



## Employment, Skills and Supply Chains: Renewable Energy in NSW – Appendices

---

Prepared for Department of Planning, Industry and Environment  
on behalf of the Renewable Energy Sector Board by UTS Institute  
for Sustainable Futures and SGS Economics and Planning

## Appendix 1: Full REZ profiles

### Introduction

This chapter examines the economic structure and performance of each REZ region within its broader economic context. The objective is to establish region-specific baselines that collectively describe the region's progress on a transition to renewable energy. This is indicated by their integration within local and global supply chains, industry composition, the depth of training and development opportunities available to local and incoming workforces, and current labour market capacity.

In this chapter, 'region' refers to a spatial approximation of the REZ region. For the purposes of this analysis, regions are defined by concurrence between ABS' administrative boundaries and the best approximation of the REZ's geographic extent. For priority REZs (Central-West Orana, New England and South West), concurrence is based on SA1s and the indicative site boundaries that are published online by NSW government.

In the absence of published maps, the Hunter-Central Coast uses SA4 boundaries as a proxy, while Illawarra is based on SA3s. Planning for these are in their early stages and indicative sites have not been specified. While the administrative boundaries do not perfectly align, they are the best fit for the purpose of census data collection and analysis.

Using a combination of ABS and qualitative data, this chapter profiles each regions as outlined in Table 1:

Table 1 Components of REZ profiles

Baseline theme	Elements
<b>Demographic profile</b>	<ul style="list-style-type: none"><li>• Population size in 2016 and projected population to 2041</li><li>• Population density</li><li>• Age distribution</li><li>• Educational attainment</li><li>• First Nations share of population</li><li>• Skills profile</li><li>• Employment status</li><li>• Average income</li></ul>
<b>Economic structure</b>	<ul style="list-style-type: none"><li>• GRP growth, compared to state-wide and national GRP growth</li><li>• Industry mix and contribution to the region's GRP</li><li>• Shifts in the industries' share of production, 2015-2020</li><li>• The region's competitive strengths</li></ul>
<b>Institutional endowments and industry specialisations</b>	<ul style="list-style-type: none"><li>• Major educational institutions and their course mix, in terms of highest attainment level and industry pathway</li><li>• Industry qualifications by share of residents</li></ul>

Key barriers and constraints for REZ development are also discussed at a high level. These are based on stakeholder inputs from workshops, interviews and surveys conducted as part of this study, as well as desktop research.

### 2.2 Economic concepts and notational convention

The following terms and concepts are used to describe the economic structure of the regions. They are defined here for ease of reference:

- **Location quotient (LQ)** – a ratio that compares the region to a larger reference region (for this analysis it is NSW) according to some characteristic. In the bubble charts, a position on far right indicates specialisation while a larger bubble size indicates the average annual employment growth between 2012 and 2017.

- **Gross Regional Product (GRP)** – a measure of size or net wealth generated by the local economy. Changes in this figure can indicate employment shifts, changes to productivity and/or industry mix.

## 2.4 Central-West Orana

### Summary

Moderate population growth is forecast in the region, driven by a combination of natural increase and recent investment attraction to encourage the regional relocation of businesses and residents. In addition to the REZ, Central-West and Orana is home to:

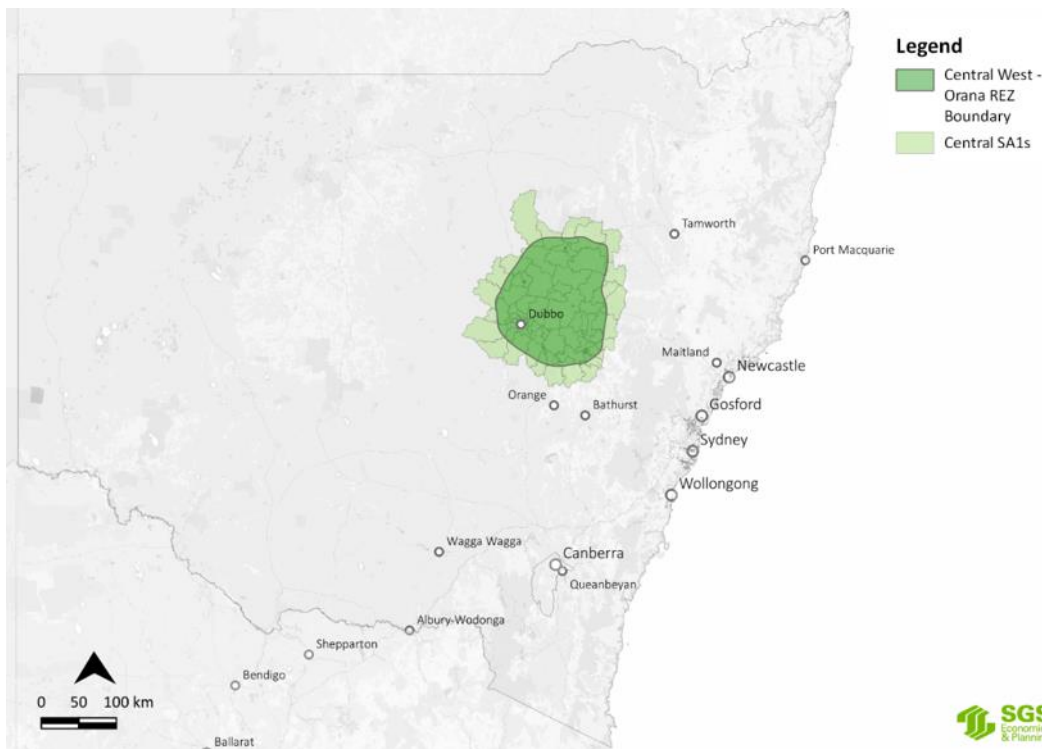
- The Parkes Special Activation precinct (a leader in greening initiatives through the establishment of Australia’s first Eco-Industrial precinct)
- The Parkes site of the Gig State project (which aims to deliver metro-level digital connectivity)
- Major critical infrastructure across the health, justice and education domains.

Central-West and Orana’s local economy has a strong agrarian history, although mining, food processing and service provision are growing in their share of employment. Planned solar and wind energy projects in the region will increase demand for appropriately skilled workers such as wind turbine technicians, system designer and installation technicians. While the region currently has a sizeable talent pool of technicians and tradespeople, education and training is likely to become a central focus, given known skills shortages and a need to reskill or upskill the existing workforce to engage in specific renewable energy activities.

In preparation for REZ construction commencing in 2027, a preliminary assessment indicates that institutional capacity to deliver core and secondary skills along the renewables supply chain is low. There is an enabling role for governments and industry to pinpoint the right skills mix and training support to maximise regional benefits from the Central-West & Orana’s renewables specialisation

The Central-West Orana REZ is shown in Figure 1.

Figure 1: Central-West Orana REZ – indicative boundary



Source: SGS Economics Planning, 2021

Central-West and Orana’s economy is diverse, demonstrating strong agribusiness, mining and construction sectors (REDS, 2018). Several solar and wind developments are already operational: Dubbo Solar Hub,

Bodangora Wind Farm and Burrundulla Solar Farm, with many others under construction, approved, or in planning phase.

Beyond the indicative REZ site, wind and solar farms extend as far as Nyngan, Forbes, Blayney and Gunnedah. The Parkes Special Activation Precinct lies to the south-west of the Central-West and Orana REZ and is expected to increase electricity demand in Central-West NSW. Currently, 132kV transmission lines provide connection between Parkes and the REZ region (TransGrid, 2021).

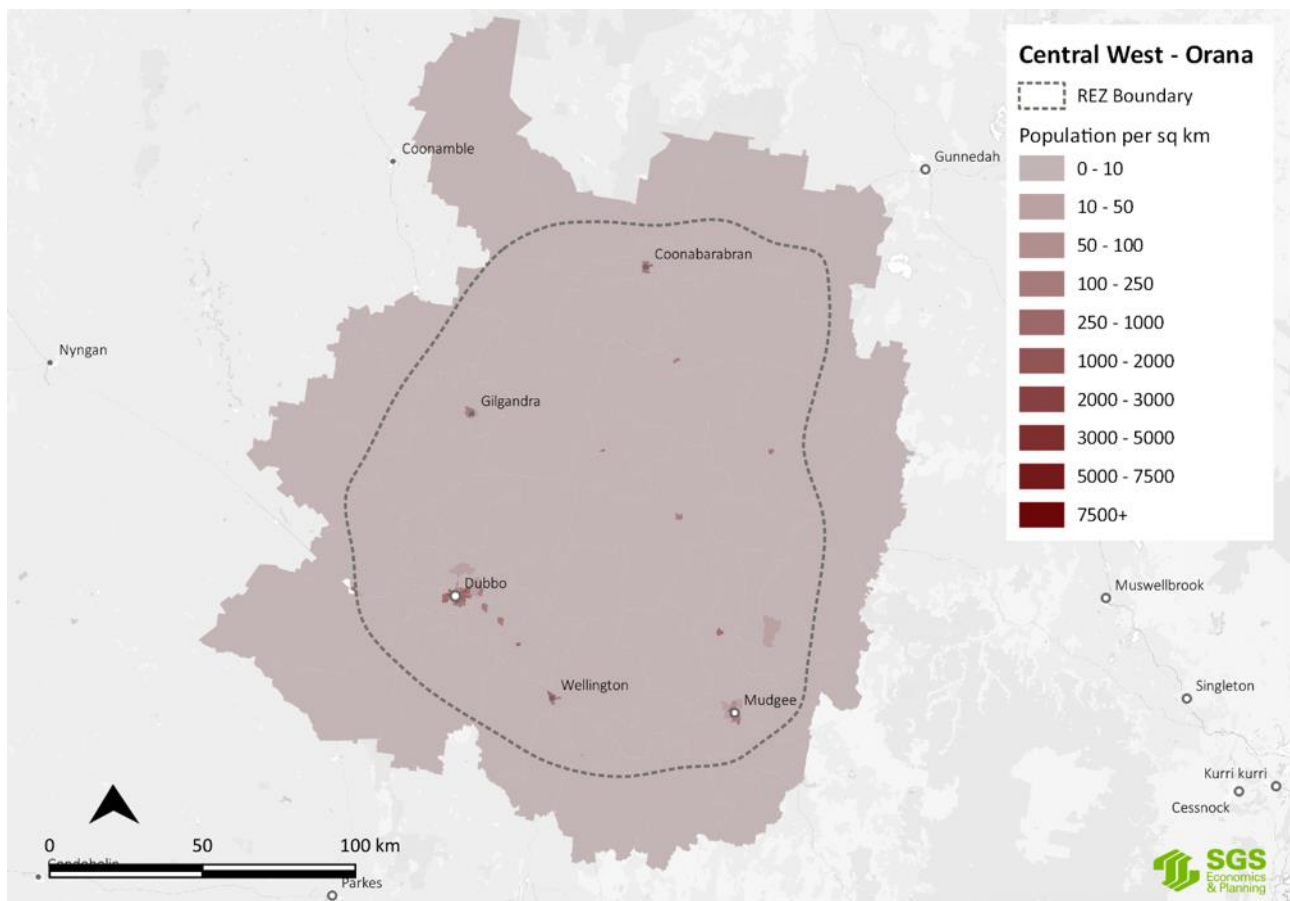
## Demographic profile

### Population size and density

In 2016, the population within the Central-West REZ was 87,140 based on the identified SA1s (ABS, 2016), with population density concentrated in key centres (Figure 2). Based on DPIE planning region projections, the broader Central-West region's population (extending beyond the REZ boundary) is estimated to grow by 7.5% from a base of 284,679 in 2016 to 306,011 in 2041 (DPIE, 2020).

This is expected to translate into a slight to moderate increase of the local workforce, noting that the region has a higher proportion of retirement aged individuals compared to the state average (Figure 3).

Figure 2 Map of population density in Central-West Orana REZ



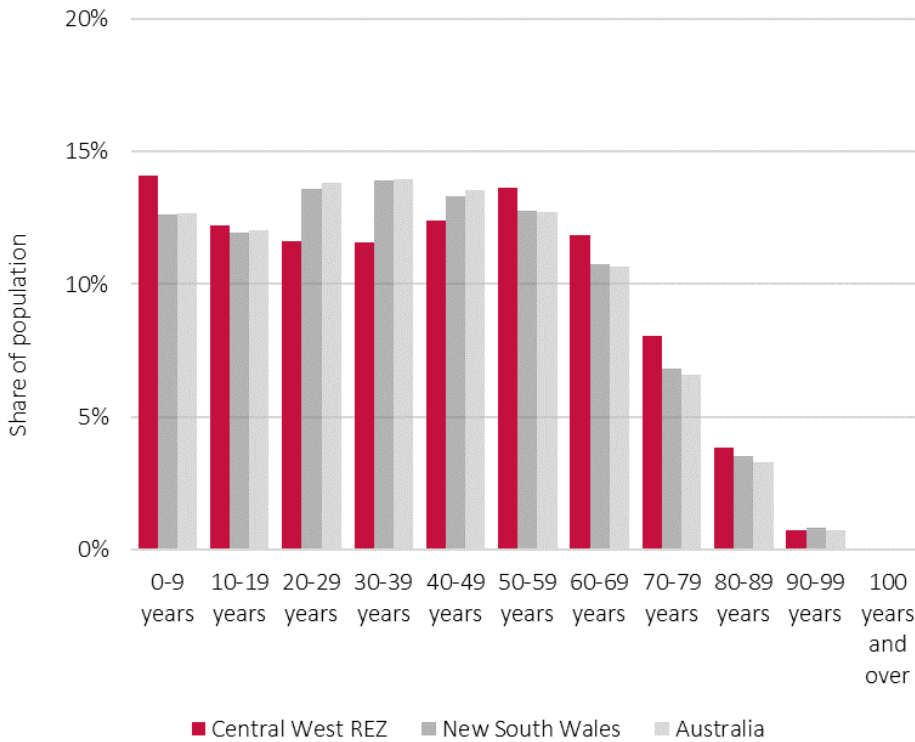
Source: ABS, Census 2016

### Age distribution

The age distribution of the region is skewed slightly older than the NSW average, with lower proportions across all age groups between 20-29 and 40-49 years old. This is generally characteristic of regional communities, which have historically observed a trend of younger populations seeking out education and employment opportunity in metropolitan areas or regional centres.

The age groups between 50-59 and 80-89 all contain a higher proportion of the region's population compared to the NSW average. There is however a slightly higher share of children aged 0-9 and 10-19. Interestingly, the 0-9 year old age group is the largest, being 14.6% of the total population.

Figure 3: Age distribution, Central-West and Orana REZ region, 2016



Source: ABS, Census 2016

### First Nations share of population

The First Nations share of population is relatively high at 13.4% (Table 2). This is significantly higher than the NSW state average (3.1%).

Table 2: First Nations population, Central-West and Orana REZ region, 2016

	First Nations	Non-First Nations	Total
<b>Total</b>	10,630	68,992	79,622
<b>Share</b>	13.4%	86.6%	100%

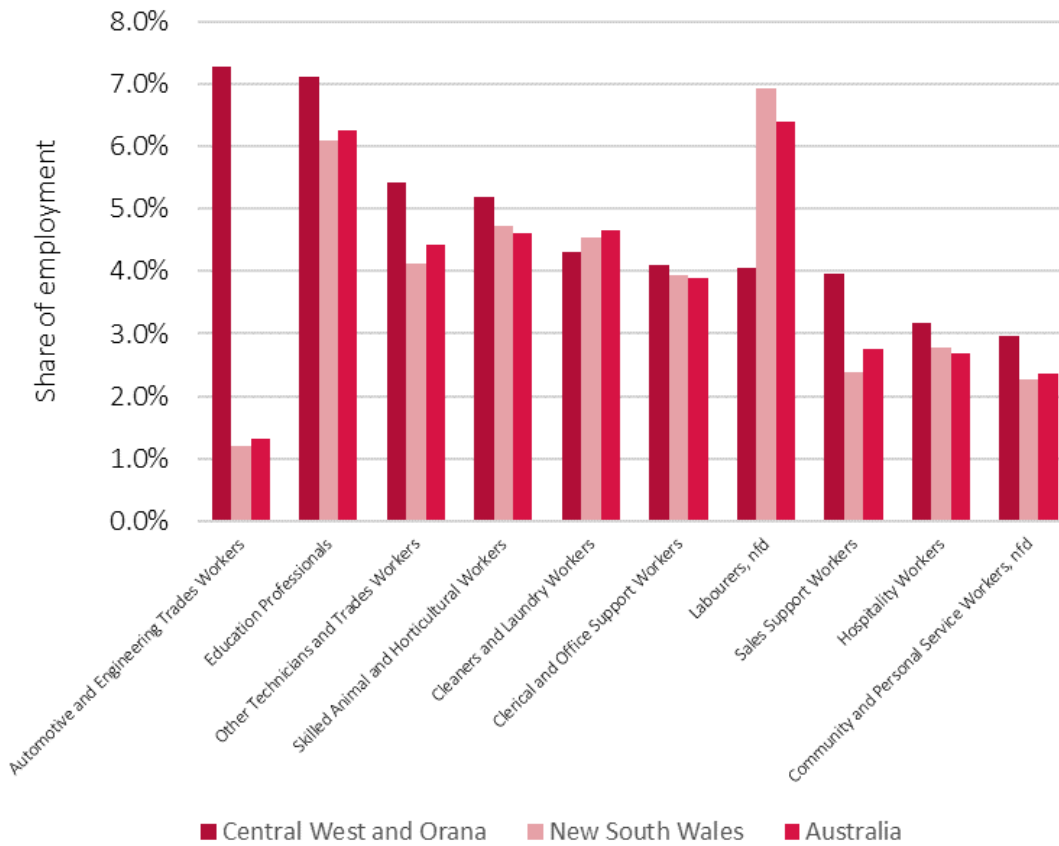
Source: ABS, Census 2016

### Skills profile

The ABS uses a skill-based classification of occupations that is agnostic to the industry within which the job is held. The Central-West and Orana region's largest employing occupations in 2016 were automotive and engineering trades workers, education professionals, other technicians and trades workers and skilled animal and horticultural workers (Figure 4). These occupations largely reflect the industry distribution in the area and speak to the need for trade workers with skills in engineering, likely for use in agricultural machinery and mining machinery maintenance and operation.

There is therefore some alignment with the technical occupational needs of renewable energy activities, as well as education professionals to support the skills response of education providers and industry. The relative scarcity of labourers compared to the NSW and the national shares of employment suggest a potential pressure point for REZ construction if these skills must be sourced from outside the region. As in many sectors, the region's ageing workforce may also present challenges to increasing the skills base for in-demand skills.

Figure 4: Ten largest occupation groups (2-digit level) in the Central-West and Orana REZ region

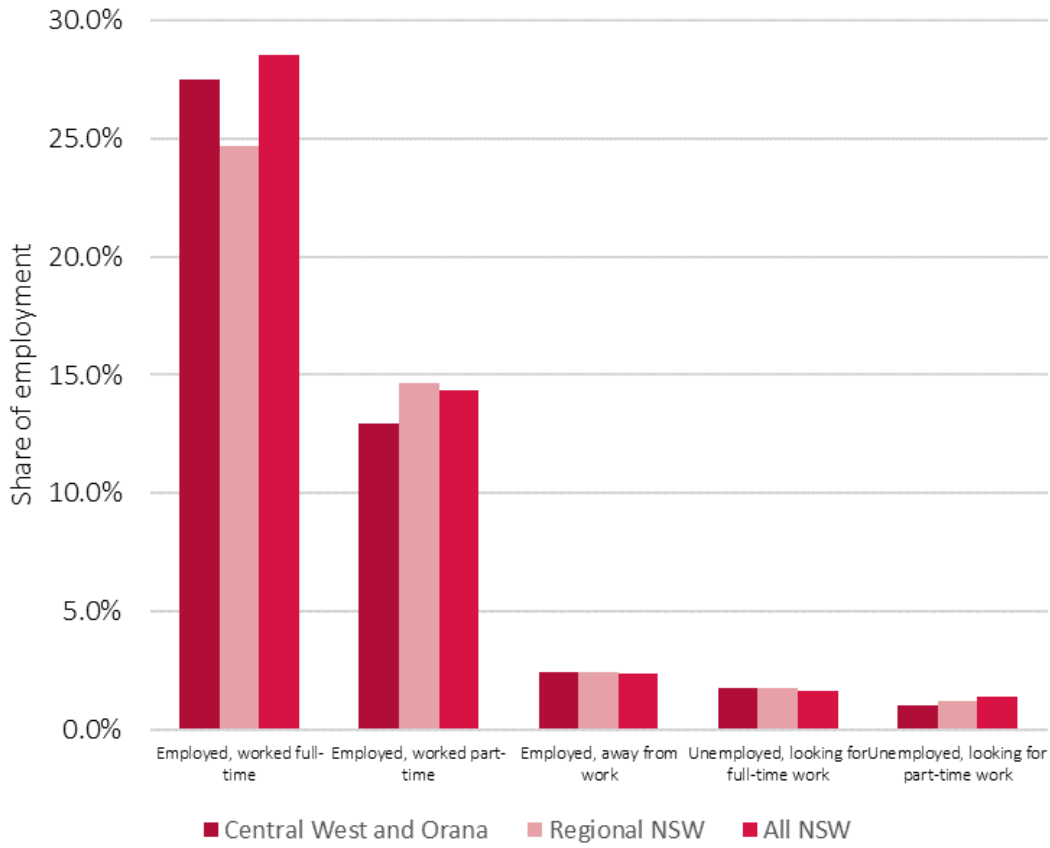


Source: SGS Economics and Planning using 2016 census data

### Employment status and average income

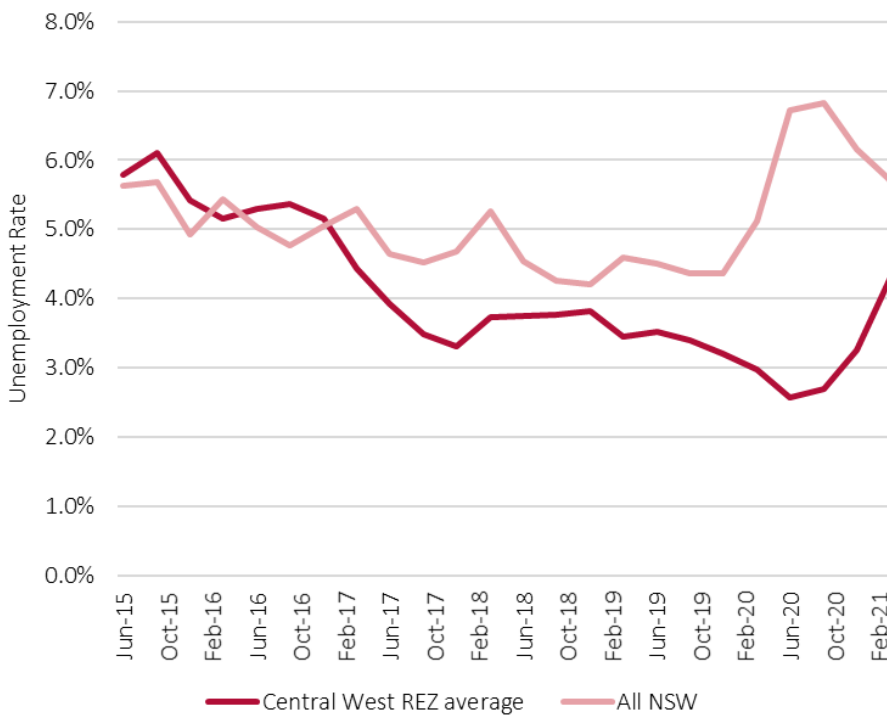
Compared to the regional NSW average, the Central-West and Orana region has a slightly higher share of full-time workers and lower share of part time workers (Figure 5). Its levels of unemployment are largely in line with state-wide average (Figure 6). This suggests that there is not a lot of unused labour capacity in the region that can be easily redirected into other uses.

Figure 5: Labour force status, Central-West and Orana REZ region



Source: ABS, Census 2016

Figure 6: Unemployment, Central-West REZ, 2015 to 2021



Source: Department of Education, Skills and Employment, 2021

In 2016, the share of First Nations unemployment in the region was 10.2% (Table 3) compared to the NSW average of 8.9% (Table 4). Shares of the First Nations population not in the labour force are also higher in this region.

Table 3: First Nations and Non-First Nations population by work status, Central-West and Orana REZ region, 2016

	Full-time	Part-time	Unemployed	Not in labour force	Total
<b>First Nations</b>	26.9%	15.2%	10.2%	47.7%	100.0%
<b>Non-First Nations</b>	40.9%	18.9%	3.2%	37.0%	100.0%

Source: ABS, Census 2016

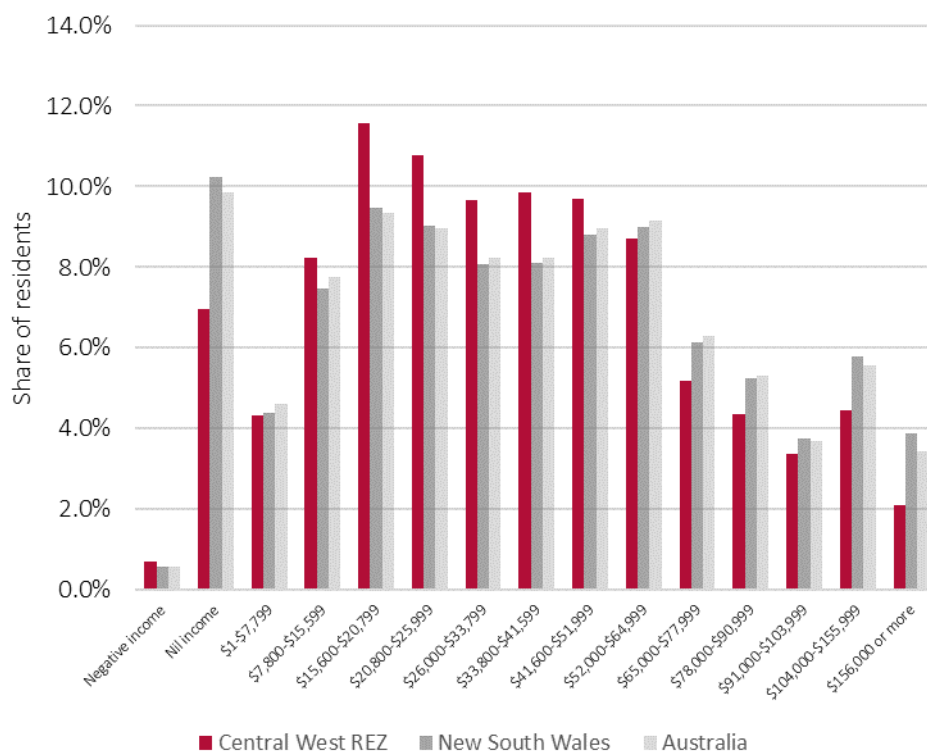
Table 4: First Nations and Non-First Nations population by work status, All New South Wales, 2016

	Full-time	Part-time	Unemployed	Not in labour force	Total
<b>First Nations</b>	28.7%	16.7%	8.9%	45.7%	100.0%
<b>Non-First Nations</b>	39.0%	19.5%	4.0%	37.5%	100.0%

Source: ABS, Census 2016

In 2016, Income distribution in the Central-West Orana region was skewed more towards the lower end of income bands than the rest of NSW and Australia, although income earnings have been increasing gradually in the ten years to May 2021 across NSW.

