expenditure. An Input Output Model estimates jobs and income predictions through the inherent interdependencies between industries (multiplier effect). The Input Output multipliers capture:

- Direct (initial) benefits
- Indirect (Secondary) benefits
- Total benefits (sum of direct and indirect benefits)

The process undertaken for the economic assessment is outlined in Figure 2 below:

Figure 2: The end-to-end process undertaken to conduct input-output modelling



Step 1: ABS data obtained

- Input output multipliers were underpinned by the latest input-output tables produced by the Australian Bureau of Statistics:
    - 5209.0.55.001 - Australian National Accounts: Input-Output Tables, 2016-17

Step 2: ABS Data manipulated to determine multipliers

- The latest input-output table for South Australia, Victoria, New South Wales and Queensland was combined with labour force data to generate estimates of economic multipliers consistent with the methodology outlined by the Australian Bureau of Statistics.

Step 3: Construction investment estimated

- The economic assessment relied on capital construction costs (Capex) provided by Neoen and the expected share of labour and equipment sourced from the relevant State. CAPEX was disaggregated by:
    - Wind power investment
    - Solar power investment
    - Battery power investment
    - Other site investment

Step 4: Construction multiplied by relevant ABS industry multipliers

- Assumed relevant ABS industries and percentage of total investment cost:
  - Non-Residential Construction – 30%
  - Professional, Scientific and Technical Services – 10%
  - Heavy and Civil Engineering Construction – 50%
  - Road Transport – 10%
- The multipliers outlined in the tables below were used to estimate the indirect economic activity that will stem from the construction of the CBEP.

Step 5: Operational expenditure estimated

- Operational expenditure estimates provided by Neoen.
- Where actual data was not available, other Neoen sites with similar operations are an appropriate proxy.

Step 6: Operation costs multiplied by relevant ABS industry multipliers

- Assumed relevant ABS industries and percentage of total investment cost:
  - Electricity Generation – 40%
  - Electricity Transmission, Distribution, On Selling and electricity Market Operations – 40%
  - Insurance and Superannuation Funds – 20%
- The multipliers outlined in the tables below were used to estimate the indirect economic activity that will stem from the operation of the facilities.

Step 7: Total economic impact determined

- The total economic impact of the construction and operational phases of the facilities were estimated at a state and regional level. The proportion of activity generated by a renewable energy project that was accommodated by businesses within the relevant region was estimated based on a review of the population size, economic activity and development of the catchment.

Table 39: Economic multipliers used for South Australia

Multipliers (From SA Multipliers v0.1)	Type 1A			Type 2A		
	Initial effects + first round effects			Total multipliers		
	Output	Income	Employment	Output	Income	Employment
Construction phase						
Non-Residential Building Construction	1.74	0.29	4.42	4.54	1.10	14.93
Professional, Scientific and Technical Services	1.46	0.64	7.52	4.66	1.58	19.52
Heavy and Civil Engineering Construction	1.53	0.38	3.45	4.11	1.13	13.09
Road Transport	1.49	0.57	7.71	4.48	1.45	18.90
Operational phase						
Electricity Generation	1.74	0.24	3.05	3.87	0.84	10.53
Electricity Transmission, Distribution, On Selling and Electricity Market Operation	1.56	0.22	1.62	3.44	0.73	7.83
Insurance and Superannuation Funds	1.67	0.39	3.66	4.14	1.13	12.90

Document prepared by

Aurecon Australasia Pty Ltd
ABN 54 005 139 873
Aurecon Centre
Level 8, 850 Collins Street
Docklands, Melbourne VIC 3008
PO Box 23061
Docklands VIC 8012
Australia

T +61 3 9975 3000
F +61 3 9975 3444
E melbourne@aurecongroup.com
W aurecongroup.com

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