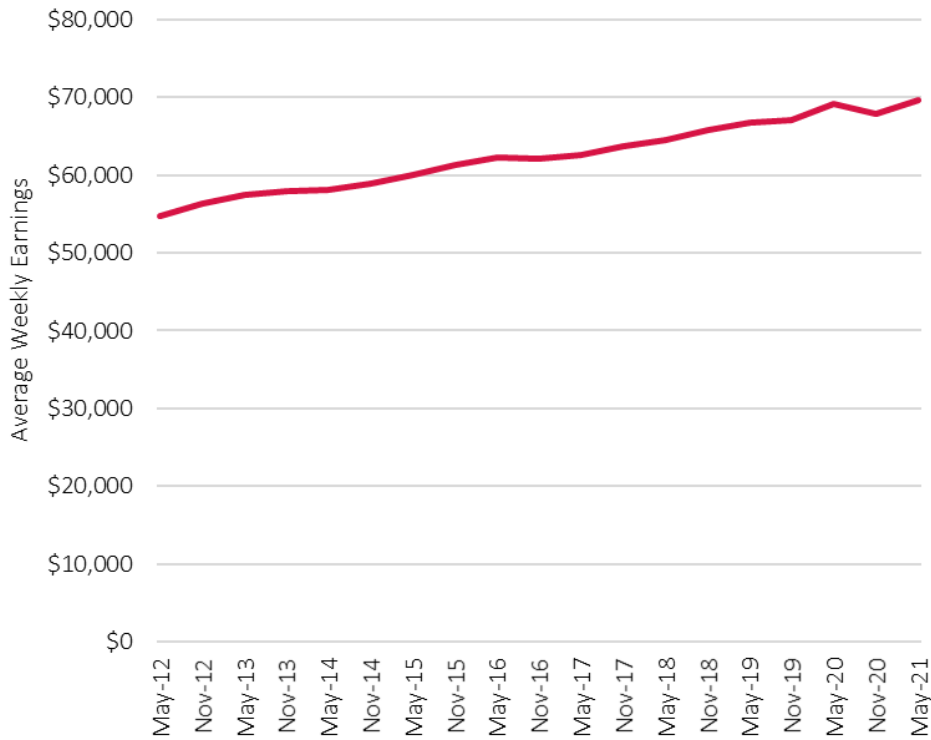
Figure 7: Average annual income, Central-West and Orana REZ region, 2016



Source: ABS, Census 2016



Figure 8: Average annual earnings, All NSW, 2012 to 2021



Source: ABS, Average Weekly Earnings, Australia, 2021

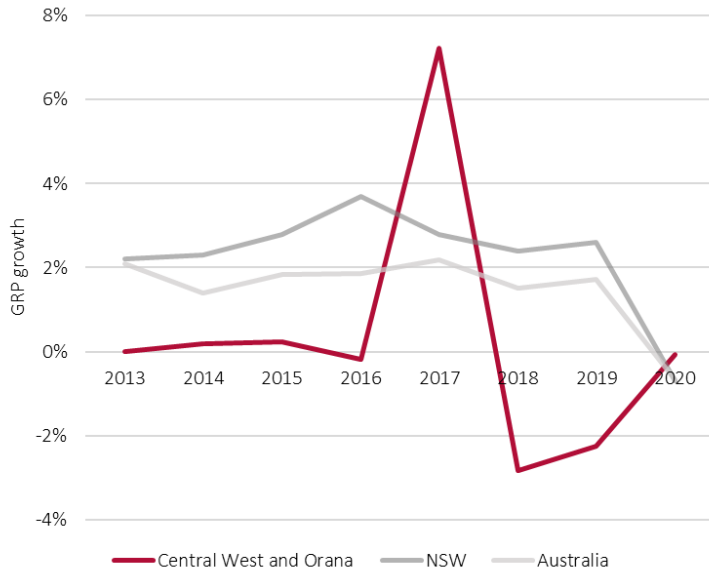
## Economic structure

### GRP growth

This region has generally underperformed against the national and state economy over the past decade, however with significant fluctuations (Figure 9). There was sharp GRP growth between 2016 and 2017, but this has since fallen sharply, in part due to the drought impacts affecting crop and pasture production between mid-2017 and 2020.

While fluctuations are typical of regional farming communities, whose economies are heavily sensitive to changes in environmental factors and trade conditions, the compounding effects of drought, water insecurity, bushfires and the COVID-19 pandemic have challenged recovery in GRP growth. As NSW shifts into drought recovery phase in 2020 and 2021, it also appears that Australia’s agricultural industries mitigated the impacts of ongoing labour supply vulnerability from travel restrictions and export disruptions by diversifying their markets (Cameron et al., 2021). This can be observed in the gradual GRP recovery to pre-COVID levels.

Figure 9: GRP growth compared to NSW and Australia, Central-West and Orana REZ region



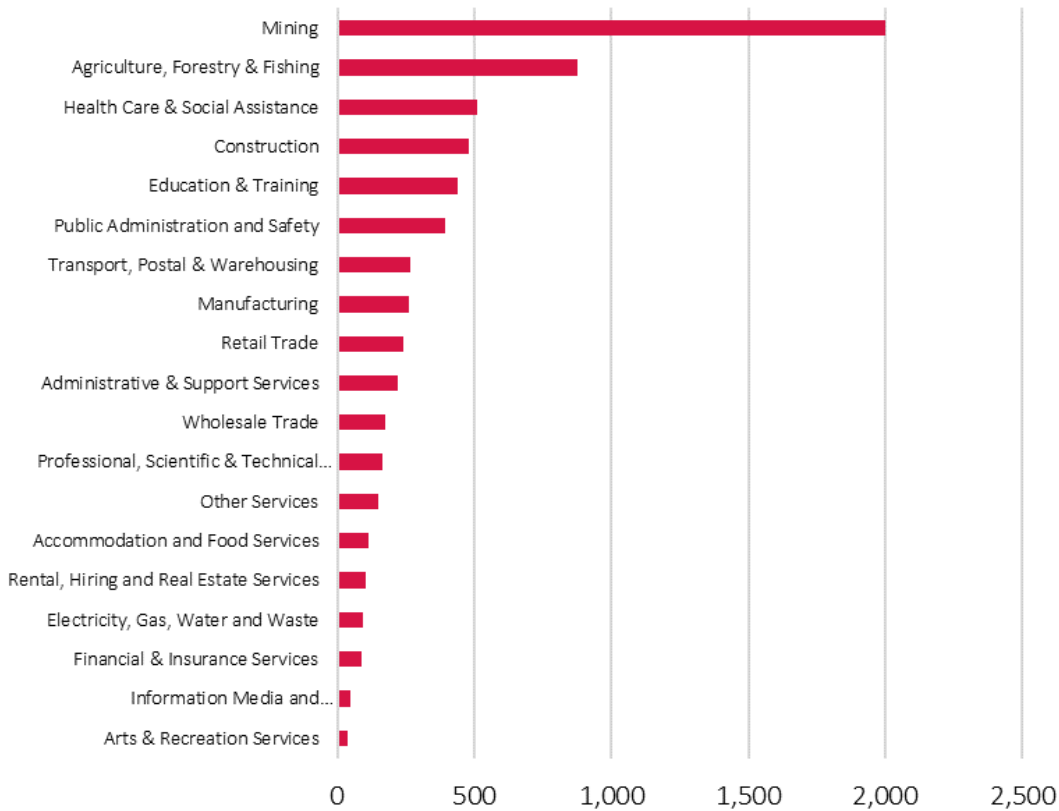
Source: Australian National Accounts: State Accounts, Cat. No. 5220.0 and SGS Economics Planning (can get data from Performance of Cities and Regions)

### Industry mix

Primary production collectively accounted for the majority of total income generated in the regional economy in 2020. 27.6% and 18.5% of the region's GRP was attributable to mining and agriculture respectively. Population serving industries such as construction (7%), health care (6%), education and training (5.2%) and public administration (5.1%) also represented large shares of GRP. Collectively, these industries accounted for nearly 70% of the region's total GRP (Figure 10).



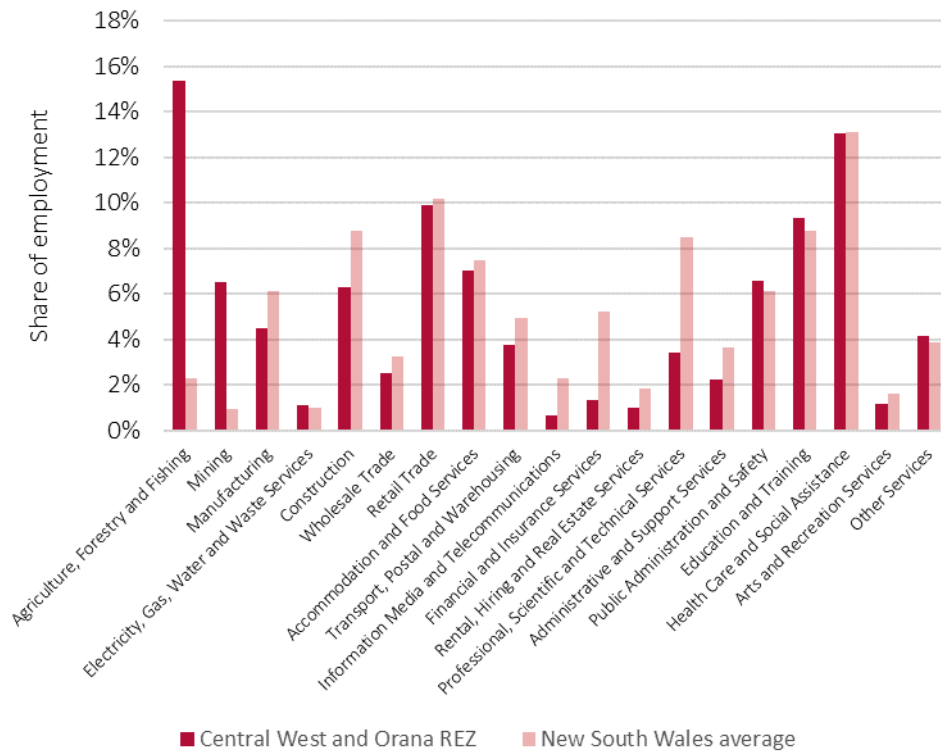
Figure 10: Industry contribution to GRP in 2020, Central-West and Orana region



Source: Australian National Accounts: State Accounts, Cat. No. 5220.0 and SGS Economics Planning

Another way to measure the size and contribution of different industries in the region is to look at the share of employment each industry makes up. This is shown in the chart below (Figure 11). Agriculture makes up the largest share of employment in the Central-West and Oran REZ, followed by health care and social assistance. While mining makes up a larger share than the state average, the industry is underrepresented compared with its contribution to GDP. This is mostly due to the capital-intensive nature of the industry and high value of outputs produced.

Figure 11: Industry share of employment, Central-West and Orana region



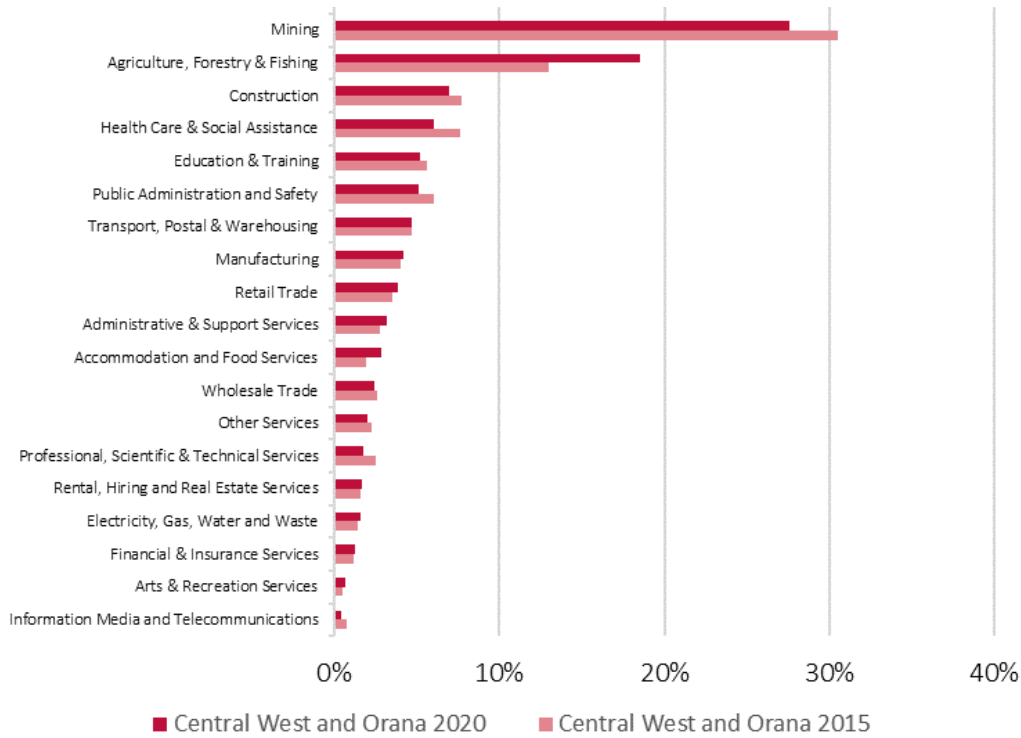
Source: SGS Economics and Planning using 2016 census data

### Shifts in industries’ share of production, 2015-2020

The dominant trend in the region’s economic structure over the past five years has been strong growth in agriculture related industries (Figure 12). As a share of GRP, these industries grew by almost 6% over the period. In comparison, mining and population serving jobs all fell slightly as a share of total production, despite growing in absolute terms over the same period.

Manufacturing grew as a share of total production in Central-West and Orana, albeit very marginally. Other industries experiencing growth included retail, professional, scientific and technical services, and accommodation and food services. The lack of a clear link between the types of industries that have grown proportionally in the area over the past five years suggests that there are no major structural shifts taking place in this regional economy at the current time.

Figure 12: Industry structure over time (GRP contribution 2015-2020), Central-West and Orana region



Source: Australian National Accounts: State Accounts, Cat. No. 5220.0 and SGS Economics and Planning

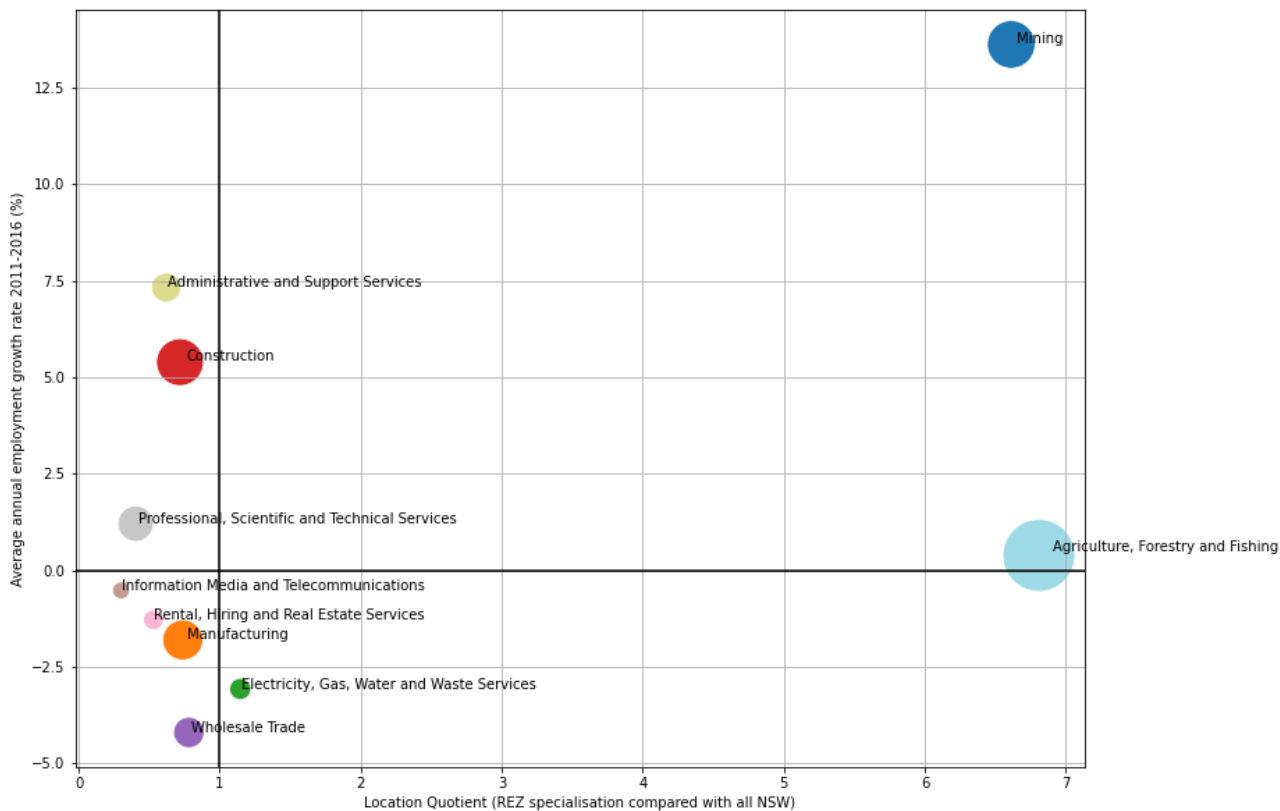
### Competitive strengths

The location quotient (LQ) analysis shown in Figure 13 provides some insight to the competitive strengths inherent in the region’s economic structure. As expected, the region’s agriculture and mining sectors are outliers in their relative growth and specialisation, shown by their positioning on the far right of the x-axis.

Slight specialisations in electricity, gas, water and waste services and education and training were also observed. Construction and administrative and support services are growing quickly compared to the state of NSW, but would generally not be considered an area of specialisation in the region based on available data.



Figure 13: Location Quotient of industries in the Central-West and Orana region



Source: SGS Economics and Planning using 2016 census data

## Institutional endowments and qualifications

### Major education institutions

Educational assets in the region include the Charles Sturt University, which has a campus at Dubbo. The campus offers two Bachelor programs; a Bachelor of Social Work and Bachelor of Nursing. There are TAFE campuses at Dubbo, Wellington, Gilgandra, Coonabarabran, Dunedoo, Gilgandra and Mudgee. Dubbo TAFE offers Advanced Diplomas and Diplomas, while the others offer Certificates.

In the Castlereagh area, the TAFE campuses at the Gilgandra, Coonabarabran and Dunedoo do not offer courses on trade skills. Apprentices must travel to other campuses to access these education pathways. There are Connected Learning Centres at Coonabarabran and Grenfell, which offer remote learning.

A combination of factors challenges education provision in the region, including the variable quality of high-speed internet to support remote learning and the tyranny of distance, which makes travel costs for students and employers prohibitively high. This has contributed to a skills gap in the workforce (REDS, 2018).

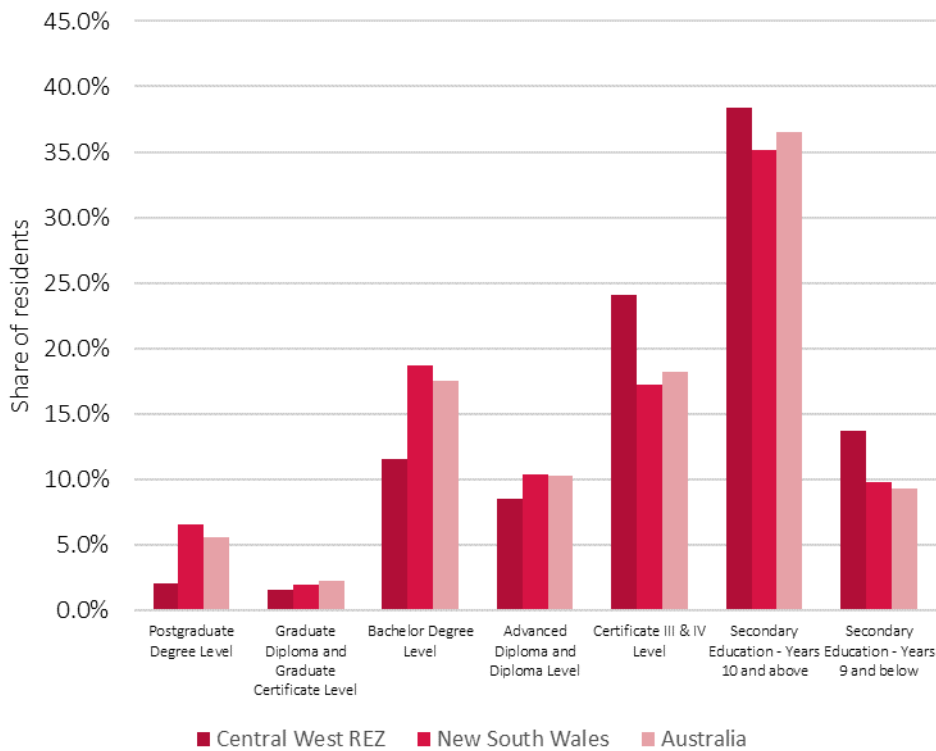
Registered Training Organisations (RTO) also providing training coverage to the region, offering recognised training courses for construction, work at heights, and crane operation at a Certificate level. Two Group Training Organisations (GTO) further serve the area with targeted placement of school leavers with employers in engineering and construction.

There are opportunities for greater engagement on science, technology, engineering and mathematics (STEM) at the primary and secondary school level. This can motivate the pipeline of talent into renewable energy industries. STEM skills are increasingly sought after by industry, as there are significant skill shortages of workers with these capabilities. Raising the standard of baseline STEM skills would provide benefit for workers to acquire a broader interdisciplinary skillset, combining scientific expertise with software and data skills (CSIRO Futures, 2016).

### Tertiary qualifications by share of all residents

The population of Central-West Orana has a higher level of the population with Certificate III and IV than the rest of NSW and Australia and a commensurately lower proportion of those with Bachelors or Masters Degrees.

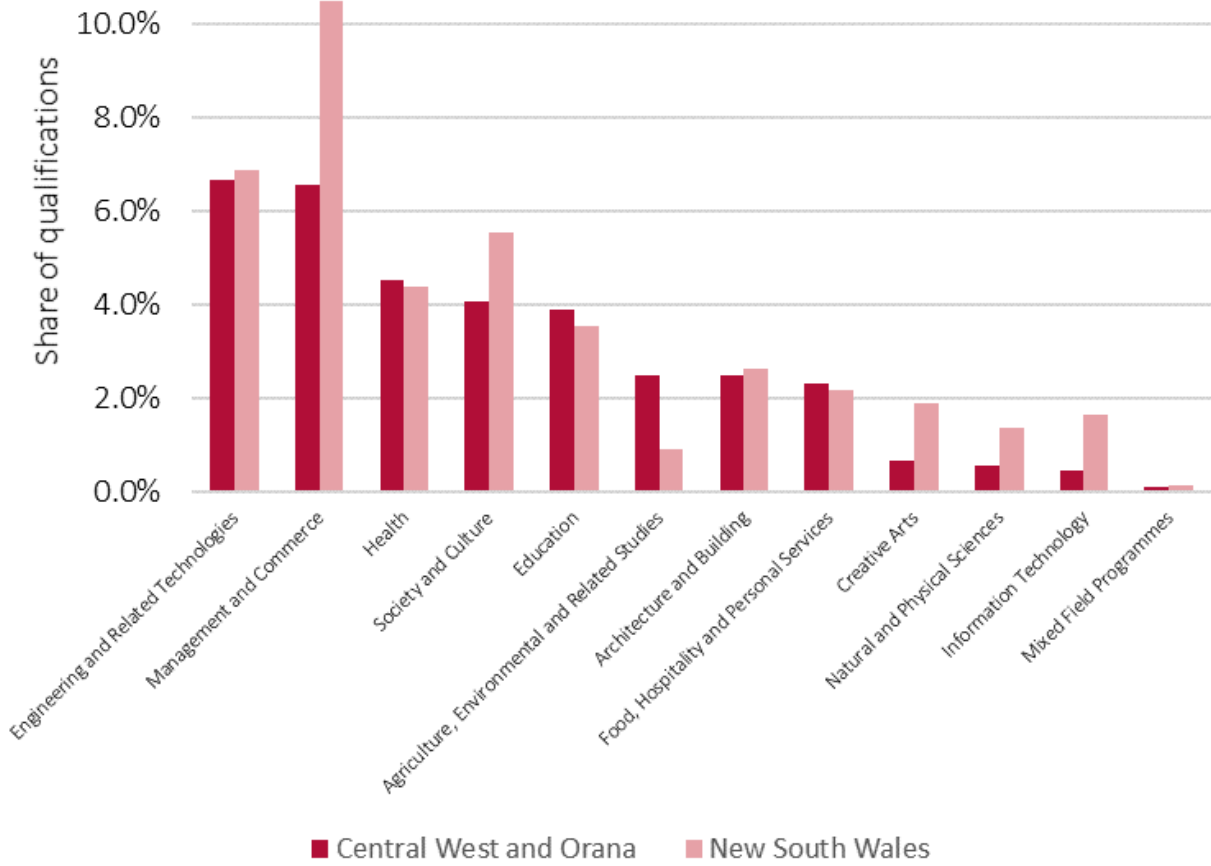
Figure 14: Highest level of educational attainment, Central-West and Orana REZ region, 2016



Source: ABS, Census 2016

Engineering and related technologies accounts for the largest share of qualifications in the region, followed by management and commerce (Figure 15). However, compared with the rest of NSW, there is a significantly lower share population with qualifications in management and commerce. This is unsurprising given the region’s focus on primary production and mining, which are less likely to impose a qualification based entry to industry.

Figure 15: Top qualifications by share of all residents, Central-West and Orana REZ region



Source: SGS Economics and Planning using 2016 census data





- Skills and labour shortages were noted to be a considerable barrier in this region alongside the ability to attract and retain staff. There is a specific gap in training electricians. The training sector (e.g., TAFE) also experiences significant constraints.
- In Orana, a skilled workforce needs to be developed for mining and related industries (REDS, 2018), as well as for renewable energy projects. There is an existing shortage of trade skills such as electricians, plumbers and mechanics in the Mid-Western region (REDS, 2018).
- The Central-West Orana region also experiences barriers within the local supply chain. Transport bottlenecks and disruptions are significant with upgrades needed.
- The lack of housing availability and the compounding factor of access to construction materials is considered to be an infrastructure barrier.
- Both planning capacity and processes are seen as barrier as well as a lack of understanding of contractual requirements for local businesses. Community engagement is low and there is uncertainty regarding the social benefits of the REZ within the community.
- The increased cost of housing alongside lack of financial support for businesses compound some of these challenges within the economic development and finance space.
- A lack of coordination between different levels of government to be able to share local knowledge is an ongoing barrier.

## 2.5 New England

### Summary

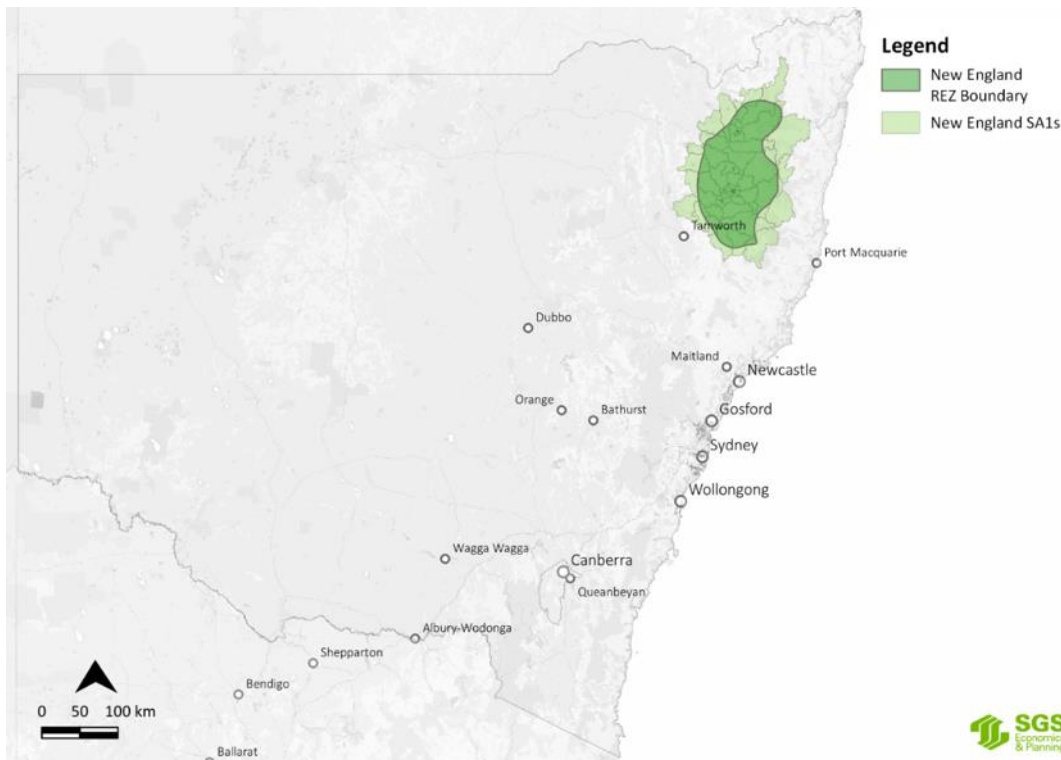
New England is a diverse economy and accounts for a significant share of NSW's agricultural employment and output. Education and training make the second largest contribution to GRP and supports labour force development across a range of ancillary industries, resulting in a relatively diverse skills base. However, there is an identified need to better support the region's manufacturing potential by improving accessibility to skilling initiatives, training models and course mix to meet the areas and timeframes to need. Major investments such as the New England REZ and the nearby Moree Special Activation Precinct will in the future create demand for agribusiness, logistics and food processing skills, in addition to upfront construction and ongoing operational jobs.

As is the case in many regional communities, the New England region has experienced demographic change in recent times, owing to an ageing population and the digital trends in the future of work. Balancing this with the challenges of regional workforce attraction and retention will be key to sustaining the opportunity for economic diversification. The attractive lifestyle and airport connections in the south of the region provide some advantage in attracting high-skilled labour.

Recent climate events have also highlighted that New England is among NSW's most drought-impacted areas, with severe impacts to business confidence and the livelihoods of the local community. The 2019-20 bushfires also disrupted agricultural supply chains and caused the loss of agricultural assets. Opportunities for local economic diversification should be backed by community resilience and capacity building initiatives, recognising that climate events may in the future become more frequent and severe.

The New England REZ is in north-east NSW, spanning from the west of Port Macquarie and Grafton, and stretching westward to Gunnedah. This is shown in Figure 16 below.

Figure 16: New England REZ boundary – indicative boundary



Source: SGS Economics Planning, 2021

Agriculture is a primary industry, with livestock and horticulture growing specialisations, reflecting the region’s productive agricultural land (REDS, 2018). Transport, freight and logistics is an enabling sector, given the region’s proximity to agricultural processing infrastructure in south-east Queensland (REDS, 2018). In the future, digital advancements will enable networked infrastructure to support the uptake of agricultural technology (ag tech) to maximise on-farm productivity.

The region is conducive to wind and solar energy generation due to its climate and location, while some of the rivers have been identified as having hydro-electricity potential (REDS, 2018). Several solar and wind developments are already operational: University of New England Solar Farm, White Rock Wind Farm 2, with many others under construction, approved, or in planning phase. The broader catchment around Inverell also has an operational bioenergy development, Bindaree Beef Bioenergy Plan, as well as the Copeton Hydro Power Station. Currently, networked transmission lines provide connection between Armidale, Glen Innes, Inverell and Tenterfield (TransGrid, 2021).

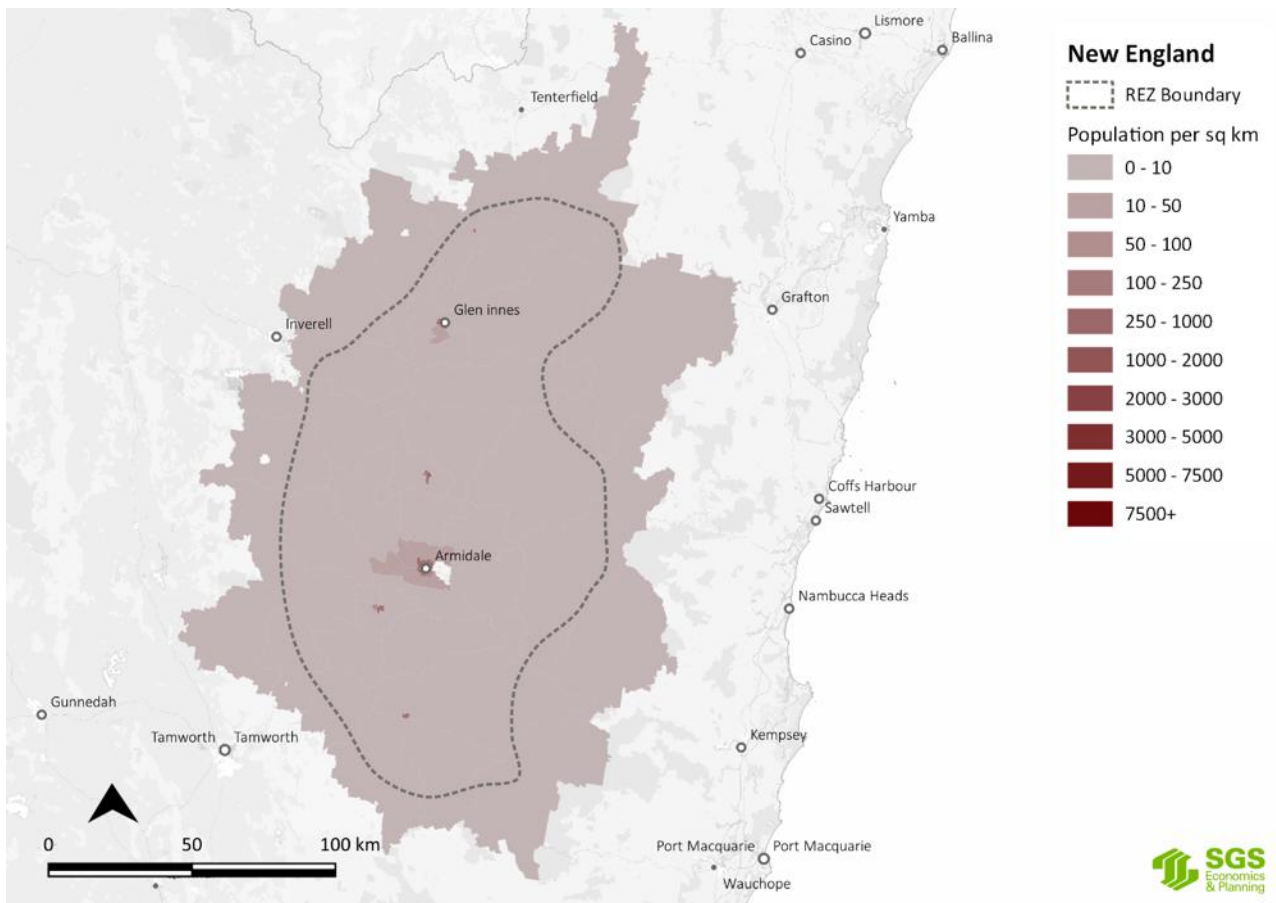
While there is not an existing manufacturing specialisation, improvements to road and air connectivity that leverage Walcha’s road freight services and Armidale’s airport could facilitate expansion in specialised industrial manufacturing (REDS, 2018).

## Demographic profile

### Population size and density

Population in the New England REZ is 49,162 based on the identified SA1s, according to the definition shown in Figure 17 and 2016 ABS census data. Population in the broader New England North West (beyond the REZ) as defined by DPIE in their planning region projections is estimated to grow relatively slowly, by 2.4% from 185,681 in 2016, to 190,965 in 2041. The main population centres in the region are Armidale, Warwick, Uralla, Glen Innes, Stanthorpe, Tenterfield and Walcha, as seen in the distribution of population density (Figure 17).

Figure 17 Map of population density in New England region

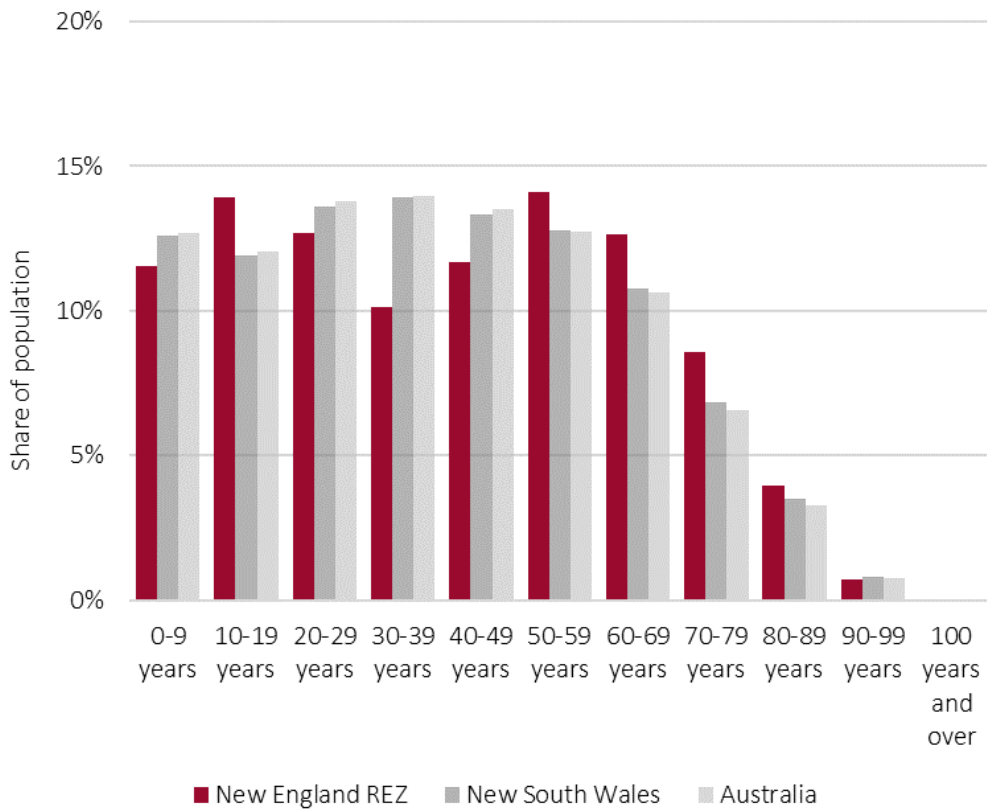


Source: ABS, Census 2016

### Age distribution

As is common to many regional communities, the region has a higher proportion of older residents in the 50- to 89-year-old age groups. There are lower shares in all younger age groups, with the exception of a high share of 10–19-year-olds compared to the state and national proportions (Figure 18).

Figure 18: Age distribution, New England REZ region, 2016



Source: ABS, Census 2016

### First Nations share of population

The share of First Nations residents in the area is relatively high at 7.3% (Table 5) compared to the state average of 3.1% (ABS, 2016).

Table 5: First Nations population, New England REZ region, 2016

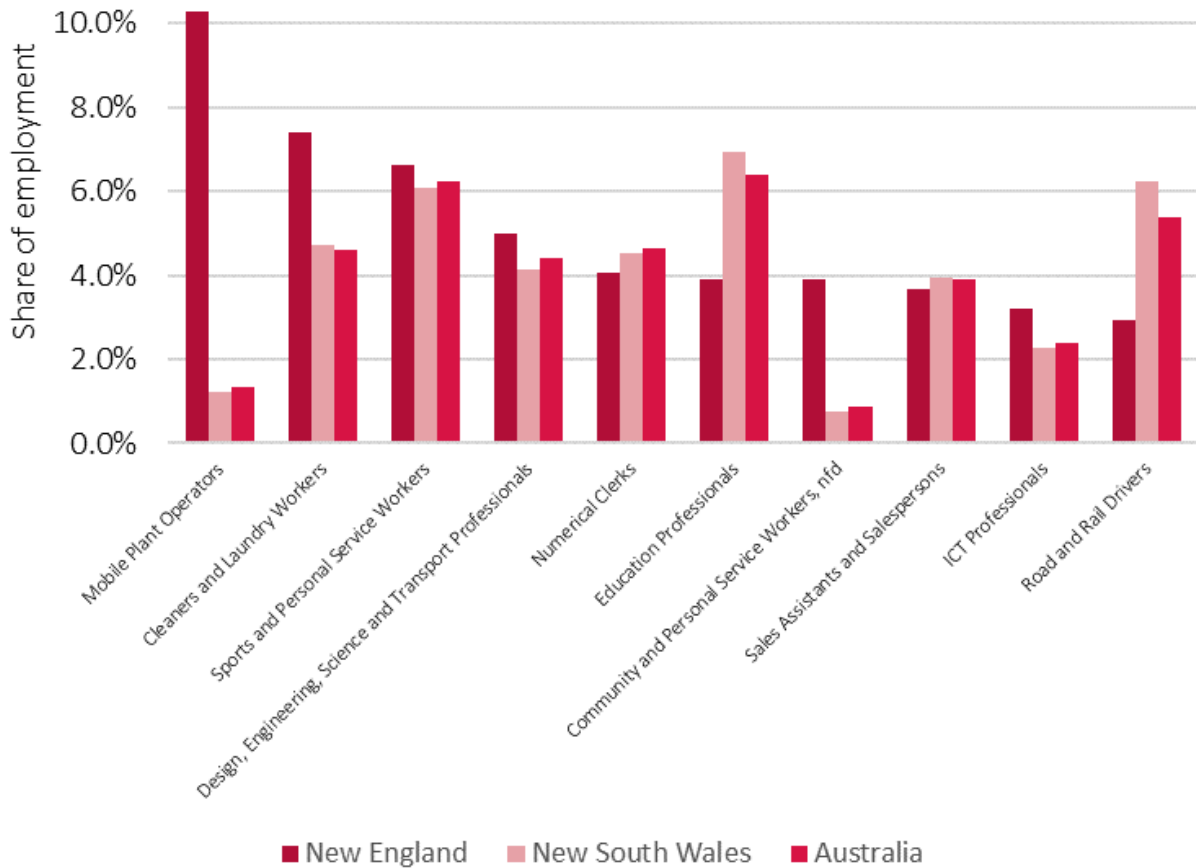
	First Nations	Non-First Nations	Total
<b>Total</b>	3,316	41,916	45,232
<b>Share</b>	7.3%	92.7%	-

Source: ABS, Census 2016

### Skills profile

Figure 19 identifies that there is a relative concentration of mobile plant operators (>10%) in this region, which is likely linked to the machinery operations in the agricultural setting. There is also a higher share of cleaners, sports and personal service workers (possibly tutors attached to the education and training sector strengths of the region) and design and engineering professionals. Many of these positions likely support the region's broad industry mix.

Figure 19: Ten largest occupation groups (2-digit level) in the New England REZ region



Source: SGS Economics and Planning using 2016 census data

### Employment status and average income

The New England REZ has a relatively lower share of full time employed workers compared with NSW and similar shares of part time and unemployed individuals (Figure 20). The latter suggests that there is not a lot of unused labour capacity in the region that can be easily redirected into other uses.

Historically, unemployment levels have been much higher in New England than the rest of NSW, however this gap closed significantly in 2019 and now broadly follows NSW trends (Figure 21).

Figure 20: Labour force status, New England REZ region

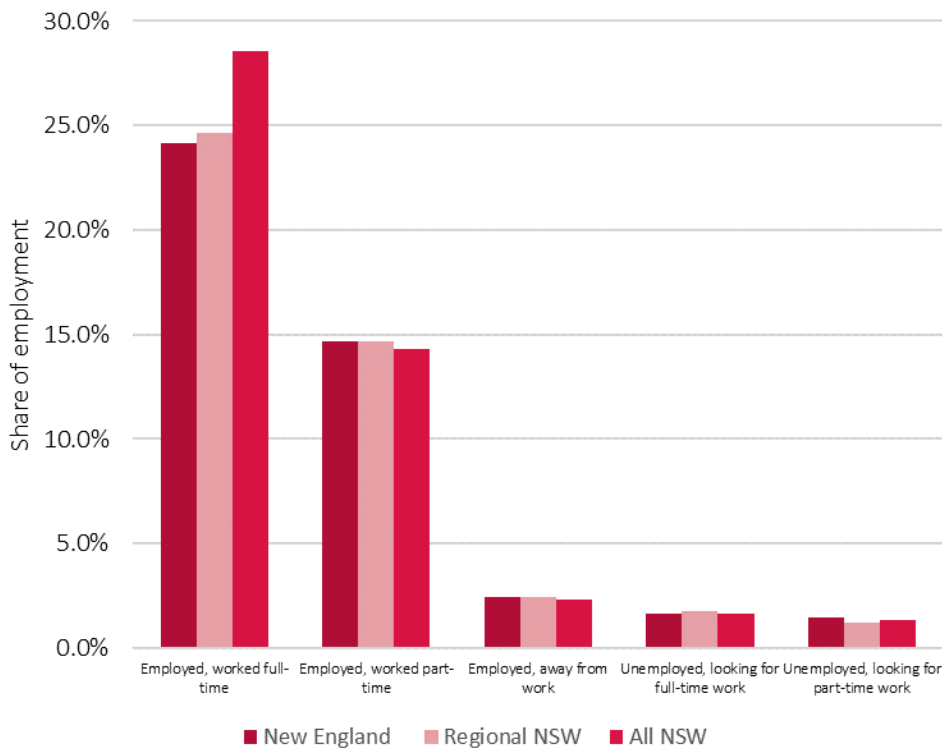
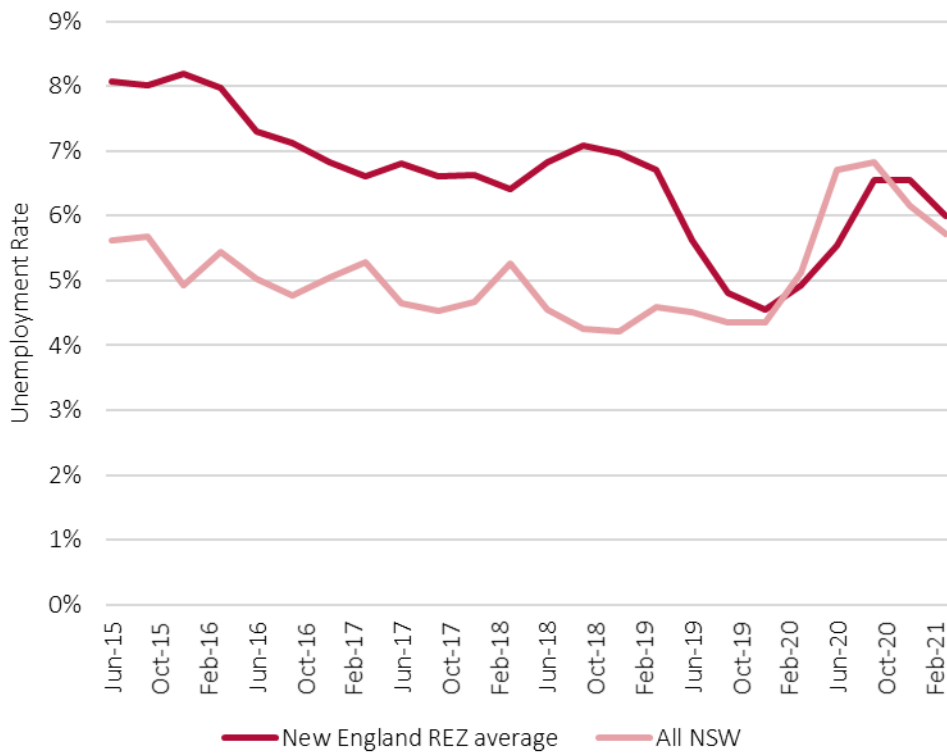


Chart sources: SGS

Economics and Planning, 2021; Australian Government Department of Education, Skills and Employment, 2021

Figure 21: Unemployment, New England REZ, 2015 to 2021



Source: Department of Education, Skills and Employment, 2021

In 2016, First Nations unemployment in the area measured 1% higher than the state average. The share of the First Nations population not in the labour force is extremely high at 55% (Table 6) – nearly 10% higher than the state-wide average (45.7%) (Table 7). While the drivers and barriers to First Nations labour force participation are diverse, influenced by social, cultural and geographic factors, there is an opportunity to leverage the region’s education and training strengths to improve labour market outcomes as the evidence indicates ‘virtually no gap in employment rates’ among First Nations Australians with higher levels of education (Closing the Gap Report, 2020).

Table 6: First Nations and Non-First Nations population by work status, New England REZ region, 2016

	Full-time	Part-time	Unemployed	Not in labour force	Total
<b>Non-First Nations</b>	34.3%	20.6%	4.0%	41.1%	100.0%
<b>First Nations</b>	19.4%	15.7%	9.9%	55.0%	100.0%

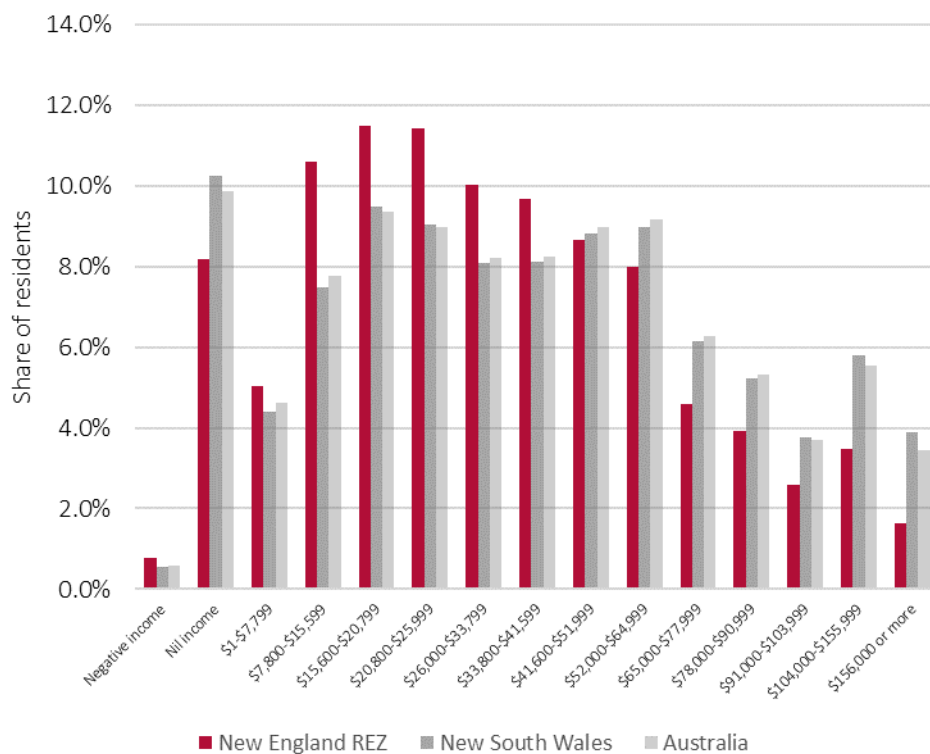
Source: ABS, Census 2016

Table 7: First Nations and Non-First Nations population by work status, All New South Wales, 2016

	Full-time	Part-time	Unemployed	Not in labour force	Total
<b>First Nations</b>	28.7%	16.7%	8.9%	45.7%	100.0%
<b>Non-First Nations</b>	39.0%	19.5%	4.0%	37.5%	100.0%

Source: ABS, Census 2016

Figure 22: Average annual income, New England REZ, 2016



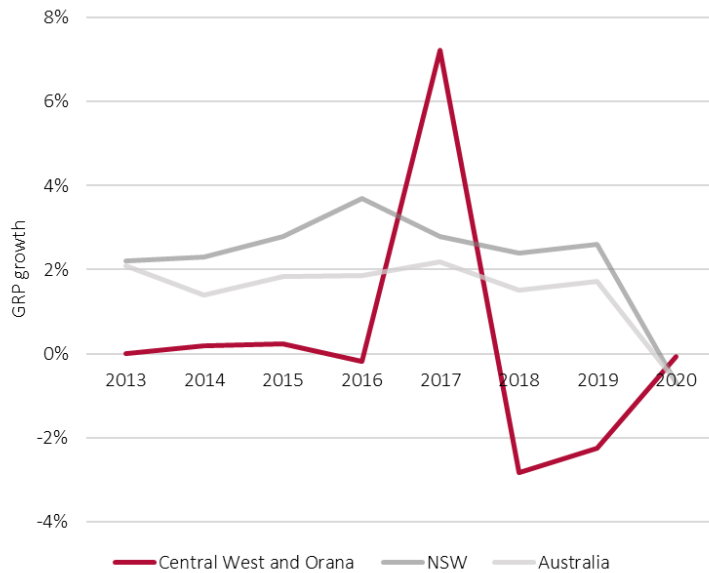
Source: ABS, Census 2016

## Economic structure

## GRP growth

The New England region has generally underperformed compared with the state and national averages. There have been substantial fluctuations around this trend however, with particular growth experienced in 2017 followed by a sharp downturn, from which the region is only slowly recovering from (Figure 23). From mid-2017, drought impacts on agribusiness were severe, although conditions improved in 2020.

Figure 23: GRP growth compared to NSW and Australia, New England REZ region



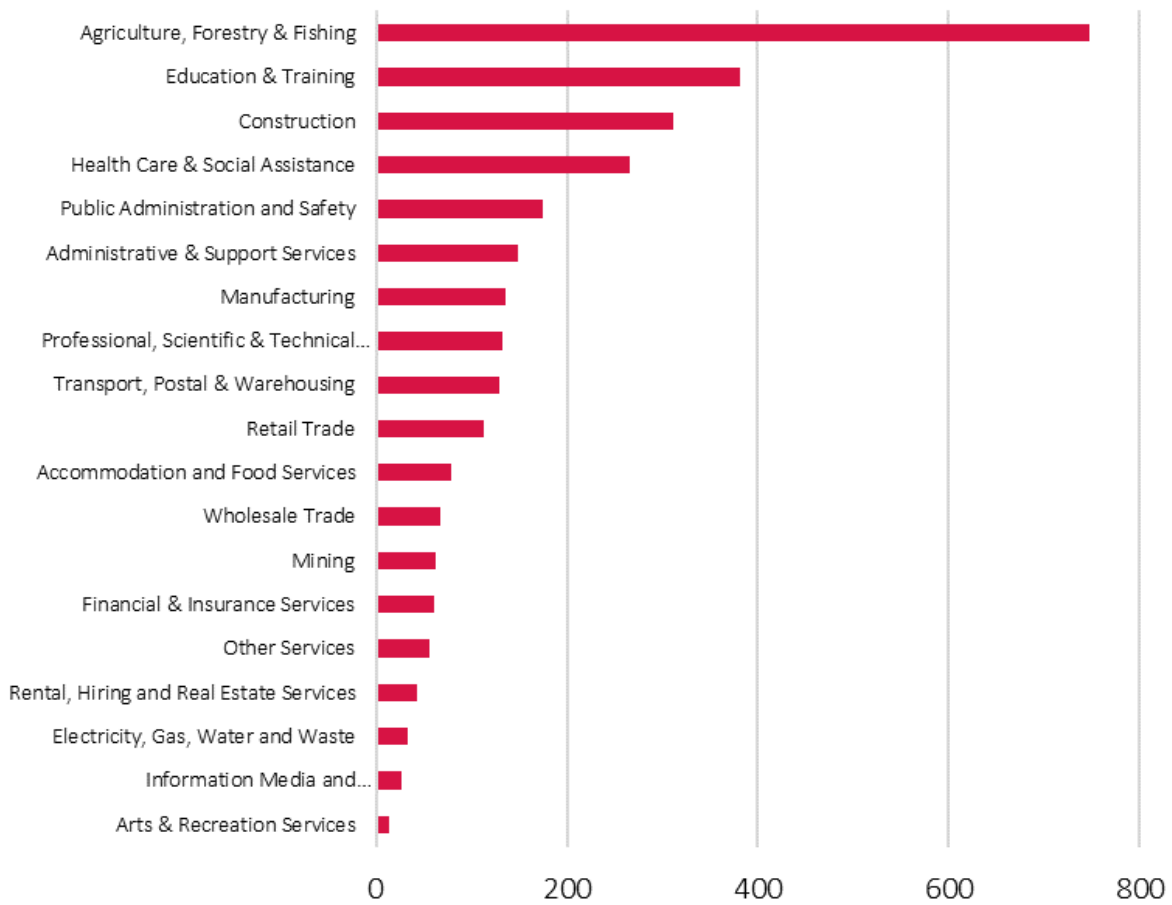
Source: Australian National Accounts: State Accounts, Cat. No. 5220.0 and SGS Economics Planning, 2021

## Industry mix

Agriculture is the largest contributor to growth in the area, making up 25% of GRP in 2020. Interestingly for a regional area, education and training was the second largest contributor to GRP at nearly 13% (Figure 24). This is likely due to the presence of the University of New England in Armidale elevates tertiary education as a key specialisation in the region, as it employs and provides services to workers and students from outside of the region. TAFE sites, including TAFE Digital NSW, and private schools also contribute to the higher education cluster.



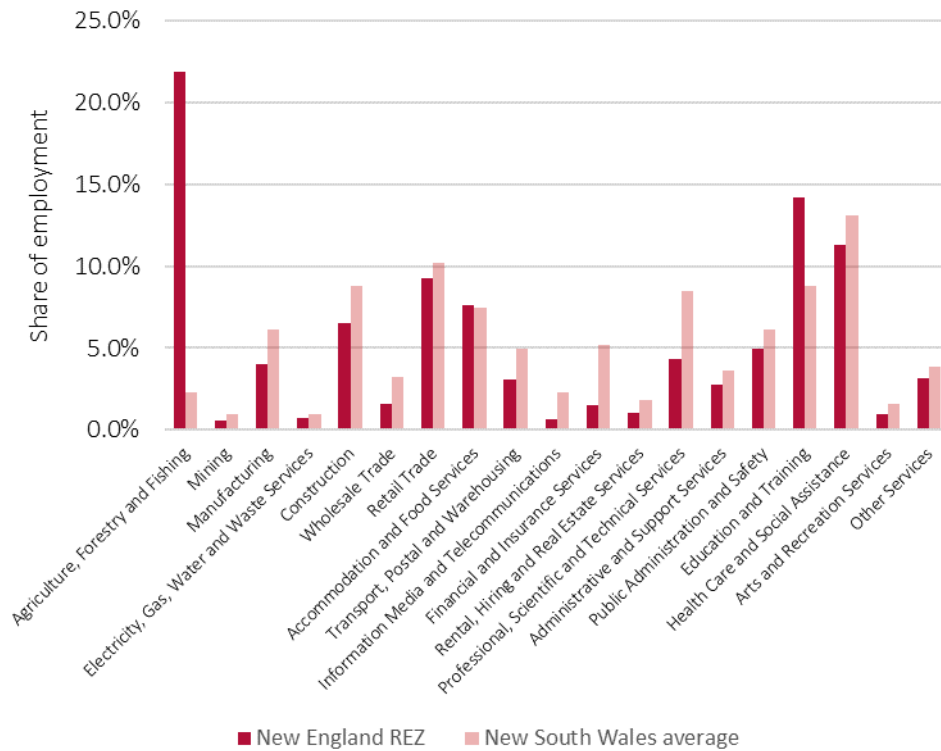
Figure 24: Industry contribution to GRP in 2020, New England REZ region (\$M)



Source: Australian National Accounts: State Accounts, Cat. No. 5220.0 and SGS Economics Planning

When looking at industry size in terms of employment, the agriculture, forestry and fishing industry remains the largest (Figure 25). In the New England REZ, more than one in five workers are employed by this industry. Other large industries in terms of GRP output such as education, health care and construction also contribute large shares of the region’s employment.

Figure 25: Industry share of employment, New England REZ, 2016

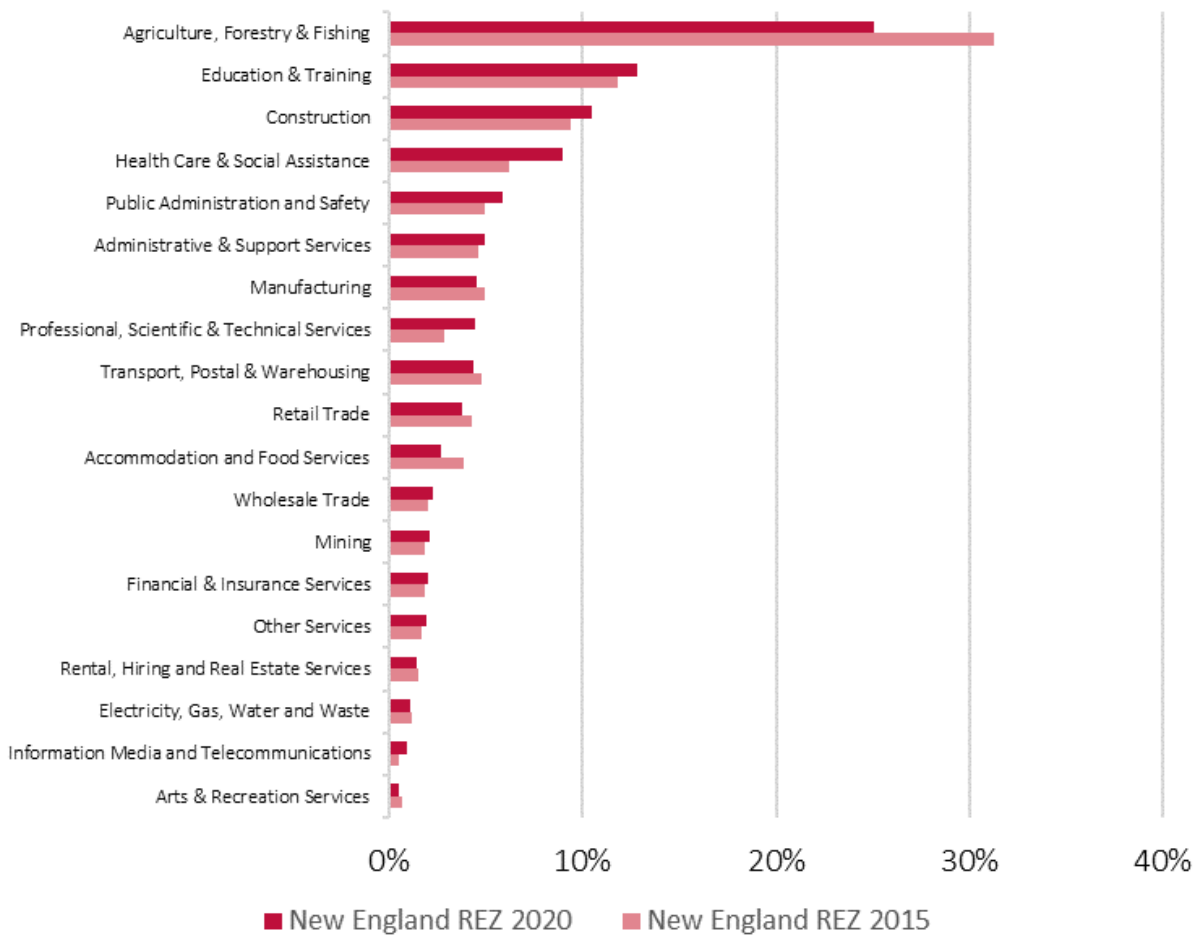


Source: ABS, Census 2016

### Shifts in industries' share of production, 2015-2020

Agriculture, forestry and fisheries have decreased both proportionally and in outright production over the past five years (Figure 26). Other industries to have declined include manufacturing, transport and retail trade. This share of production has instead been taken up by education, construction and health care and public administration. Interestingly, professional, scientific and technical services have grown, albeit from a low base.

Figure 26: Industry structure over time (GRP contribution 2015-2020), New England REZ region



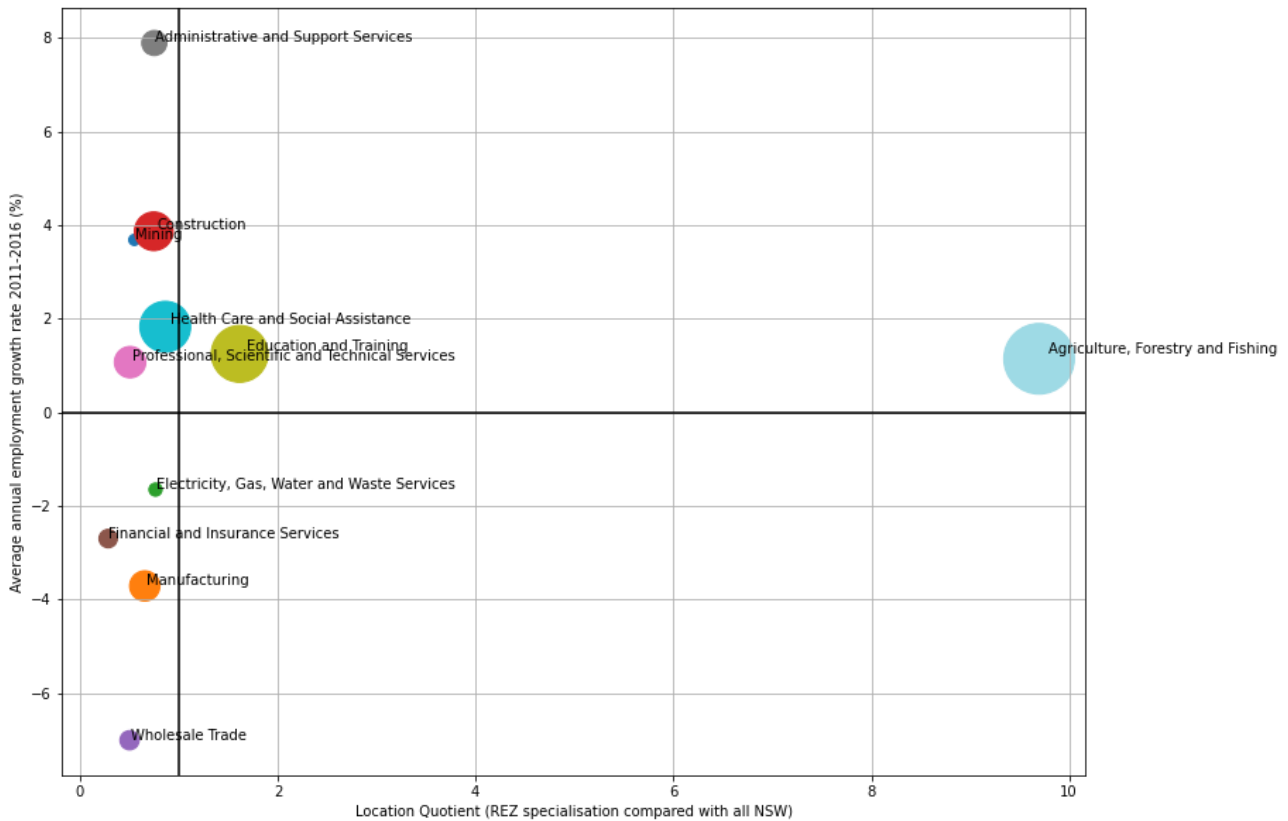
Source: Australian National Accounts: State Accounts, Cat. No. 5220.0 and SGS Economics Planning

### Competitive strengths

The LQ analysis in Figure 27 provides some insight to the competitive strengths inherent in the New England region’s economic structure. Unsurprisingly, agriculture is highly specialised. There are slight specialisations in education, professional services and carers and assistance services. Construction, administrative services and mining have all grown strongly as shown by their positioning in the upper quadrants, however mining has only grown by a small share, as shown by the small bubble size.



Figure 27: Location quotient of industries in the New England REZ region



Source: SGS Economics and Planning using 2016 census data

## Institutional endowments and qualifications

### Major education institutions

The University of New England’s main campus is in Armidale. The university has a teaching strength in agriculture, Ag Tech and science. TAFEs at Tenterfield, Armidale and TAFE Connected Learning Centres in Glen Innes enable remote learning opportunities. All three campuses offer a wide-range of courses at advanced diploma, diploma and certificate level. A Country University Centre North West in nearby Narrabri and Moree has been established to respond to regional need for higher education opportunities and general academic support.

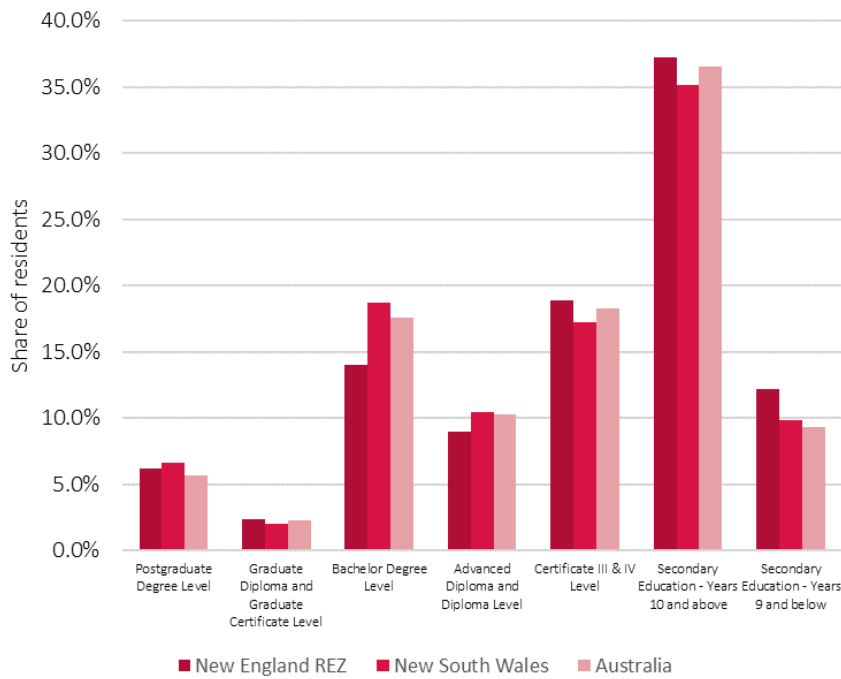
The Australian Training and Consulting (ATAC) based in Tamworth is an RTO which offers civil construction courses for individuals and businesses seeking to upskill their employees. Tamworth Community College and New England Community College (Armidale, Glen Innes, Guyra, Uralla, and Walcha) offer short courses in construction and safety.

There are opportunities to promote a STEM focus in primary and secondary education settings, helping to motivate the next generation of talent into renewable energy industries. STEM skills, particularly science and mathematics, are under-represented in business operations and are foundational to engineering and technology related roles (SGS, 2020).

### Tertiary qualifications by share of all residents

Educational attainment profiles of New England are broadly consistent with the rest of NSW and Australia, with the largest difference being a reduced proportion of Bachelor Degree level.

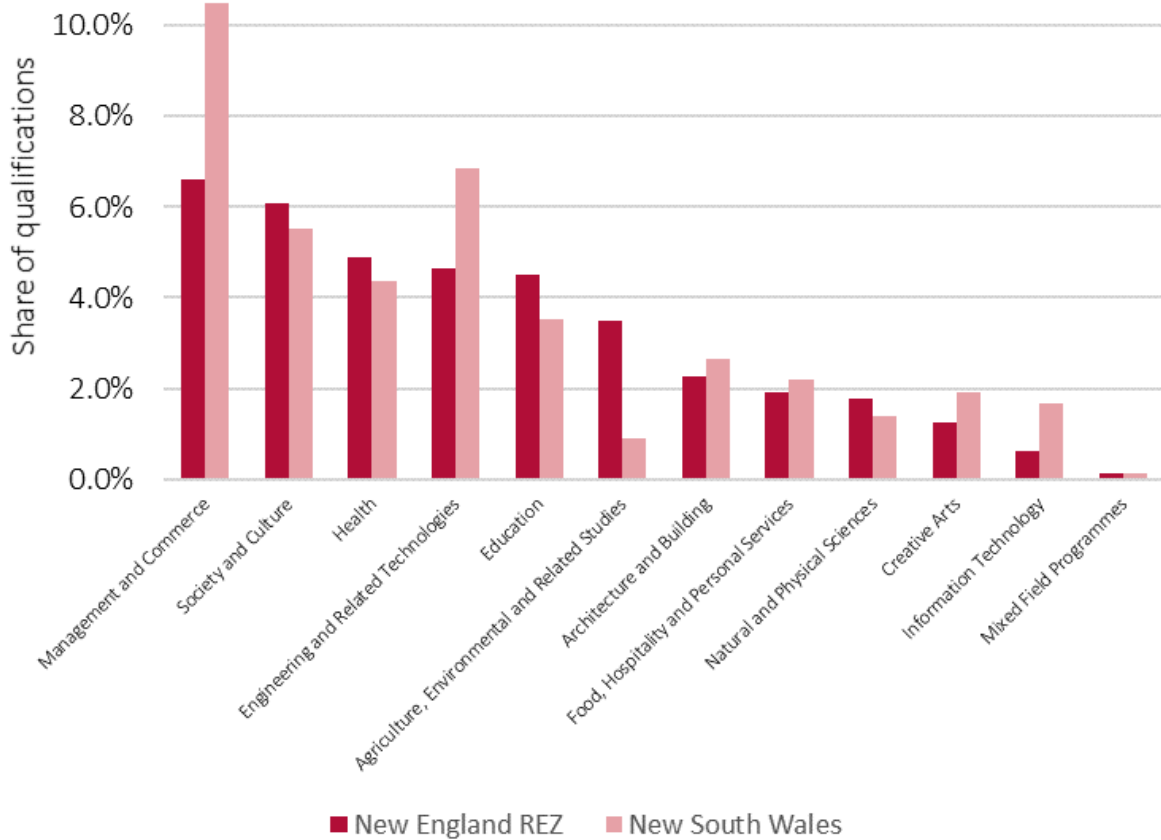
Figure 28: Highest level of educational attainment, New England REZ, 2016



Source: ABS, Census 2016

The most common areas of qualification in the New England area include management and commerce, society and culture, health and engineering (Figure 29). While management and engineering make up a smaller proportion of all qualifications, society and culture, health and education make up higher shares. Agriculture and environmental studies are much higher than the NSW average.

Figure 29: Top qualifications by share of all residents, New England REZ region



Source: Australian Government, Department of Employment, Skills, Small and Family Business (2019)

## Key barriers and constraints for REZ development

- Skills and labour shortages were noted as a barrier within the region, this is compounded by a lack of relevant training availability. Local suppliers and contractors require upskilling and incentives for sharing lessons (both positive and negative) from previous projects.
- Shortages of housing stock are a barrier in the community however there is current land availability. Community services will require additional support as will infrastructure, in terms of upgrades to roads and rail. Environmental Assessments regarding these infrastructure upgrades will need to be undertaken in a timely manner. LGAs in the region are currently resource constrained in both procurement and community engagement areas and will require additional resourcing.

## 2.6 South-West

### Summary

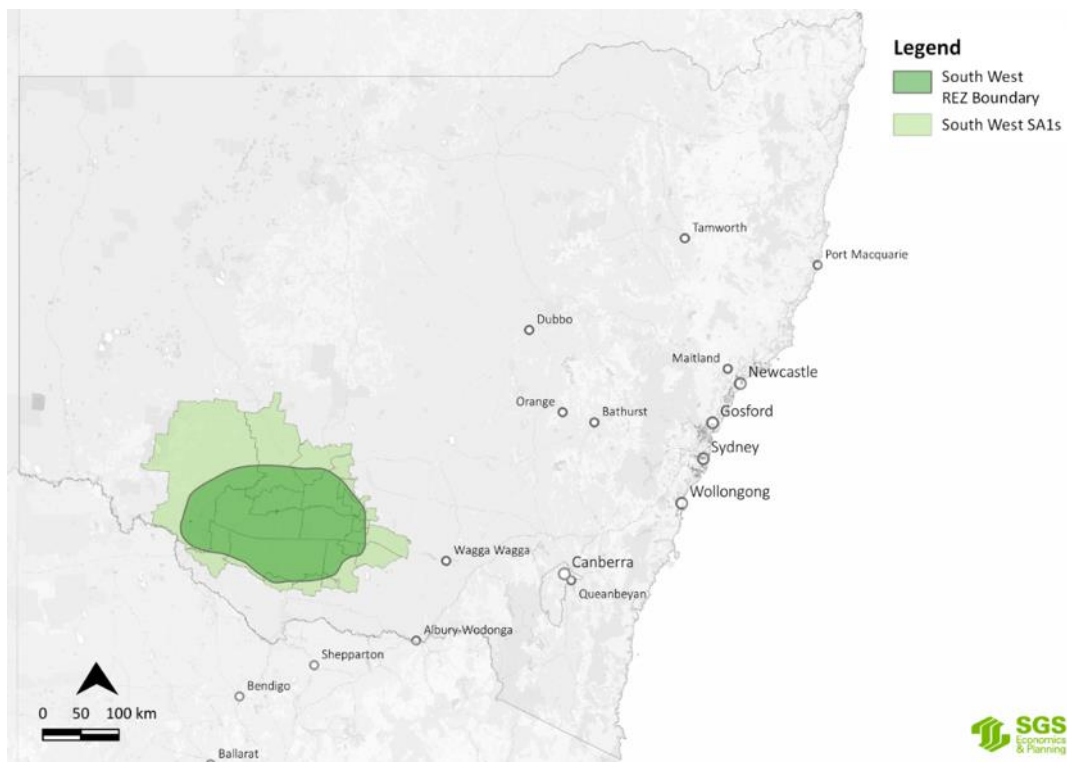
The South-West REZ region's economy is characterised by strong agriculture, forestry and manufacturing industries. The region has strategic linkages to key markets along the agricultural supply chain and already demonstrates strong agricultural employment. Increasing demand for high-value food and beverage is growing the region's specialisations in beverage and food product manufacturing, diversifying the economy from its primary production strengths. The nearby Wagga Wagga Special Activation Precinct will have a sustainability focus and is expected to strengthen industry specialisations in agribusiness, freight and logistics, advanced manufacturing, recycling and renewable energy.

The Western Murray region spanning the Wentworth, Balnarald and Hay Shire Councils has been identified as suitable for renewable energy projects due to its climatic features and proximity to existing transmission networks. Hay and Balnarald are considered suitable for large-scale solar power generation and there are associated opportunities to grow the region's mining operations in tandem while attracting growth in the construction sector (REDS, 2018).

To capitalise on these opportunities, there will be a need to support the local and incoming workforce with education and training initiatives to meet future skills demand. Education, training and employment programs such as Western Riverina's 'Grow Our Own' are focusing on cross-industry and sector partnerships to review training haps and align course mix to local needs. Given the region's proximity to Victoria, there is a potential opportunity for greater cross-border collaboration on labour mobility.

The South-West REZ is near the Victorian border, anchored by the regional township of Hay and just north of Deniliquin. The centre of the region is roughly 700 km from the Sydney CBD (Figure 30).

Figure 30: South-West REZ boundary



Source: SGS Economics Planning, 2021

Compared to the other REZs, the South-West REZ has fewer renewable sites in operation. Within the indicative REZ region, Coleambally Solar Farm is operational, but many others are under construction (Sunraysia, Limondale and Darlington Point Solar Farms) or have passed approval phase (Hay and Lang's Crossing Solar Farms). A bioenergy development, the Agriwaste Energy Project (The MacAnzac Project) is also being planned next to the Coleambally Solar Farm.

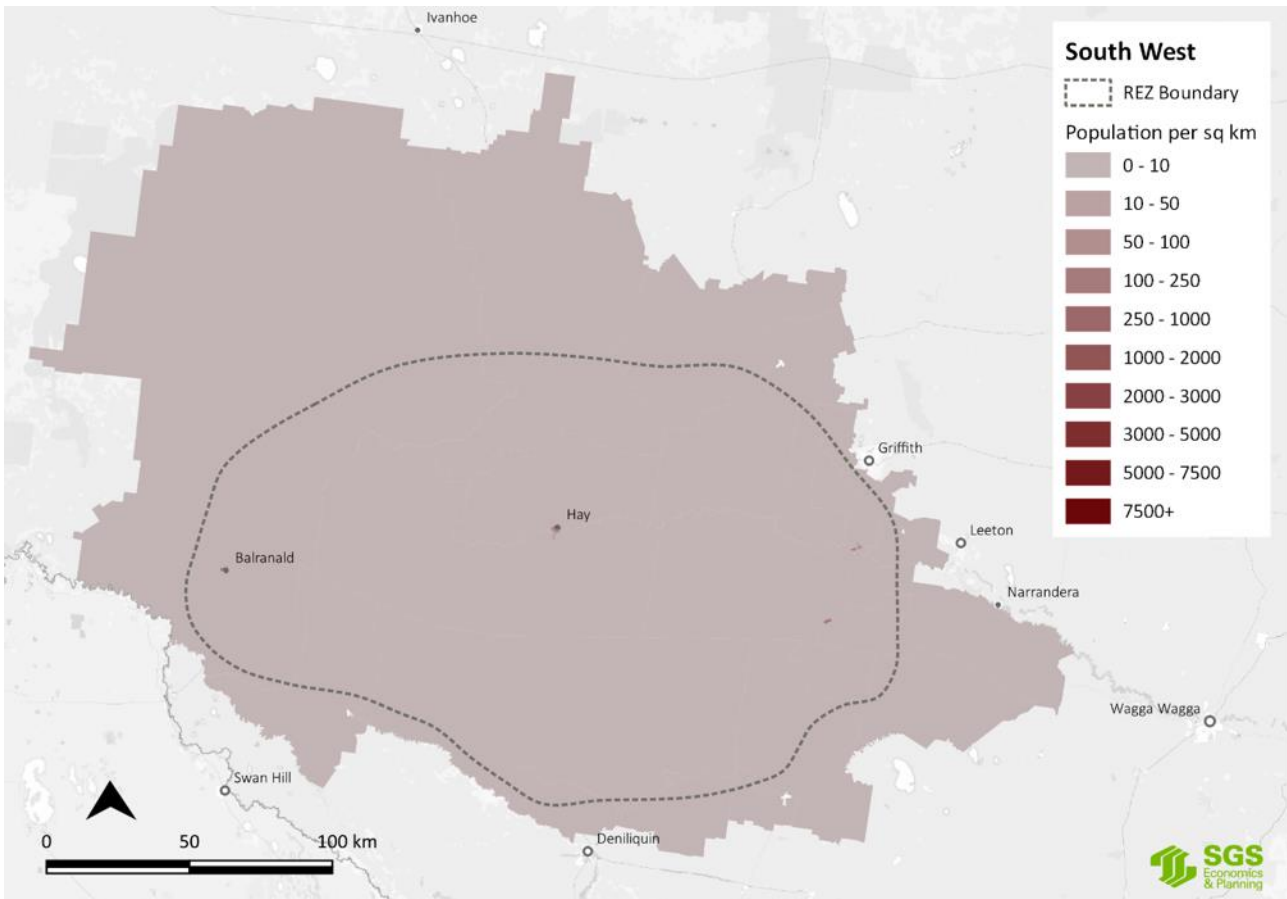
Within the REZ's broader catchment, many solar developments have been approved; these are clustered around the existing transmission capacity stretching between Wagga Wagga and Griffith, e.g. Avonlie Solar Farm, Leeton Solar Farm, Riverina Solar Farm.

## Demographic profile

### Population size and density

Population in the REZ is 11,147, based on the identified SA1s according to the definition shown in Figure 31 and 2016 ABS census data. Population in the broader Riverina Murray (beyond the REZ) as defined by DPIE in their planning region projections is estimated to grow by 3.7% from 274,044 in 2016, to 284,269 in 2041.

Figure 31: Map of population density in South-West REZ region



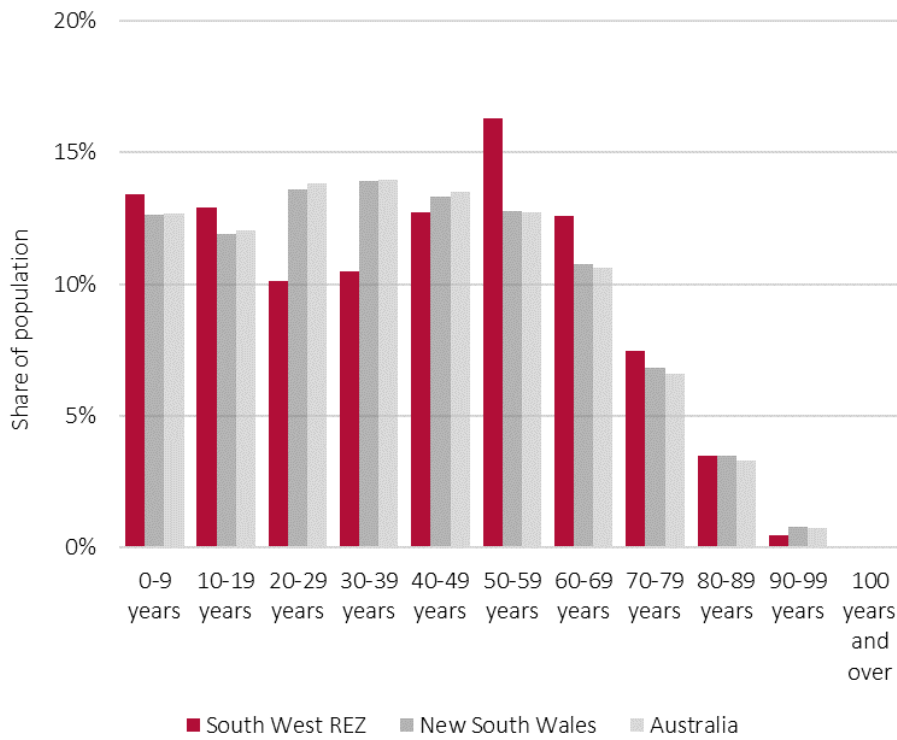
Source: ABS, Census 2016



## Age distribution

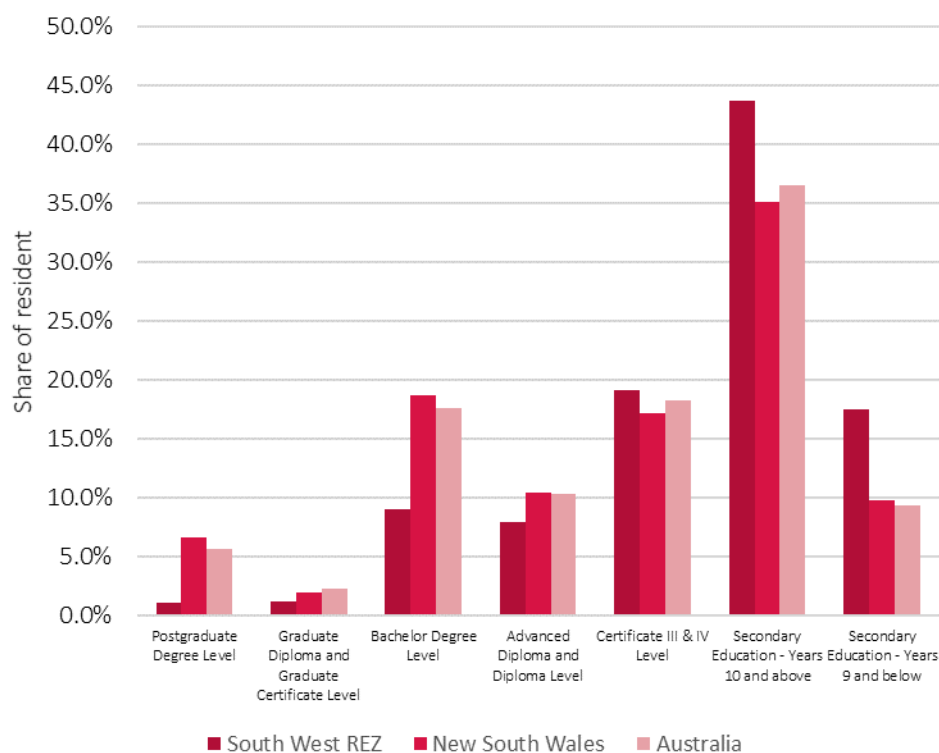
As is characteristic of many regional communities, the region has lower shares of tertiary age and working age populations, ranging from the 20-29 to 40-49 year old age groups, compared to the state average. Conversely, the region has a much higher share of 50-59 year old population and a slightly higher proportion of younger and school aged children (Figure 32).

Figure 32: Age distribution, South-West REZ region, 2016



Source: ABS, Census 2016

Figure 33: Highest level of educational attainment, South West REZ, 2016



Source: ABS, Census 2016

### First Nations share of population

The region has a higher First Nations share of population (7.1%) compared to the state average (3.1%) (Table 8).

Table 8: First Nations population, South West REZ region, 2016

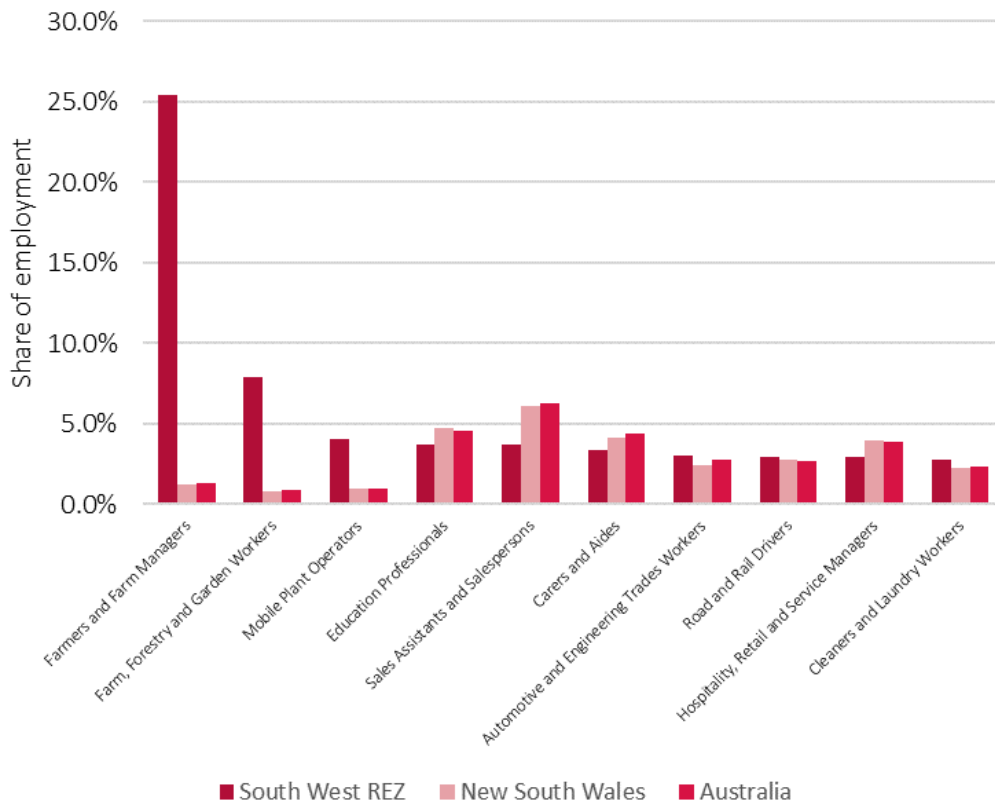
	First Nations	Non-First Nations	Total
<b>Total</b>	730	9,127	9,857
<b>Share</b>	7.4%	92.6%	-

Source: ABS, Census 2016

### Skills profile

The dominance of agricultural employment in the region is reflected in the two largest occupation groups by share of employment: Farmers and farm managers (25% of all employment) and Farm, forestry and garden workers (approximately 7%). Mobile plant operators account for the third largest share of employment in this region, likely related to farm-based machinery and infrastructure. The other top ten occupation groups are primarily population serving, and generally account for a smaller share of employment in this region (Figure 34).

Figure 34: Ten largest occupation groups (2-digit level) in the South-West REZ region

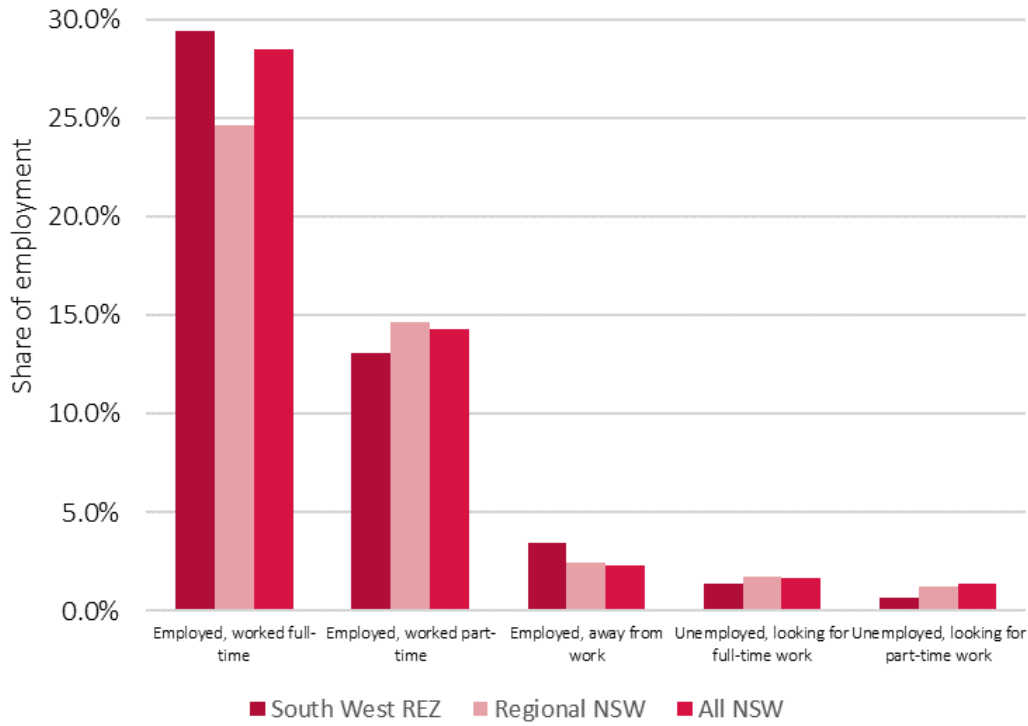


Source: SGS Economics and Planning using 2016 census data

### Employment status and average income

Compared to the regional NSW averages, the South-West REZ region has a higher share of full-time employees and lower share of part time employees (Figure 35). Unemployment rates also measure lower than the state average, suggesting that there is very little spare labour capacity in the area (Figure 36).

Figure 35: Labour force status, South-West REZ region



Source: SGS Economics and Planning, 2021; Australian Government Department of Education, Skills and Employment, 2021

Figure 36: Unemployment, South West REZ, 2015 to 2021



Source: Department of Education, Skills and Employment, 2021

In 2016, the share of the First Nations unemployment was slightly lower than the state average (Table 9), with shares of the First Nations population in full-time and part-time work higher than the state averages

(28.7% and 16.7% respectively). The share not in the labour force is slightly below the NSW average of 45.7% (Table 10). Strategically in the Western Riverina, there is a current focus on advocating for greater First Nations business and service provision opportunities as part of the broader skills development strategy (REDS, 2018).

Table 9: Share of work status by First Nations and Non-First Nations status, South-West REZ region, 2016

	Full-time	Part-time	Unemployed	Not in labour force	Total
<b>Non-First Nations</b>	44.7%	19.8%	2.8%	32.8%	100.0%
<b>First Nations</b>	31.1%	15.6%	8.0%	45.3%	100.0%

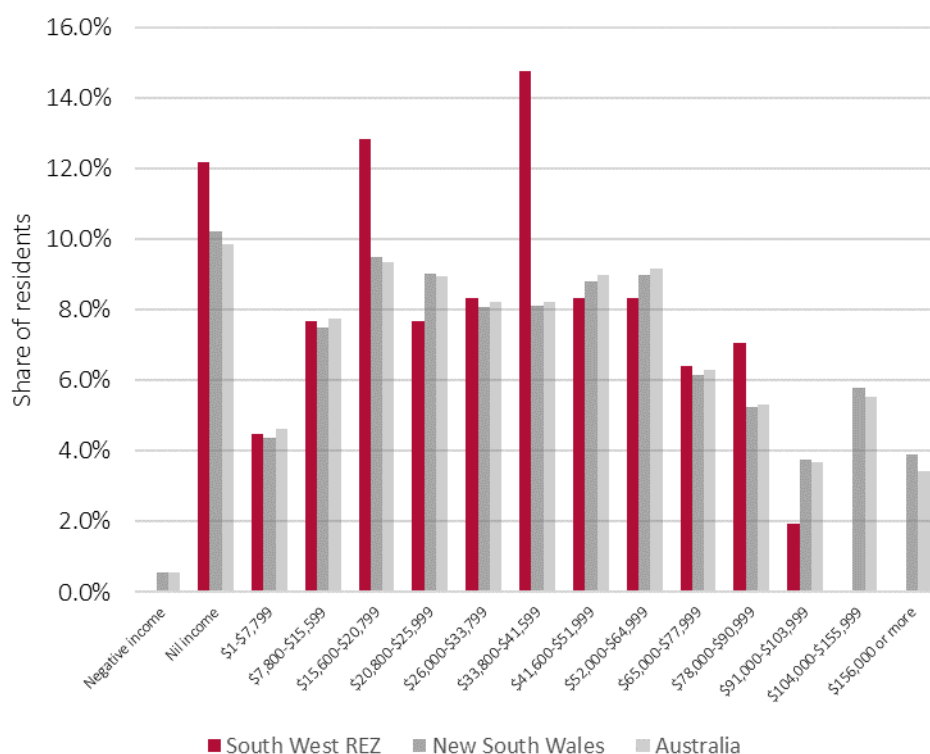
Source: ABS, Census 2016

Table 10: First Nations and Non-First Nations population by work status, All New South Wales, 2016

	Full-time	Part-time	Unemployed	Not in labour force	Total
<b>First Nations</b>	28.7%	16.7%	8.9%	45.7%	100.0%
<b>Non-First Nations</b>	39.0%	19.5%	4.0%	37.5%	100.0%

Source: ABS, Census 2016

Figure 37: Average annual income, South West REZ, 2016



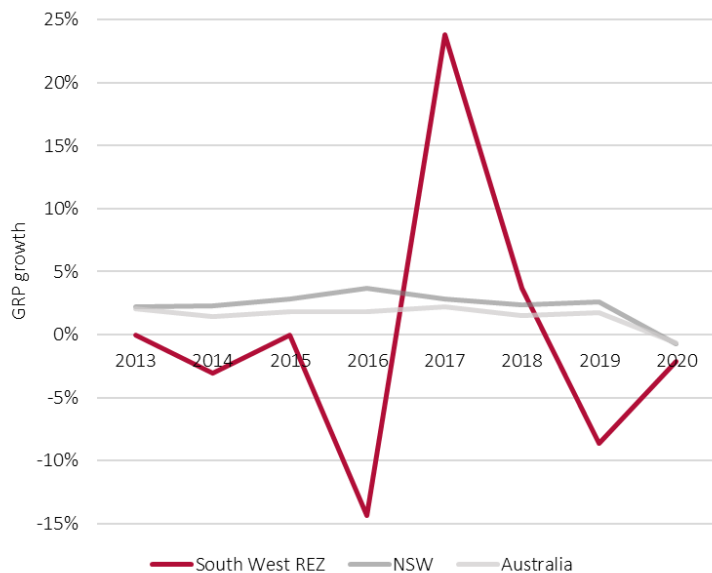
Source: ABS, Census 2016

## Economic structure

### GRP growth

The South-West REZ region has generally underperformed compared to the national and state economy over the past decade, particularly between 2013 and 2016 (Figure 38). The significant fluctuations in GRP growth between 2015 and 2020 is characteristic of agriculturally dominant economies and in 2020 and 2021, there have been concerns about the pandemic's impacts on labour accessibility for agriculture.

Figure 38: GRP growth compared to NSW and Australia

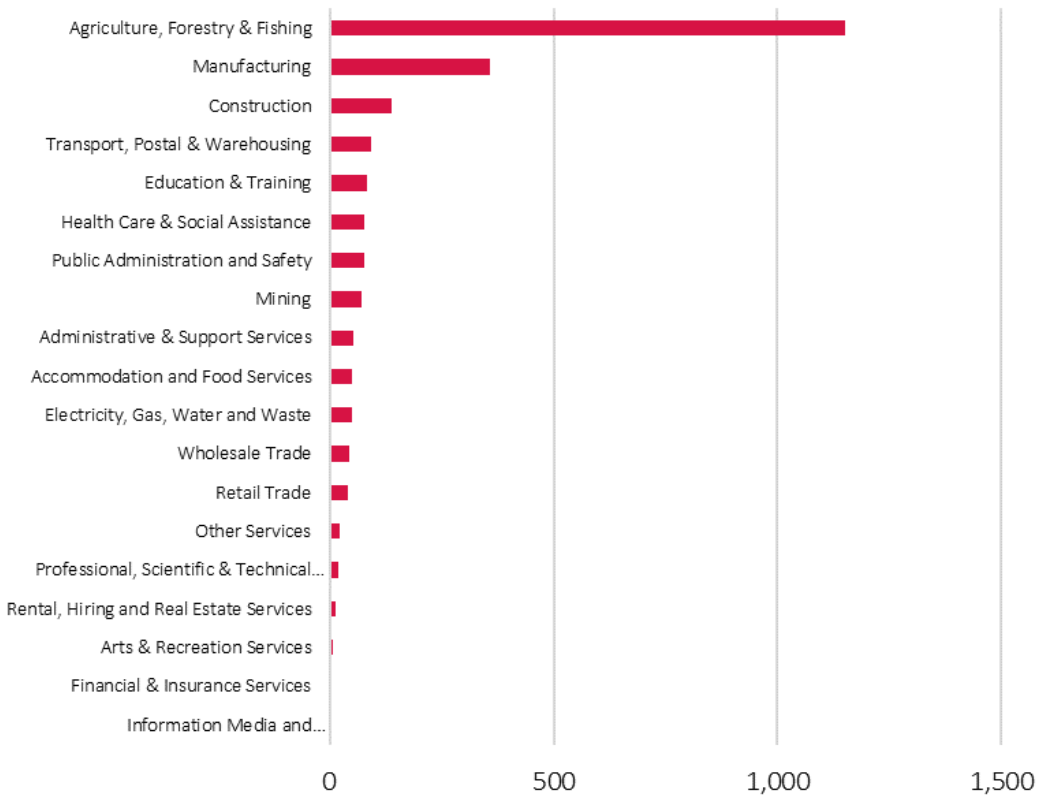


Source: Australian National Accounts: State Accounts, Cat. No. 5220.0 and SGS Economics Planning (can get data from Performance of Cities and Regions)

### Industry mix

Agriculture, forestry and fishing makes the largest contribution to the region's GRP (Figure 39). Nearly 49% of all production is attributable to agriculture, reflecting the region's identity as south-eastern Australia's food bowl for domestic and overseas markets. This is followed by Manufacturing, which generates 15% of the region's GRP. Combined, agriculture and manufacturing contribute more than 60% of business income in the Western Riverina and have been identified as key growth engines in the region's economic development strategy (REDS, 2018).

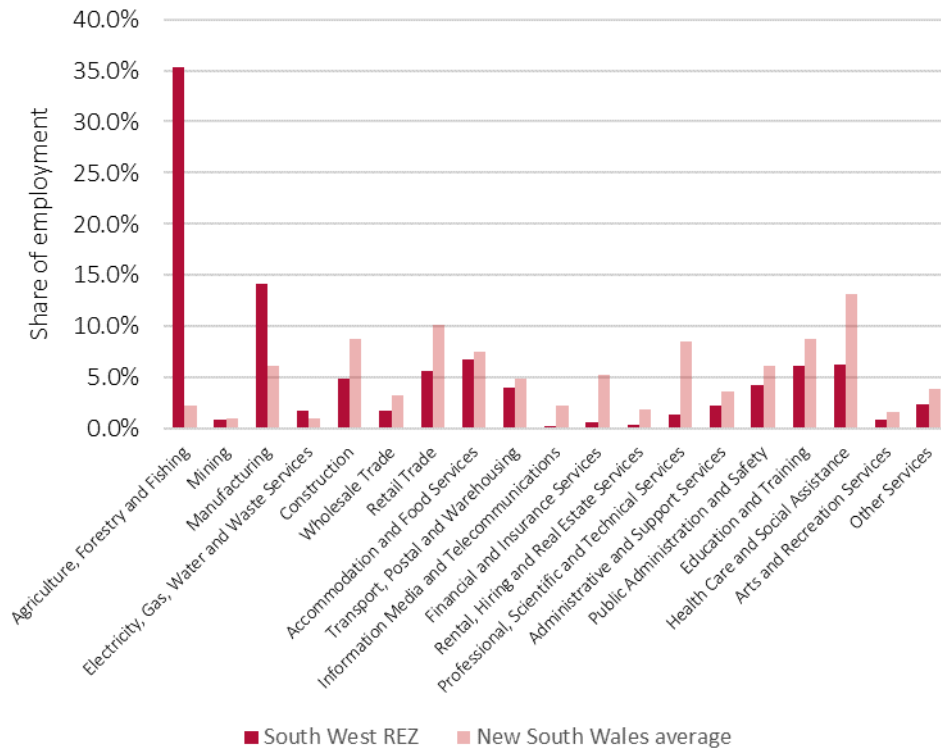
Figure 39: Industry contribution to GRP in 2020, South-West REZ region



Source: Australian National Accounts: State Accounts, Cat. No. 5220.0 and SGS Economics Planning

Agriculture, forestry and fishing remains the largest industry by a significant margin when considering the share of employees in the South West REZ (Figure 40). The same is true for the manufacturing industry. Most other industries contribute a share of employment that is consistent with the size of their GRP output in the region.

Figure 40: Industry share of employment, South West REZ, 2016



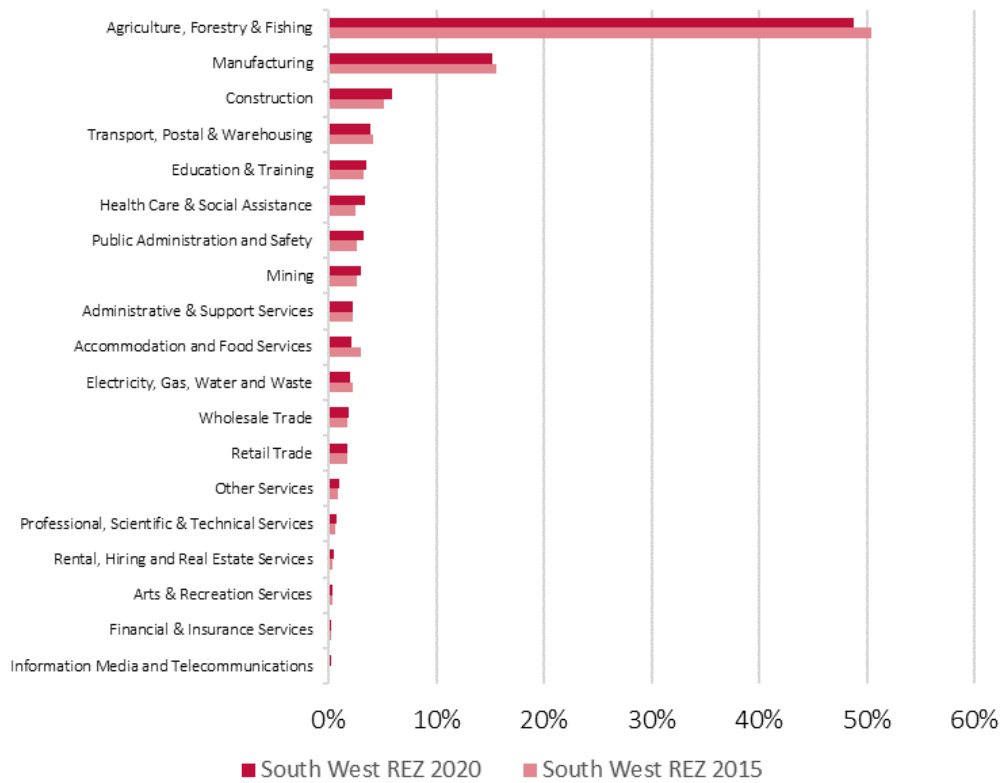
Source: ABS, Census 2016

### Shifts in industries' share of production, 2015-2020

Given the overall decline in GRP in this region, it is unsurprising that many industries have either declined or grown only marginally over the past five years. This includes the agriculture and mining engine industries, which have both declined slightly in outright terms and as a share of total GRP over the past five years (Figure 41). Construction, education and training, and health care and social assistance grew marginally in the five years to 2020.



Figure 41: Industry structure over time (GRP contribution 2015-2020), South-West REZ region

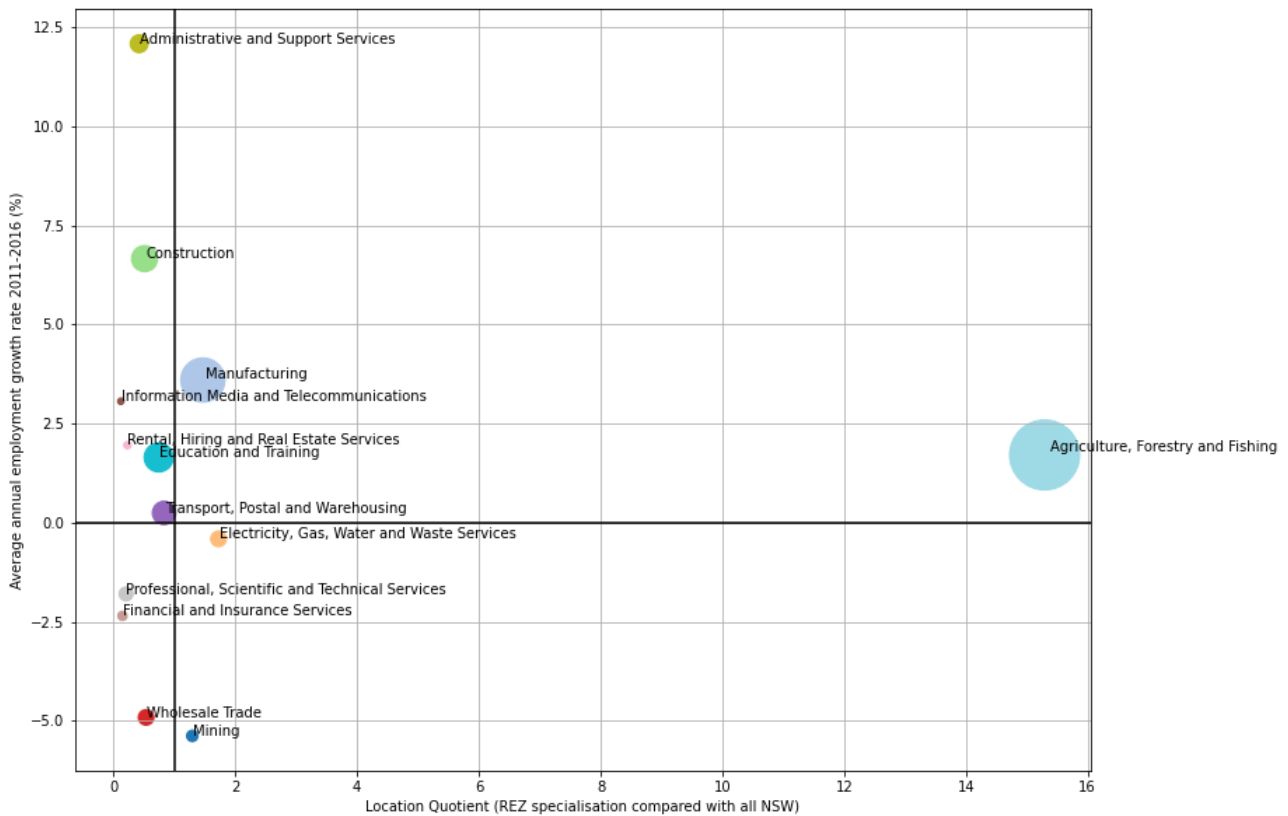


Source: Australian National Accounts: State Accounts, Cat. No. 5220.0 and SGS Economics Planning

### Competitive strengths

The location quotient (LQ) analysis shown in Figure 42 provides some insight to the competitive strengths inherent in the REZ's economic structure. As expected, there is a clear specialisation in agriculture, forestry and fishing, however the industry's average annual growth rate between 2012 and 2017 was outpaced by manufacturing. In comparison, manufacturing is currently only a slight specialisation across the region, despite being the top industry of employment in Griffith and Leeton in 2016 (REDS, 2018). Administrative and support services and Construction were relatively less specialised than the average for NSW, but are growing very quickly in this region.

Figure 42: Location Quotient of industries in the South-West REZ region



Source: SGS 2021, using ABS census 2016 data

## Institutional endowments and qualifications

### Major education institutions

La Trobe University has a campus at Mildura. The campus has a focus on industry linkages and career pathways. The University has a Regional Reward program which guarantees every regional student the opportunity to participate in a work placement program. Courses offered have a focus on health, education and business. In the science and engineering space courses in Applied Cloud Technology and Applied Information Technology are offered, as well as Masters of Science.

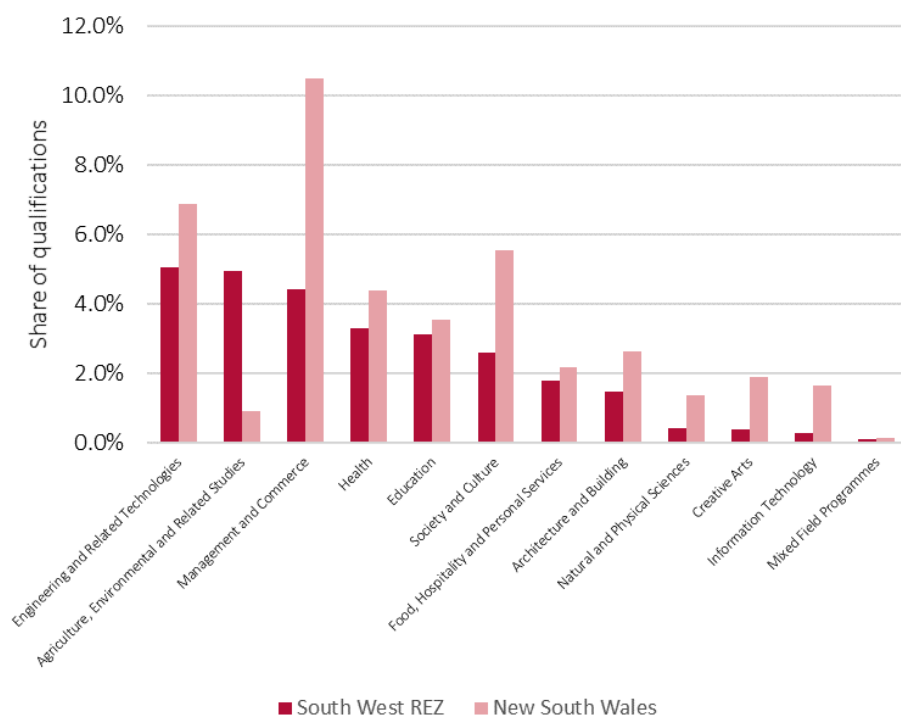
In the region there is SuniTAFE Mildura Campus, TAFE Hay, TAFE Deniliquin, TAFE Finley, TAFE Griffith, TAFE Narrandera and TAFE Leeton offering vocational education and training opportunity. However, there is a notable absence of tertiary education opportunities in the Murray, compounded by a gap in RTO coverage. However, the Western Riverina Community College offers short courses on confined space work, as well as forklift operation. Anecdotal evidence suggests there is a pull factor exerted by Victorian institutions based in Shepparton and Melbourne, which is potentially detrimental to service delivery if demand for education and workforce capacity building are difficult to estimate (REDS, 2018).

In the future, promoting a STEM focus within the primary and secondary education settings can help to develop the talent pipeline for renewable energy industries. STEM skills, particularly science and mathematics, are under-represented in business operations and are foundational to engineering and technology related roles (TAFE, 2020).

### Tertiary qualifications by share of all residents

A lower proportion of the South-West region's population has qualifications compare to the state-wide figures, reflecting the dominance of agricultural employment in the area and its traditional pathways to industry. Of the region's top ten qualifications by share of residents, many are related to agriculture, namely engineering and agriculture, environmental and related studies (Figure 43). It is worth noting that nearby Wagga Wagga is a major inland centre and its potential to add diversity and depth to the South West's workforce labour profile is not captured in this analysis.

Figure 43: Top 10 qualifications by share of all residents, compared with NSW



Source: Australian Government, Department of Employment, Skills, Small and Family Business (2019)

## Key barriers and constraints for REZ development

- Within the South-West, labour shortages are considered to be a key barrier. There are challenges to keep, and skill personnel in the renewable industry and there is high competition for labour in other industries.
- There is a housing shortage in the region which constrains the ability to attract new staff due to a lack of suitable supply.
- In addition to skill shortages, supply chain constraints, and disruption from Asia.
- Timeframes regarding the storing of waste is seen as a barrier and this has been further impacted by the landfill levy.
- The lack of certainty around government’s renewable energy objectives has been a barrier, particularly to SMEs who may find it challenging to remain updated on regulatory changes.

## 2.7 Hunter-Central Coast

### Summary

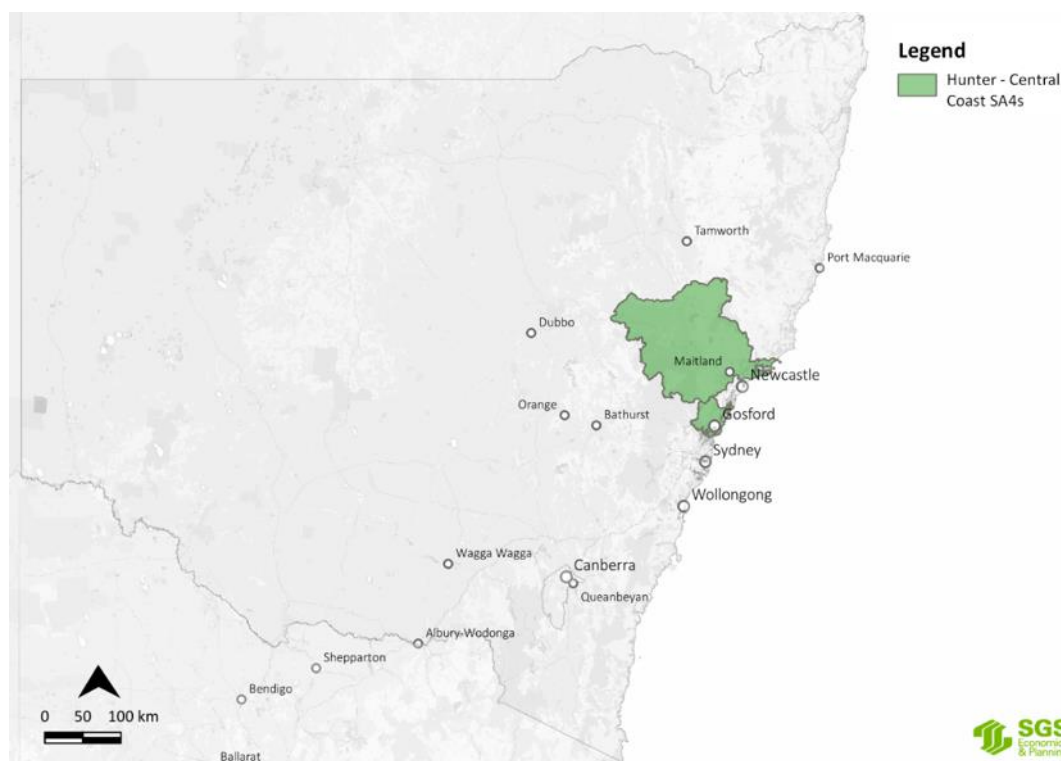
The Hunter is Australia’s largest regional economy and contributes over \$34 billion to the NSW economy (DPIE, 2018). The region has an established specialisation in mining and emerging industries, including

construction, manufacturing and wine and food tourism. These are expected to drive employment and economic growth in the future, despite recent economic disruptions from the 2019-20 bushfires and the pandemic.

The Hunter-Central Coast is also strategically positioned to leverage connections to major shipping ports across the Asia-Pacific, presenting opportunities for domestic and international export markets. The nearby Williamstown Special Activation Precinct will create a defence and aerospace hub, capitalising on the Hunter region's strong local defence, education and advanced manufacturing industries. The latter indicates potential capacity to support future demand for manufacturing operations generated by large-scale renewables infrastructure, such as the Hunter hydrogen hub.

The Hunter region profiled for this analysis is shown in Figure 44 below. To enable inter-regional comparisons, Newcastle has not been included in the baseline profiling as it is not generally considered a regional area (e.g. see *Snowy Hydro Legacy Fund Act 2018 No 38* definition of regional New South Wales: 'any part of New South Wales that is outside the metropolitan areas of Sydney, Newcastle and Wollongong').

Figure 44: Hunter REZ region – general catchment



Source: SGS Economics and Planning, 2021

The Hunter region is home to two major coal fired power plants, which supply around 30% of NSW's energy needs, as well as coal mines (REDS, 2018). Wind and solar facilities have been proposed for the Upper Hunter region, as well as a bio-refinery in Muswellbrook (REDS, 2018). CSIRO's Renewable Energy Integration Facility (REIF) in Newcastle has a solar field and together with other education institutions is exploring how electricity networks will need to adapt to a more diverse energy mix. The region's key assets for energy generation include established power stations, transmission lines, grid infrastructure and gas infrastructure (REDS, 2018).

The region's traditional industrial strengths of steel and aluminium manufacturing and processing and allied heavy engineering, particularly around the Port of Newcastle, are also shifting towards increasingly clean technology opportunities such as heavy vehicle battery manufacturing (3ME Technology) and steel recycling. Innovative new businesses, such as Mineral Carbonation Australia are seeking to base operations in the region, providing co-location opportunities for other businesses along the supply chain. Additionally, the Williamstown Special Activation Precinct will be located near Newcastle Airport and the Royal Australian Air Force base in Williamstown, reinforcing the region as a national and international hub for defence and aerospace.

The Port of Newcastle is also a major export gateway for coal to international markets, as well as an import gateway for bulk liquids and mining machinery. Notwithstanding the focus on transitioning to a low carbon economy, in the short term there is a need to tailor the right energy mix and community supports in certain regions in the leadup to coal fired stations reaching their end of life.

There are also some small-scale electrical equipment manufacturing and mining and construction machinery mining activities taking place in the region. The Central Coast also has some basic metal manufacturing activities. For example, fabricated metal manufacturing, which makes up only 1% of regional employment but remains a regional specialisation mainly due to the lack of similar operations in other areas.

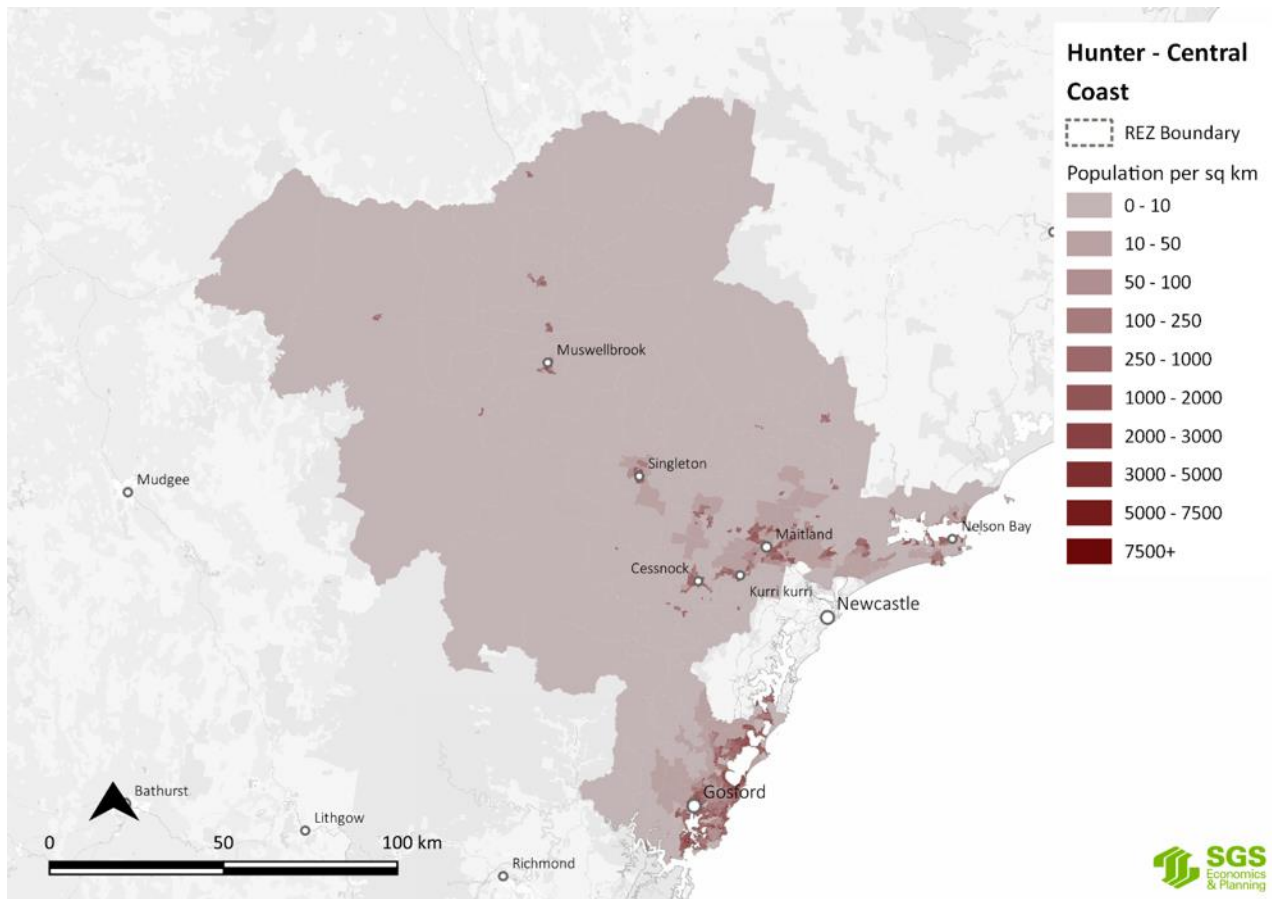


## Demographic profile

### Population size and density

Population in the region is 591,155 based on the identified SA1s, according to the definition shown in Figure 45 and 2016 ABS census data. Population in the broader Hunter region (beyond the boundary shown below) as defined by DPIE in their planning region projections is estimated to grow by 19.0% from 725,221 in 2016 to 863,131 in 2041, although noting that these are pre-COVID projections. This is expected to translate to some growth in the local workforce. The spatial distribution of the region's population is shown at Figure 45.

Figure 45: Map of population density in Hunter-Central Coast REZ region

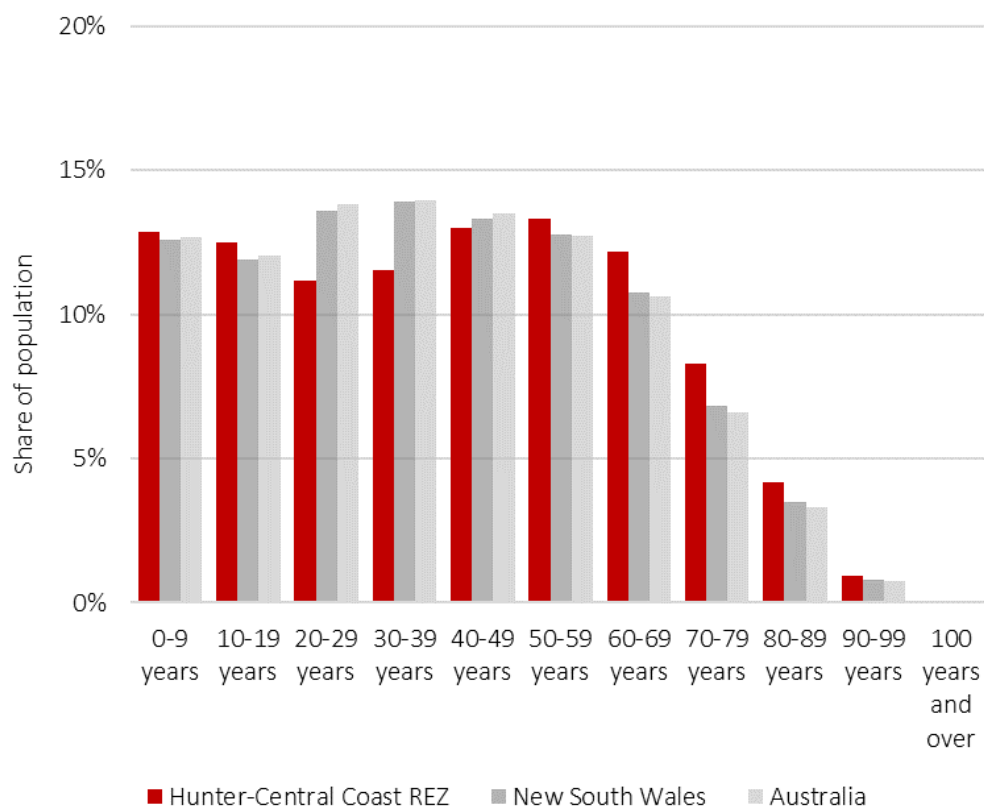


Source: ABS, Census 2016

### Age distribution

Like other REZs, the Hunter and Central Coast population is skewed slightly older than the NSW average and exhibits signs of out-migration: there are lower shares of university and working aged residents between the ages of 20 and 39 compared with the state average, whereas shares of retirement and school aged populations are relatively higher (Figure 46).

Figure 46: Age Distribution, Hunter and Central Coast REZ region, 2016



Source: ABS, Census 2016

### First Nations share of population

At 5%, the First Nations share of the local population is lower compared to other REZs, but still higher than the state-wide average of 3.1% (Table 11).

Table 11: First Nations population, Hunter and Central Coast REZ region, 2016

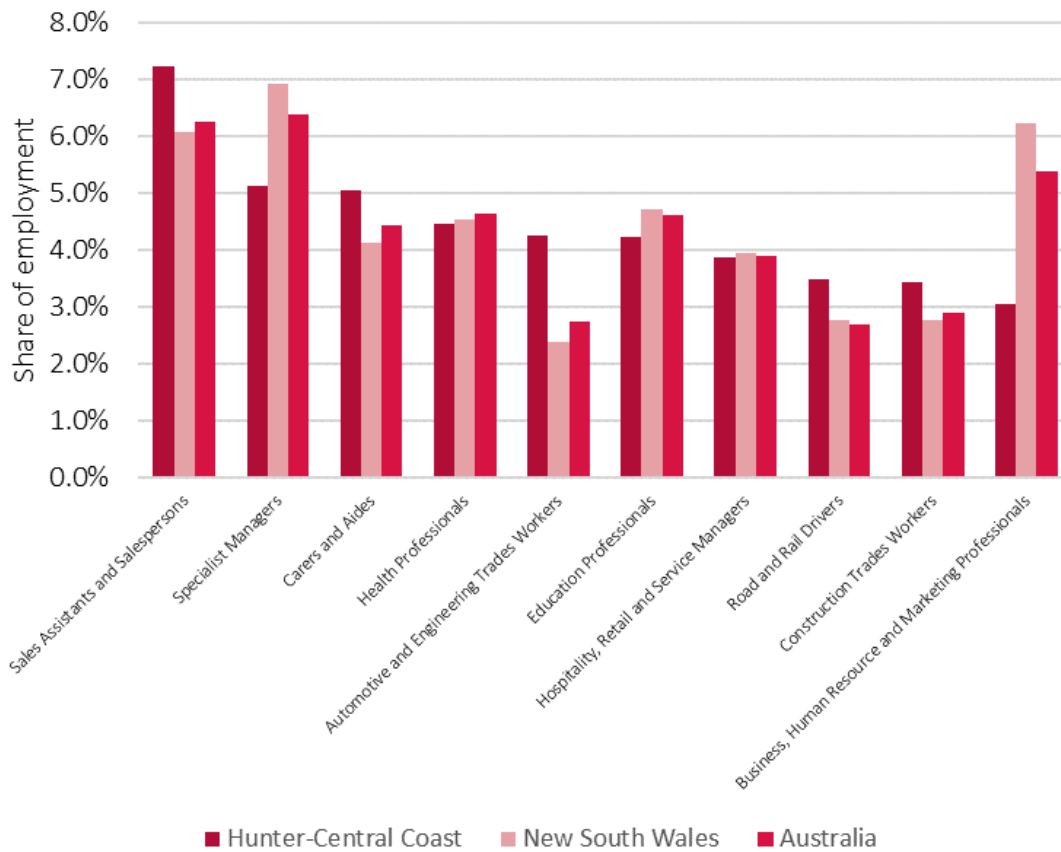
	First Nations	Non-First Nations	Total
<b>Total</b>	27,561	529,144	556,705
<b>Share</b>	5.0%	95.0%	-

Source: ABS, Census 2016

### Skills profile

The region has a relatively diverse skills base compared to other regional areas. The three largest categories are: sales assistants, specialist managers and carers and aides (Figure 47). Again, this reflects a region with a large population-serving function, acknowledging that the Hunter has one of the most sophisticated and well recognised tourism brands in regional NSW, while health care and social assistance constitute a significant and growing share of employment in the Central Coast. Major funding commitment to the John Hunter Health and Innovation Precinct in Newcastle will also attract health and allied professional skills to the region.

Figure 47: Ten largest occupation groups (2-digit level) in the Hunter and Central Coast REZ region



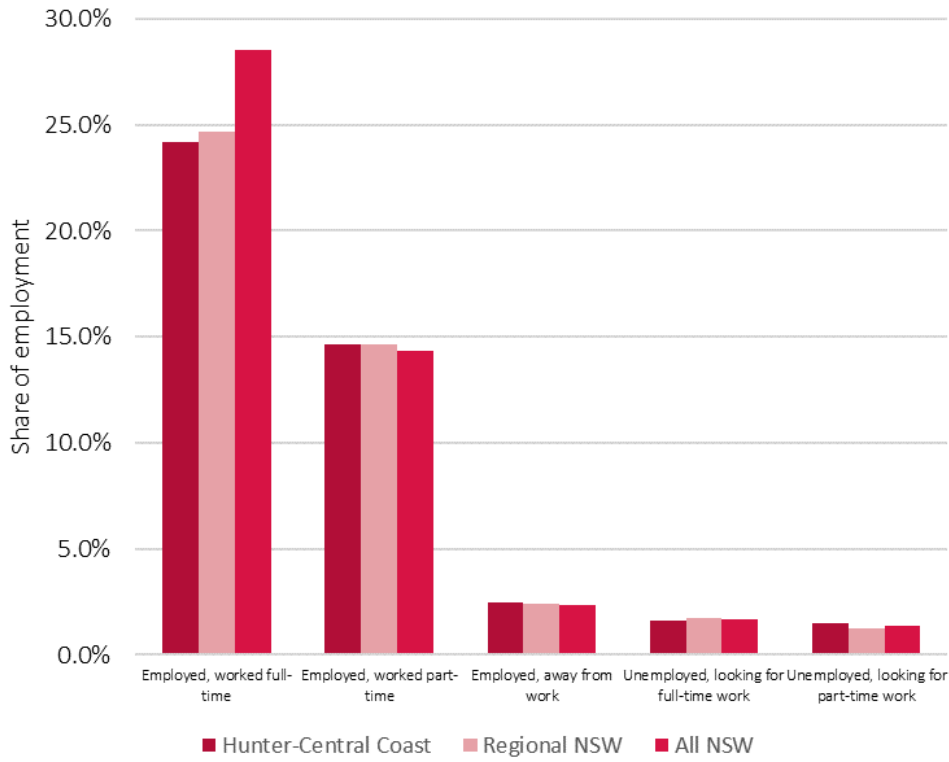
Source: SGS Economics and Planning using 2016 census data

### Employment status and average income

Compared to the regional NSW average, the Hunter and Central Coast REZ region has a slightly lower share of full-time employees and lower than the whole state average (Figure 48). Part-time employees and unemployed are comparable to NSW proportions. Unemployment rates have historically oscillated compared with wider NSW rates, but recently are reflective of the state rates.

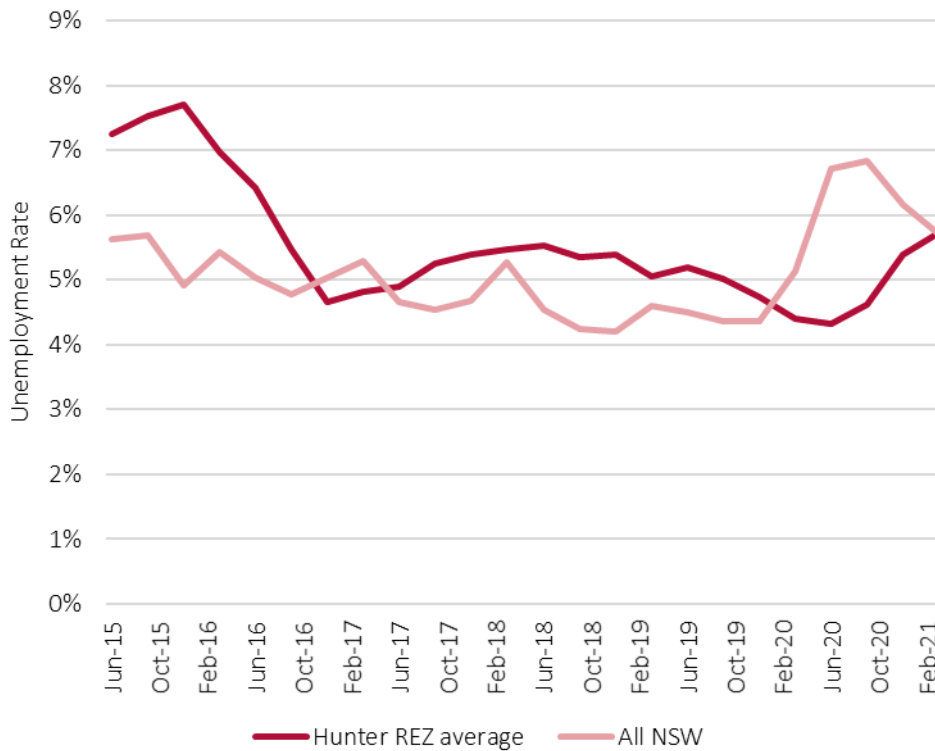


Figure 48: Labour force status, Hunter and Central Coast REZ region



Source: ABS census 2016

Figure 49: Unemployment, Hunter REZ, 2015 to 2021



Source: Department of Education, Skills and Employment, 2021

The share of First Nations unemployment in the area (Table 12) is comparable the state average of 8.9% (Table 13). However, shares in full time and part-time work are higher, due to a lower share classified as not in the labour force.

Table 12: First Nations and Non-First Nations population by work status, Hunter and Central Coast REZ region, 2016

	Full-time	Part-time	Unemployed	Not in labour force	Total
<b>Non-First Nations</b>	34.9%	20.2%	4.2%	40.8%	100.0%
<b>First Nations</b>	30.3%	18.8%	8.9%	42.0%	100.0%

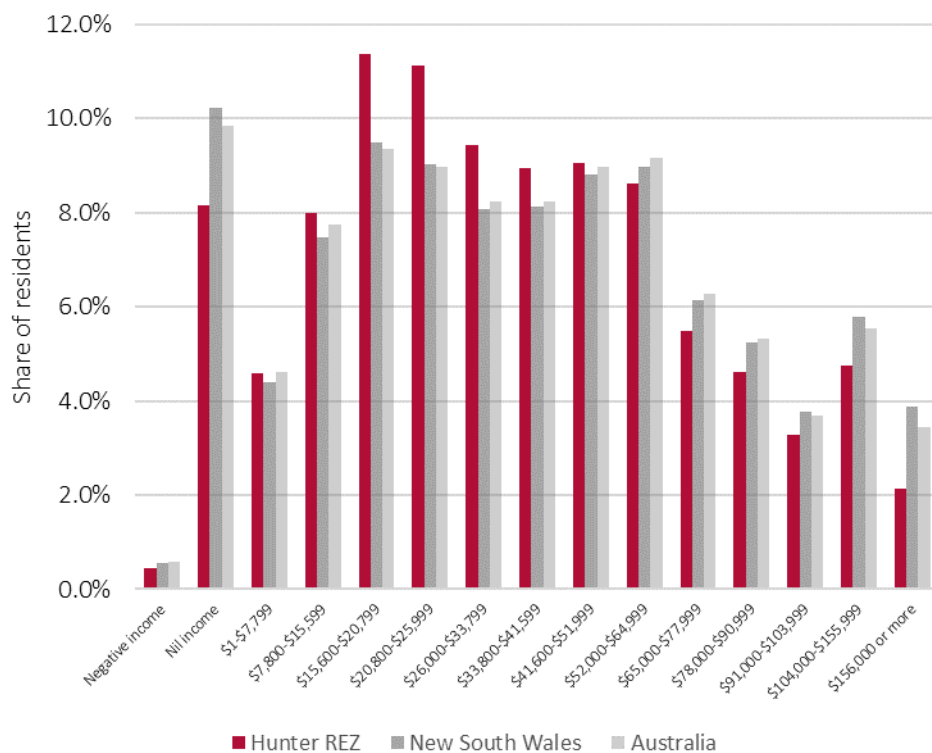
Source: ABS, Census 2016

Table 13: First Nations and Non-First Nations population by work status, All New South Wales, 2016

	Full-time	Part-time	Unemployed	Not in labour force	Total
<b>First Nations</b>	28.7%	16.7%	8.9%	45.7%	100.0%
<b>Non-First Nations</b>	39.0%	19.5%	4.0%	37.5%	100.0%

Source: ABS, Census 2016

Figure 50: Average annual income, Hunter-Central Coast REZ, 2016



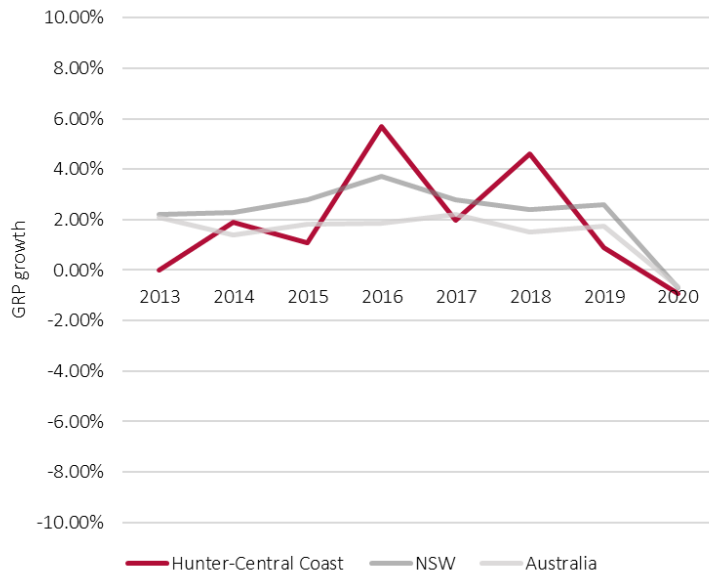
Source: ABS, Census 2016

## Economic structure

### GRP growth

The Hunter and Central Coast region has broadly outperformed the NSW and national economy since 2013 (Figure 51). Growth was particularly strong between 2016 and 2018, but experienced significant fluctuations from year to year.

Figure 51: GRP growth compared to NSW and Australia, Hunter and Central Coast REZ region

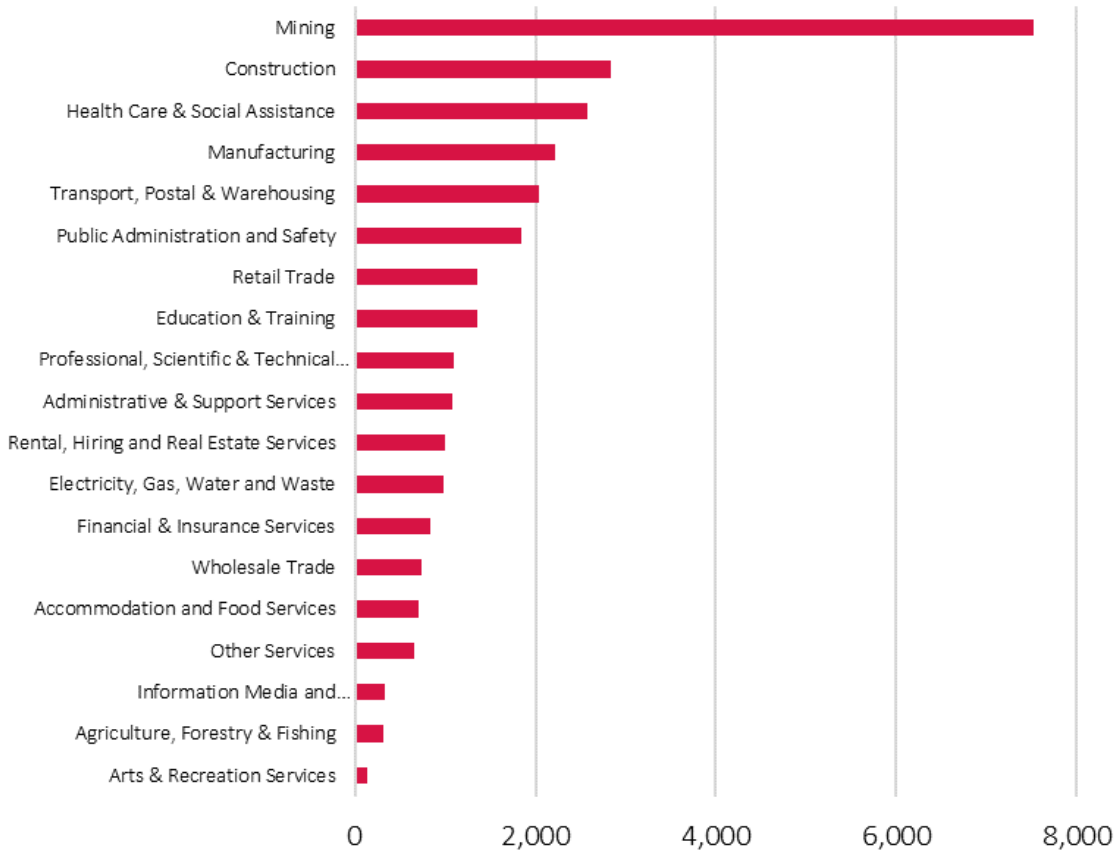


Source: Australian National Accounts: State Accounts, Cat. No. 5220.0 and SGS Economics Planning (can get data from Performance of Cities and Regions)

### Industry mix

Mining is a regional specialisation and contributes over 25% to the GRP in 2020 (Figure 52). The next largest contributors were construction, health care and manufacturing. Despite being located in a regional area, agriculture only makes up a very small share of overall output in the area (1%).

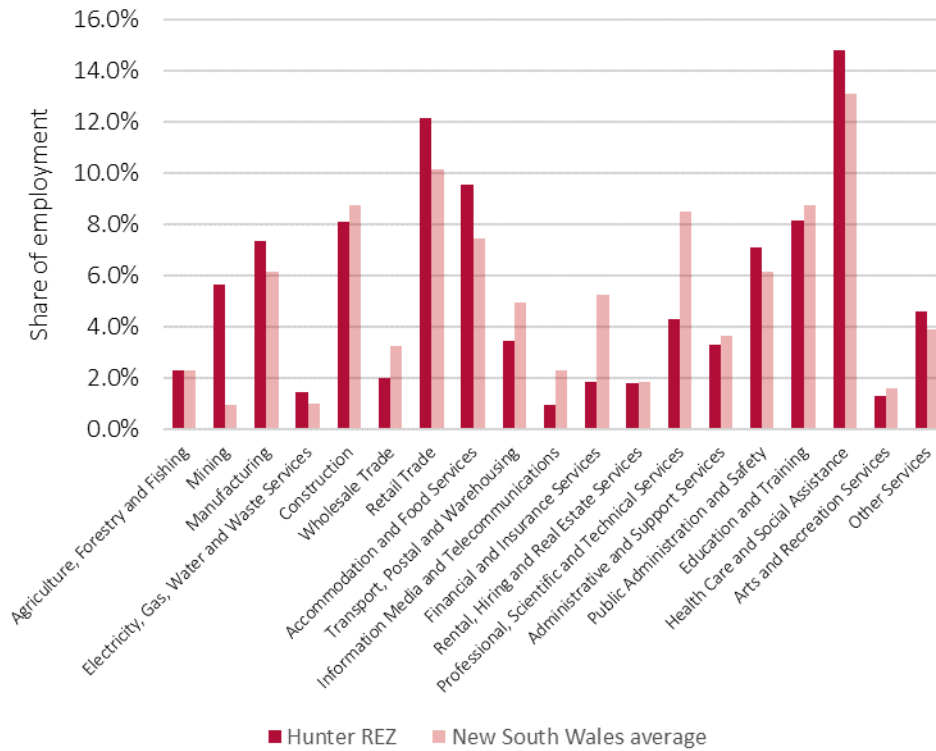
Figure 52: Industry contribution to GRP in 2020, Hunter and Central Coast REZ region



Source: Australian National Accounts: State Accounts, Cat. No. 5220.0 and SGS Economics Planning

Despite the high output from mining in the area, the share of employment is relatively low (Figure 53). This is in part due to the relatively high capital intensity of the industry. However, many workers in supporting industries may be indirectly employed by mining activity. Healthcare, retail, and accommodation and food service all employ large numbers of workers despite smaller contributions to GRP. This is common in large metropolitan areas, with large population serving industries required. These industries are highly labour intensive, and therefore employ a large number of workers in the Hunter-Central Coast area. Construction, health care and manufacturing are other large employers in the area and this aligns more closely with the share of GRP produced by each industry.

Figure 53: Industry share of employment, Hunter-Central Coast REZ, 2016

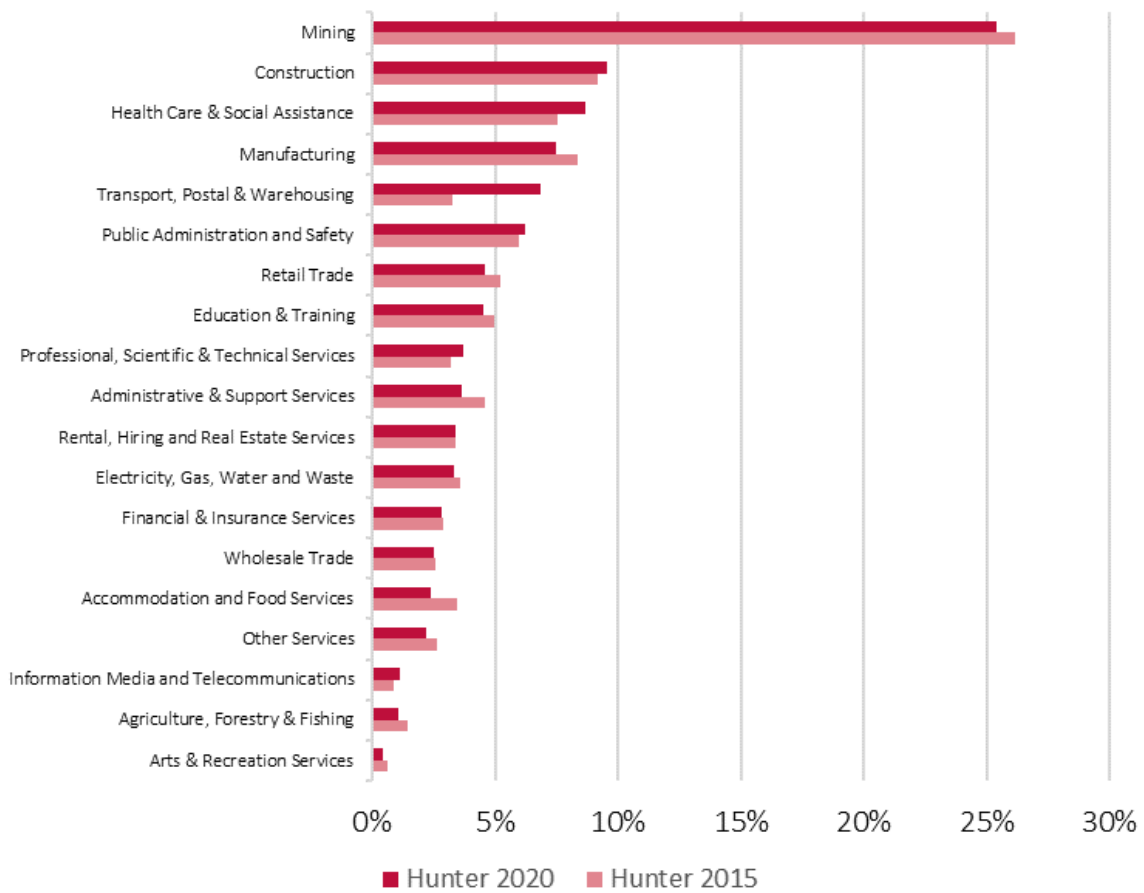


Source: ABS, Census 2016

**Shifts in industries’ share of production, 2015-2020**

In the five years to 2020, transport, postal and warehousing and health care and social assistance grew the most as a proportion of total GRP (Figure 54). Despite growing in outright terms, mining has actually contributed a smaller share of GRP over the past five years.

Figure 54: Industry structure over time (GRP contribution 2015-2020), Hunter and Central Coast REZ region

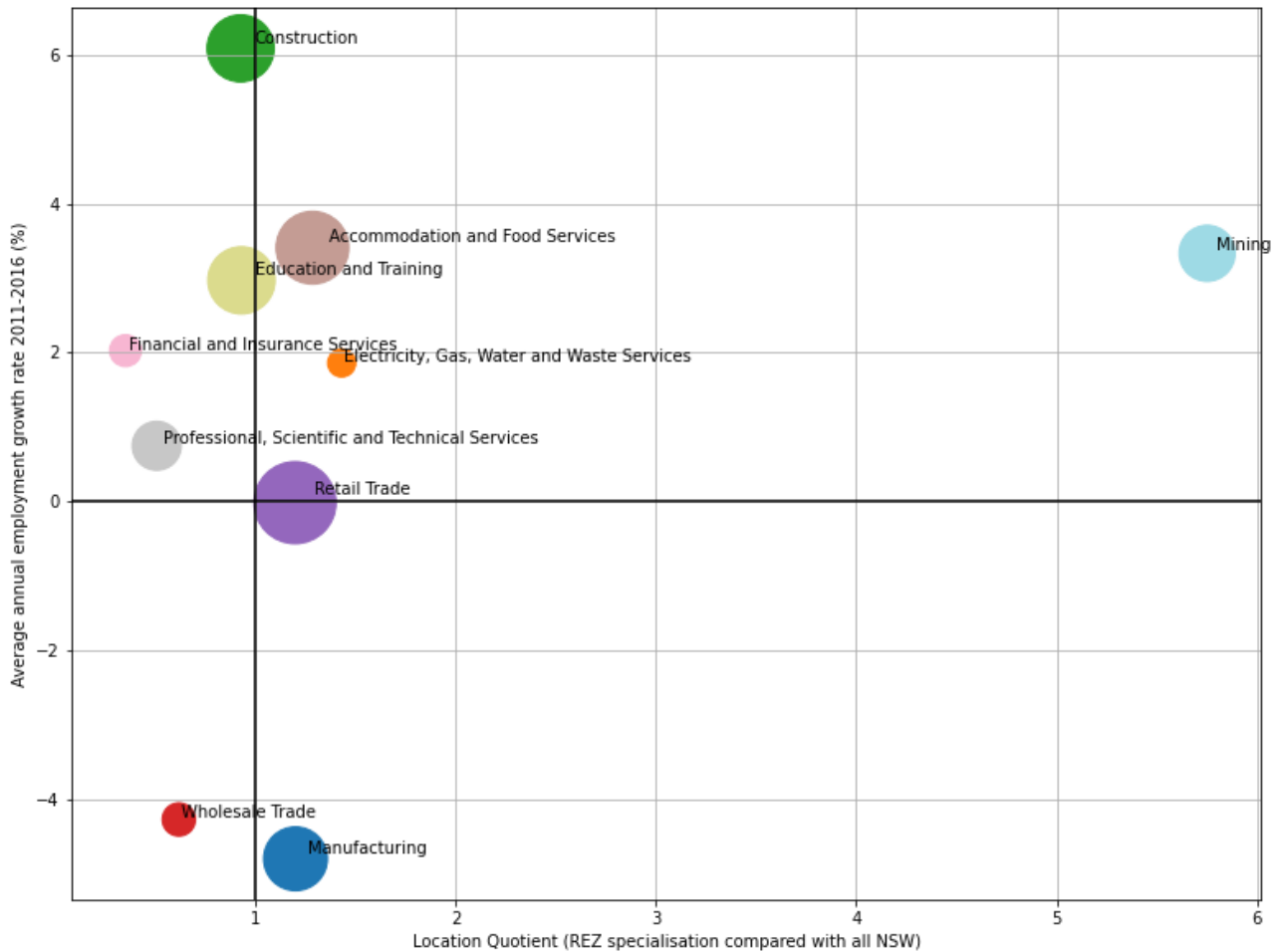


Source: Australian National Accounts: State Accounts, Cat. No. 5220.0 and SGS Economics Planning

**Competitive strengths**

The LQ analysis in Figure 55 provides some insight to the competitive strengths inherent in this REZ's economic structure. Mining is extremely specialised, as indicated by its position to the far right of the chart. There are slight specialisations in population serving industries such as health care, retail and accommodation and food services, which is common to areas that are relatively densely populated.

Figure 55: Location Quotient of industries in the Hunter and Central Coast REZ region



Source: SGS Economics and Planning using 2016 census data

## Institutional endowments and qualifications

### Major education institutions

The broader Hunter region (including Lake Macquarie and the MidCoast) has a highly skilled labour force compared to other regional areas, with a strength in STEM (Science, Technology, Engineering and Mathematics) and agricultural education (REDS, 2018), mainly at the vocational and higher education levels. A stronger focus on developing STEM skills in the REZ region’s primary and secondary schools, linking in industry participation, would help to grow the pipeline of talent needed for renewable energy industries.

The Region is home to a range of education facilities. Notably, the Region contains a campus of the University of Newcastle which offers programs across a range of schools and faculties. In addition, TAFE provides a comprehensive range of colleges and courses throughout the Region. Colleges are situated in Gosford, Ourimbah, Wyong, Belmont and Glendale. Courses offered focus on hairdressing and beauty, administration, business, library and real estate, manufacturing and engineering, community health and fitness, information technology, transport and mining, animal and equine studies.

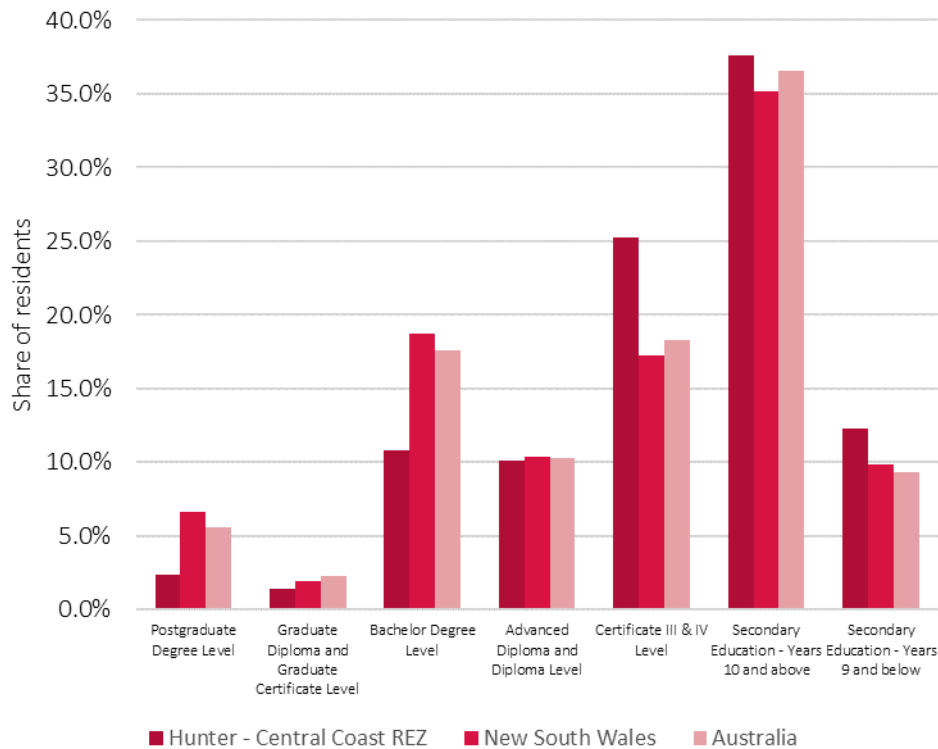
There are also several research institutions in the Region and in neighbouring Newcastle. These include two of the University of Newcastle’s (UON) innovation hubs (the Williamstown Aerospace Centre in Port Stephens and UON Upper Hunter, Muswellbrook), the Port Stephens Fisheries Institute, the local (agricultural) College (which recently received funding to establish a research apiary) and the Hunter Valley Equine Research Centre in Scone. The neighbouring City of Newcastle is home to the UON, the Hunter Medical Research Institute, the TAFE Innovative Manufacturing, Robotics and Science SkillsPoint and the Renewable Energy Integration Facility-CSIRO Energy Centre, which hosts a solar field and energy research hub.

There are relatively few RTOs offering training directly relevant to renewable energy industries, although there are some offering electrical safety courses. There is also a Master Builders Group Training targeted to the Hunter workforce and which promotes apprenticeships and traineeships across all levels of building and construction.

### Tertiary qualifications by share of all residents

The Hunter-Central Coast region has a higher proportion of people with Certificate III and IV qualification and a lower number of people with Bachelors or Post-graduate degrees.

Figure 56: Highest level of educational attainment, Hunter-Central Coast REZ, 2016

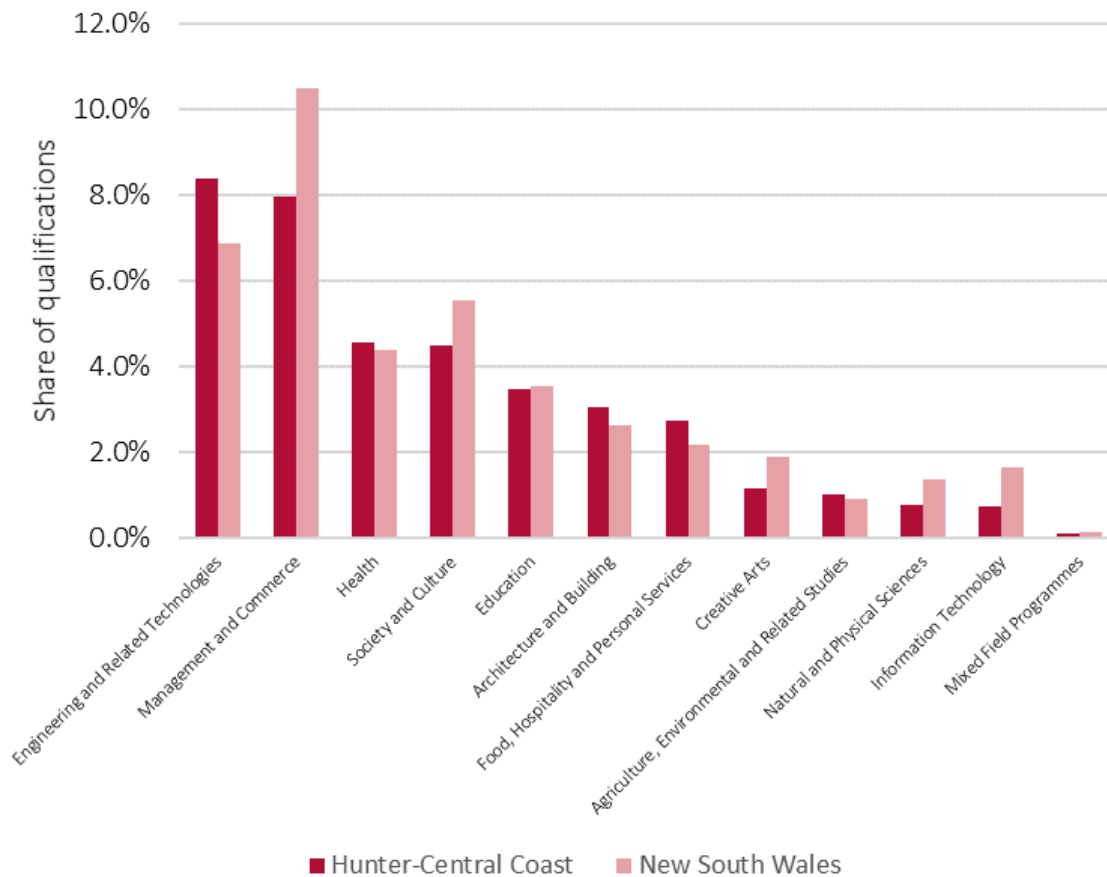


Source: ABS, Census 2016

The most common qualifications held in the Hunter-Central Coast area are related to engineering, management and commerce, and health (Figure 57). The region has a higher share of residents with engineering related qualifications than the NSW average. This may be due to the dominance of mining in the regional economy –in terms of employment share, contribution to GRP and regional exports – and suggests an opportunity to leverage these skills for future renewable energy construction, operations and maintenance.



Figure 57: Top qualifications by share of all residents, Hunter and Central Coast REZ region



Source: Australian Government, Department of Employment, Skills, Small and Family Business (2019)

### Key barriers and constraints for REZ development

- There is both a skills shortage and local supply chain shortage in the region.
- Timings of RE projects and transparency regarding planning is seen as a key barrier. This impacts the ability of the region to know what skills are required for the appropriate project to ensure that skills could be either transferred, or training developed and/or delivered.
- There is limited capacity for manufacturing which may be due to limited land availability. This availability of land may change as mining land is remediated, however the ecological impacts and the utility of those lands are not yet known.
- There is currently a lack of renewable energy generation projects in the region, although the Hunter-Central Coast is well connected to the grid due to legacy factors.
- A lack of communication, collaboration, transparency and consistency across areas of policy makes it challenging to plan for the future. This lack of clarity regarding investment and local benefits create ongoing uncertainty.

## 2.8 Illawarra

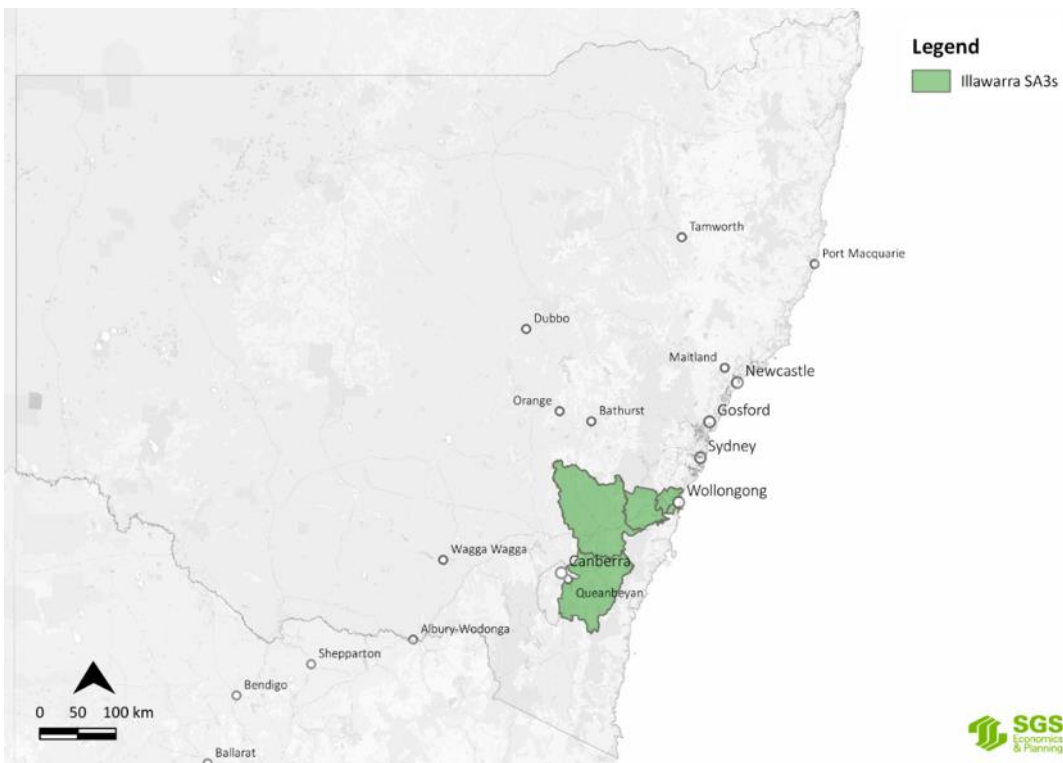
### Summary

Illawarra's economy is underpinned by its strong manufacturing and mining industry, while green hydrogen production at Port Kembla is emerging as a priority growth sector. There is also a concentration of steel production at Port Kembla. Due to the region's proximity to the major centres of Canberra and Wollongong, there is relative diversity in the local economy compared to other regional areas and a greater share of white collar and population serving employment.

Large scale solar farms, wind turbines and waste to energy projects in the Southern Tablelands present opportunities to pursue economic and social development opportunities in the vicinity.

The general catchment of the Illawarra REZ is located to the south of Sydney, covering an area roughly between Wollongong and Batemans Bay (Figure 58). The Southern Tablelands is strategically located near existing transmission capacity and carries the Moomba to Melbourne gas pipeline (REDS, 2018).

Figure 58: Illawarra REZ region – general catchment



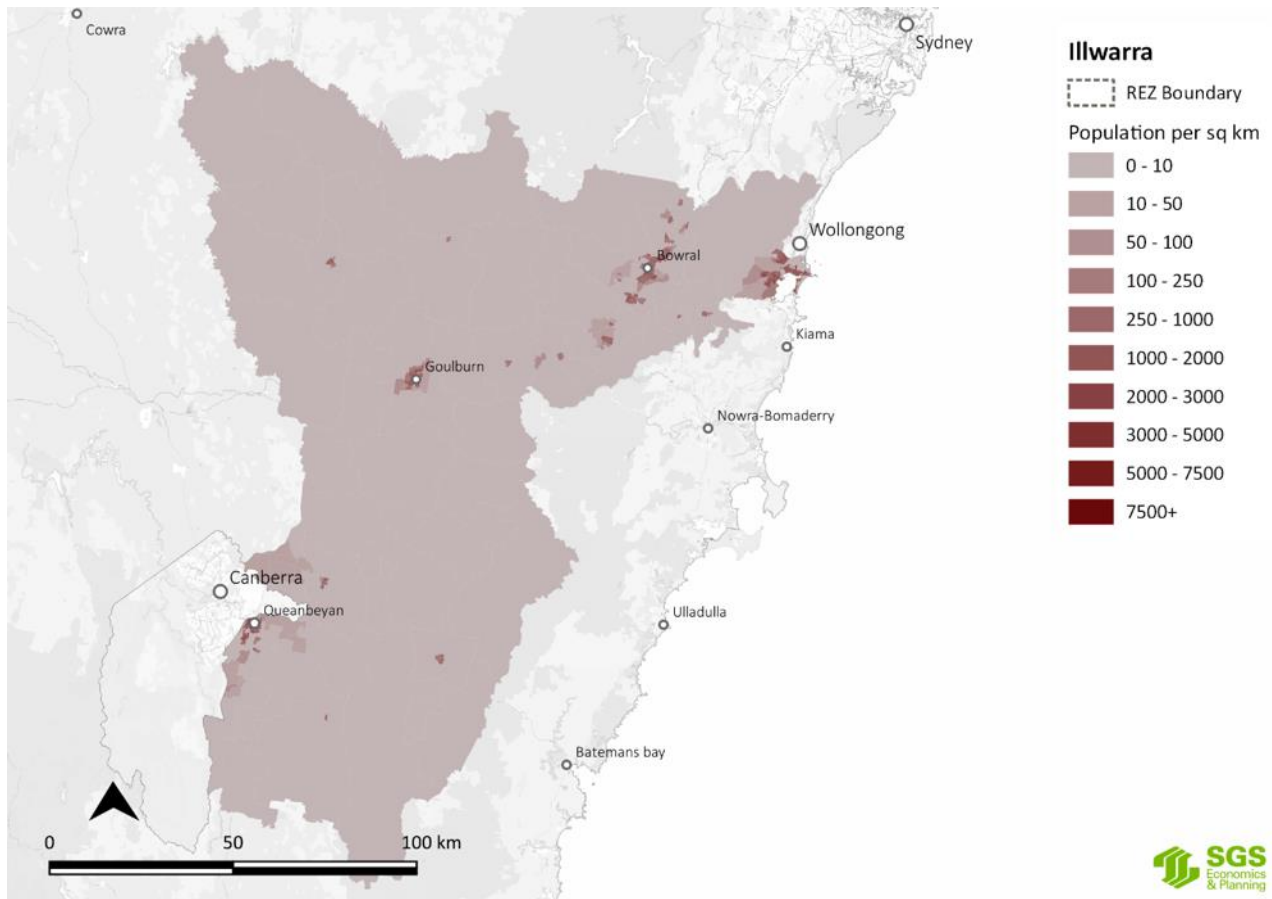
Source: SGS Economics & Planning, 2021

## Demographic profile

### Population size and density

The SA3s outlined in Figure 58 above are estimated to have a population of 216,120. Population in the broader Illawarra-Shoalhaven area as defined by DPIE in their planning region projections is estimated to grow strongly by 24.7% from 404,837 in 2016, to 504,910 in 2041. The spatial distribution of population is mapped at Figure 59.

Figure 59: Population density in Illawarra region

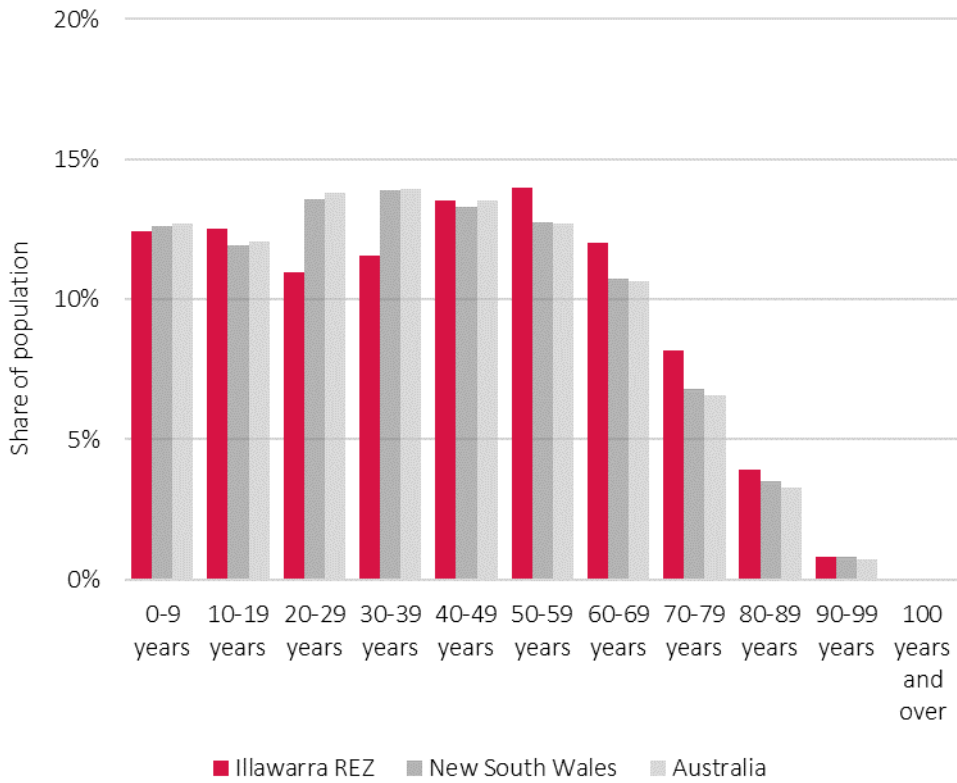


Source: ABS, Census 2016

### Age distribution

Similar to other regional areas, the Illawarra region has higher shares of younger (0-19 year age groups) and older (40+ year age groups) compared to its share of 20-39 year old residents (Figure 60).

Figure 60: Age Distribution, Illawarra region, 2016



Source: ABS, Census 2016

### First Nations share of population

The First Nations share of population is relatively low compared to other REZ regions at 3.3%. However, it is still slightly higher than the state-wide average of 3.1%. This is shown in Table 14.

Table 14: First Nations population, Illawarra region, 2016

	First Nations	Non-First Nations	Total
<b>Total</b>	6,735	196,383	203,118
<b>Share</b>	3.3%	96.7%	-

Source: ABS, Census 2016

### Skills profile

The most common occupations are professionals and managers (Figure 61), reflecting the region’s proximity to major centres such as Canberra and Greater Sydney and a degree of labour mobility among the regional workforce.

Figure 61: Ten largest occupation groups (2-digit level) in the Illawarra region



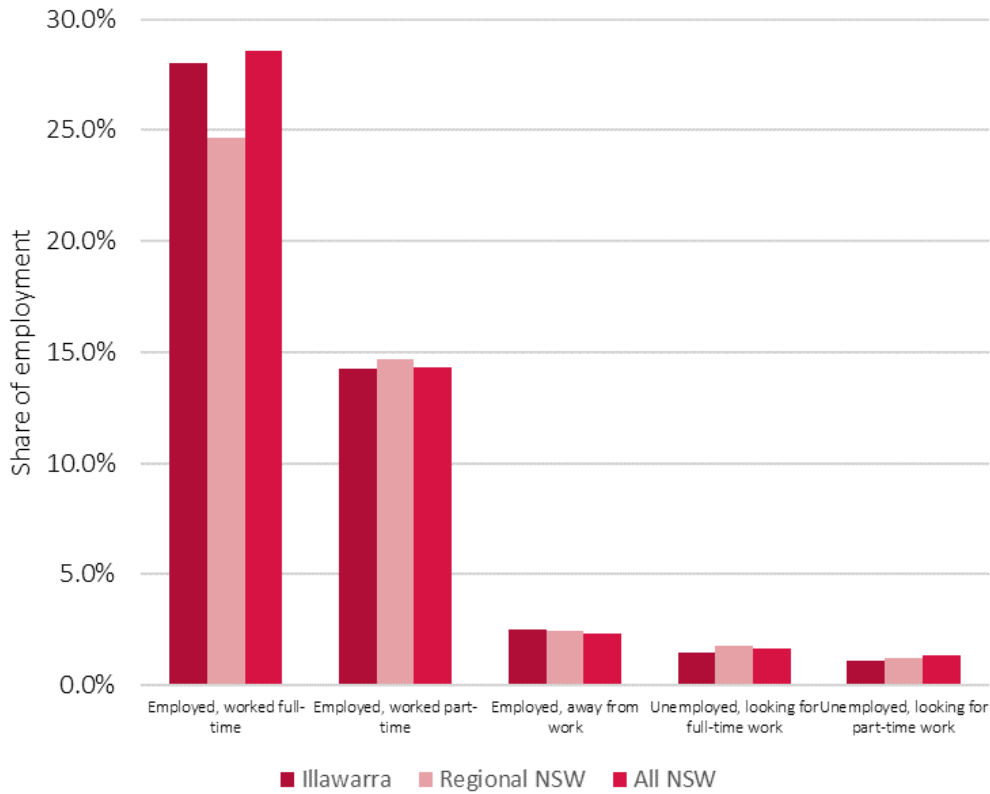
Source: SGS Economics and Planning using 2016 census data

### Employment status and average income

Compared to the regional NSW averages, Illawarra has slightly higher rates of full-time employment, and relatively similar levels of unemployment (Figure 62). This suggests that there is little spare capacity in the labour market when compared with other areas in NSW.

Unemployment has historically been much higher than the rest of NSW, however falls in the unemployment rate in the region through 2019 brought it into line and the region has followed wider NSW trends since COVID-19 (Figure 63).

Figure 62: Labour force status, Illawarra region



Source: SGS Economics and Planning using 2016 census data

Figure 63: Unemployment, Illawarra REZ, 2015 to 2021

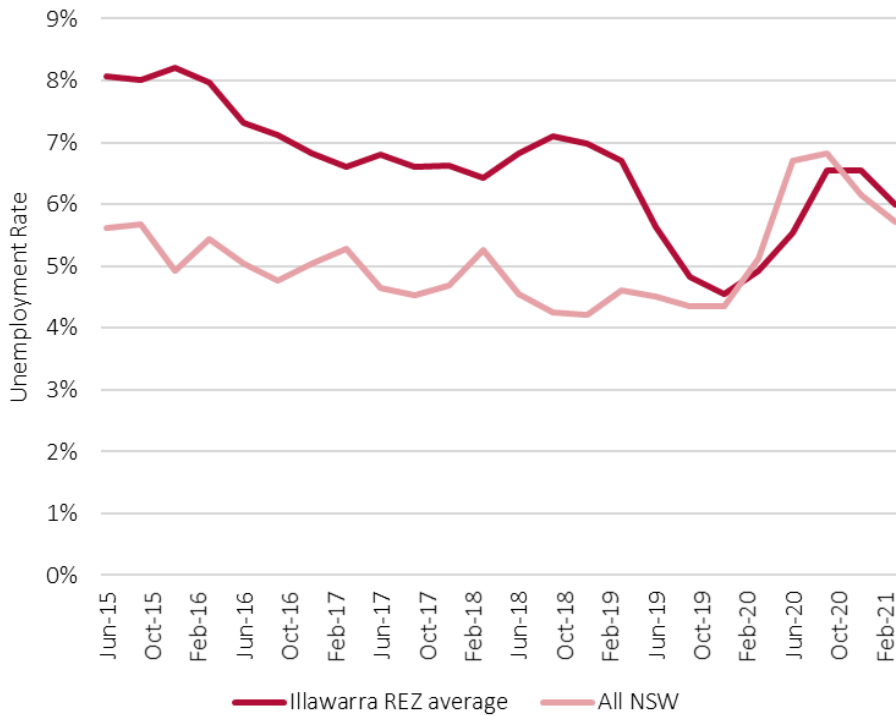


Chart sources: Department of Education, Skills and Employment, 2021

The First Nations share of unemployment (Table 15) is slightly lower than the state-wide average of 8.9%(Table 16). The share not in the labour force is also lower than the NSW average, while shares in full-time and part-time are higher.

Table 15: First Nations and Non-First Nations population by work status, Illawarra region, 2016

	Full-time	Part-time	Unemployed	Not in labour force	Total
<b>Non-First Nations</b>	38.4%	19.5%	3.4%	38.7%	100.0%
<b>First Nations</b>	32.1%	17.3%	8.1%	42.4%	100.0%
<b>Not stated</b>	25.2%	13.3%	4.3%	57.2%	100.0%

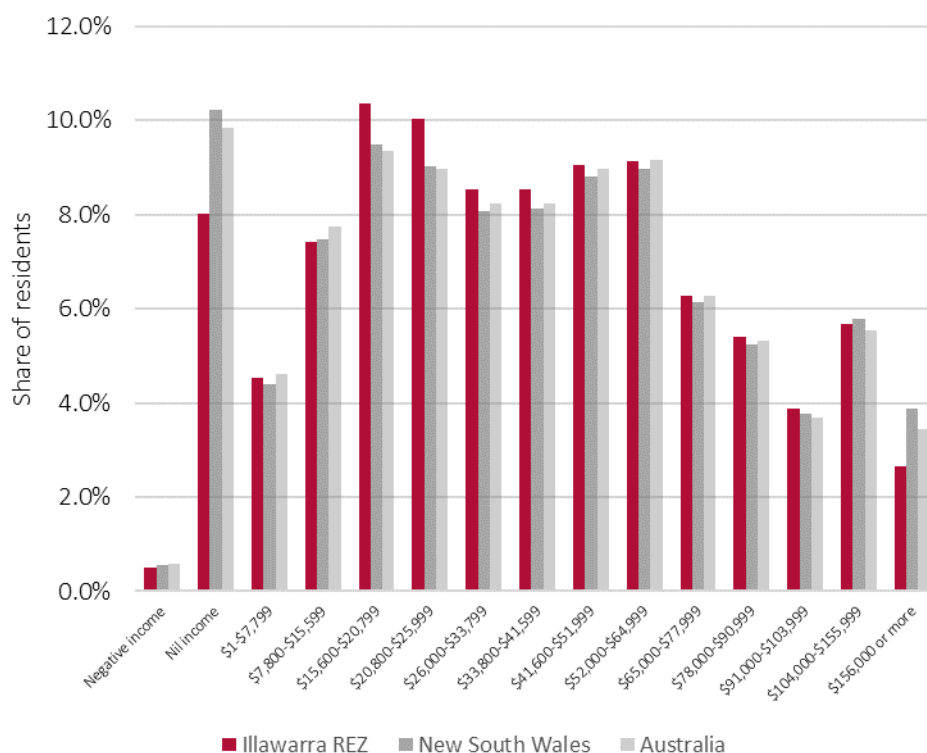
Source: ABS, Census 2016

Table 16: First Nations and Non-First Nations population by work status, All New South Wales, 2016

	Full-time	Part-time	Unemployed	Not in labour force	Total
<b>First Nations</b>	28.7%	16.7%	8.9%	45.7%	100.0%
<b>Non-First Nations</b>	39.0%	19.5%	4.0%	37.5%	100.0%

Source: ABS, Census 2016

Figure 64: Average annual income, Illawarra REZ, 2016



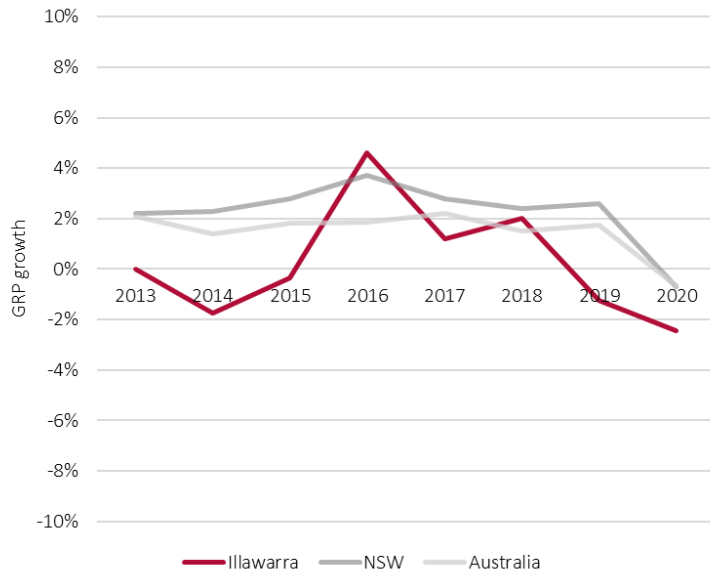
Source: ABS, Census 2016

## Economic structure

### GRP growth

This REZ has slightly underperformed compared to the state and national economies since 2013, notwithstanding strong growth in 2016 (Figure 65). Since 2018, growth has continued to trend downward.

Figure 65: GRP growth compared to NSW and Australia, Illawarra REZ



Source: Australian National Accounts: State Accounts, Cat. No. 5220.0 and SGS Economics Planning (can get data from Performance of Cities and Regions)

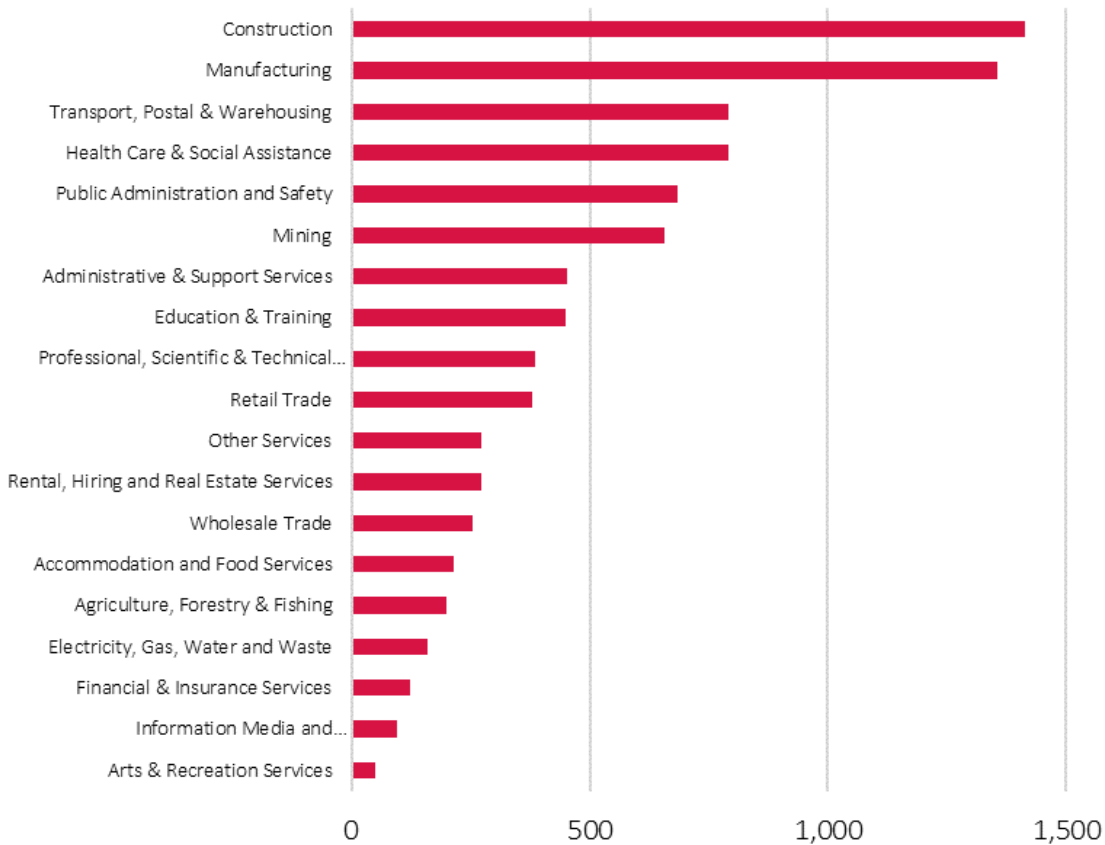
### Industry mix

Given the proximity to larger centres in Canberra and Wollongong, the industry profile reflects a higher employment density with a range of service-based industries, including construction, public administration, health care and education (Figure 66). There is also a solid share of manufacturing in the area, making up 5.6% of all production, although this is primarily related to the food industry.





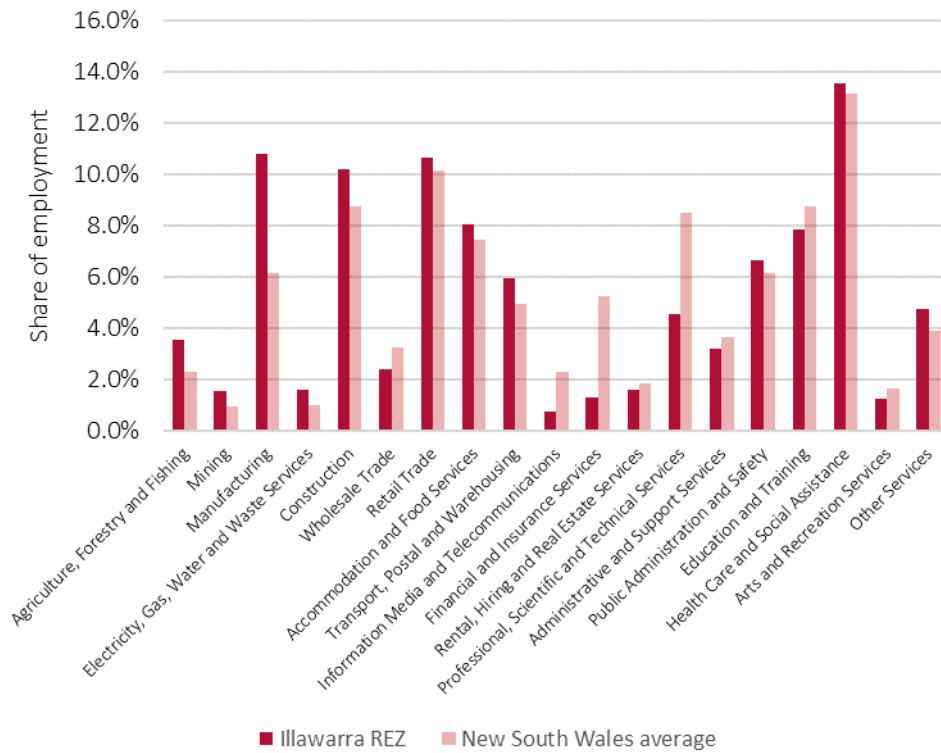
Figure 66: Industry contribution to GRP in 2020, Illawarra region



Source: Australian National Accounts: State Accounts, Cat. No. 5220.0 and SGS Economics Planning

Health care and personal services, retail, manufacturing and construction are the largest employing industries in the Illawarra REZ area (Figure 67). The first two contribute a large share of employment in line with their contribution to GRP. The second two contribute a much smaller share of the region’s GRP. However, retail and health care are population serving industries that are highly labour intensive. As a result, their large share of employment reflects the large population living in the Illawarra area.

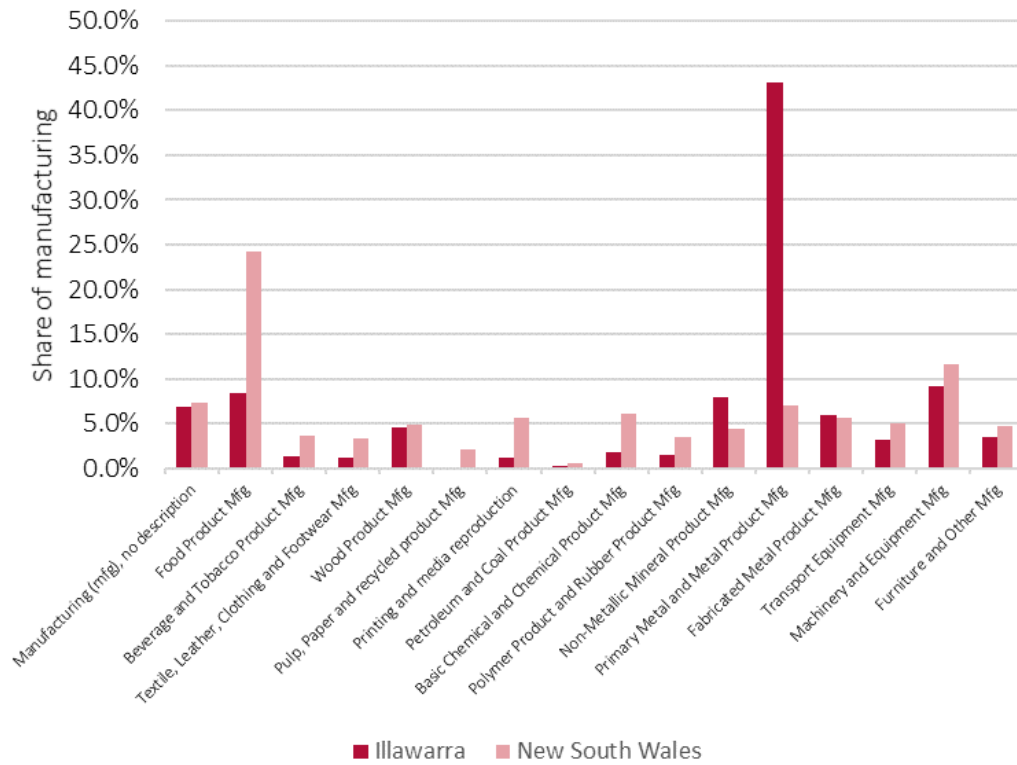
Figure 67: Industry share of employment, Illawarra REZ, 2016



Source: ABS, Census 2016

The composition of manufacturing is shown in Figure 68 below. The vast majority of employees in this sector work in primary metal product manufacturing, which suggests that this makes a very large share of the output shown above. Primary metal and metal product manufacturing mainly captures early stages of metal production such as smelting and casting activity.

Figure 68: Manufacturing summary, by employment, Illawarra REZ

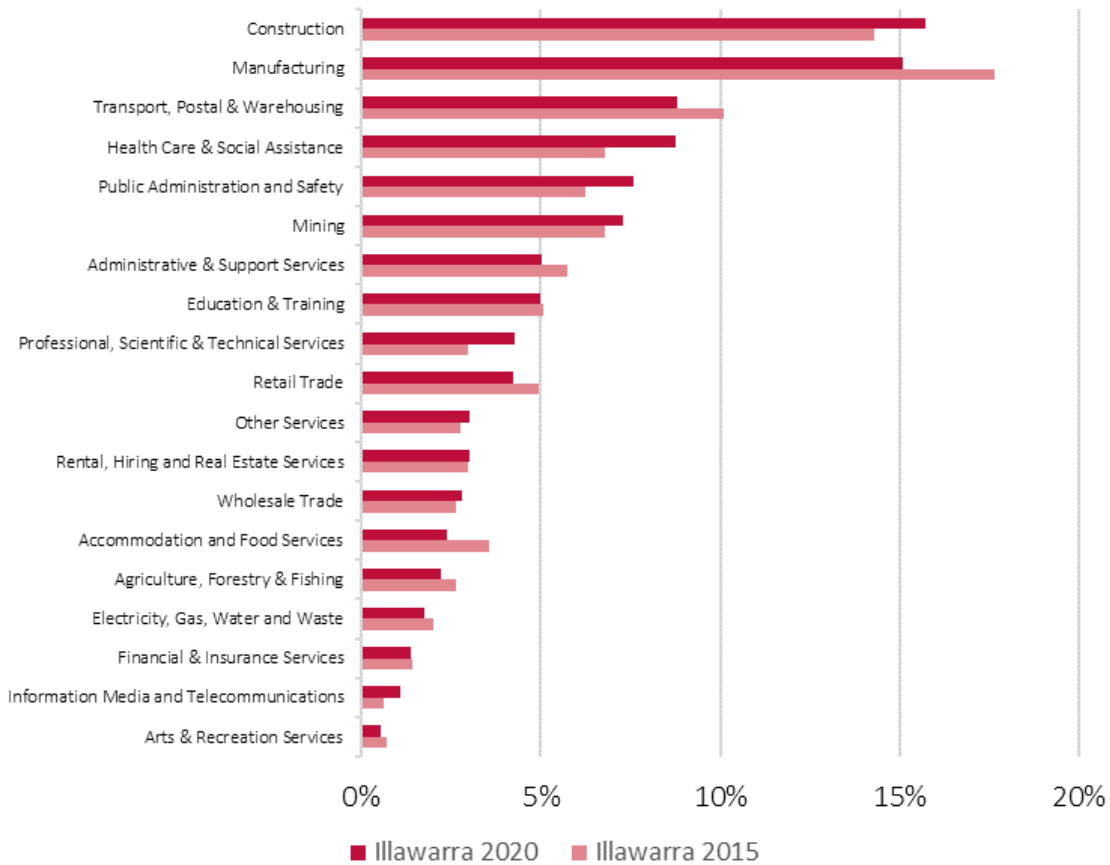


Source: ABS census 2016

**Shifts in industries’ share of production, 2015-2020**

The largest growing industries in the five years to 2020 were construction, public administration and health care and social assistance (Figure 69). Professional services have also grown strongly over the past five years. Meanwhile, accommodation and food services and transport, postal and warehousing fell in their share of GRP over the time period.

Figure 69: Industry structure over time (GRP contribution 2015-2020), Illawarra region

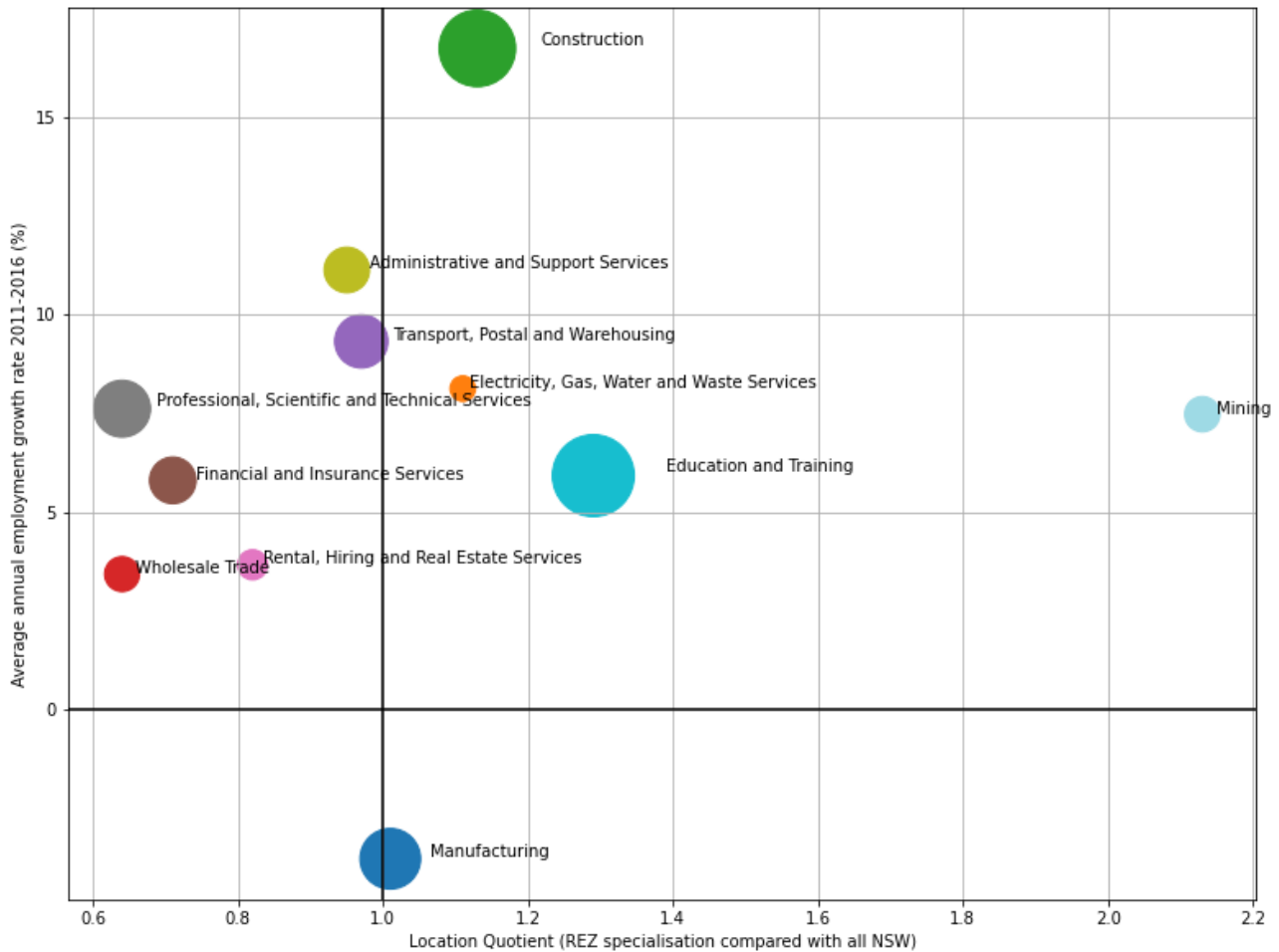


Source: Australian National Accounts: State Accounts, Cat. No. 5220.0 and SGS Economics Planning

### Competitive strengths

The LQ analysis shown in Figure 70 provides some insight to the competitive strengths inherent in the REZ’s economic structure. There are a range of specialised industries in the area, including construction, mining, agriculture and electricity and other utilities. Public administration is a specialisation and has also grown significantly over the past ten years. In contrast, manufacturing has decreased significantly in terms of total employment over the past decade.

Figure 70: Location Quotient of industries in the Illawarra region



Source: SGS Economics and Planning using 2016 census data

## Institutional endowments and industry specialisations

### Major education institutions

The main Wollongong University campus is located nearby and is ranked by QS World University Rankings among the best 20 modern universities globally. It has established an excellent reputation for teaching and learning across its five faculties; Business; Engineering and Information Sciences; Law, Humanities and the Arts; Science, Medicine and Health and Social Sciences. Students have a choice of 11 engineering majors: Architectural, Biomedical, Civil, Computer, Electrical, Environmental, Materials, Mechanical, Mechatronic, Mining and Telecommunications.

In the region, Charles Sturt University has a Goulburn campus, but the only course offered is an Associate Degree in Policing Practice from the NSW Police Force Academy. The University of Wollongong has a campus at Wingecarribee. The campus offers a Bachelor Degree in Arts, business, and commerce, as well as a masters of teaching. There are TAFE campuses at Goulbourn, Yass, Wingecarribee. All three offer courses at a certificate level.

Queanbeyan-Palerang region of the REZ neighbours Canberra and therefore draws on the extensive education institutions located there including the Australian National University, Canberra Institute of Technology and the University of Canberra.

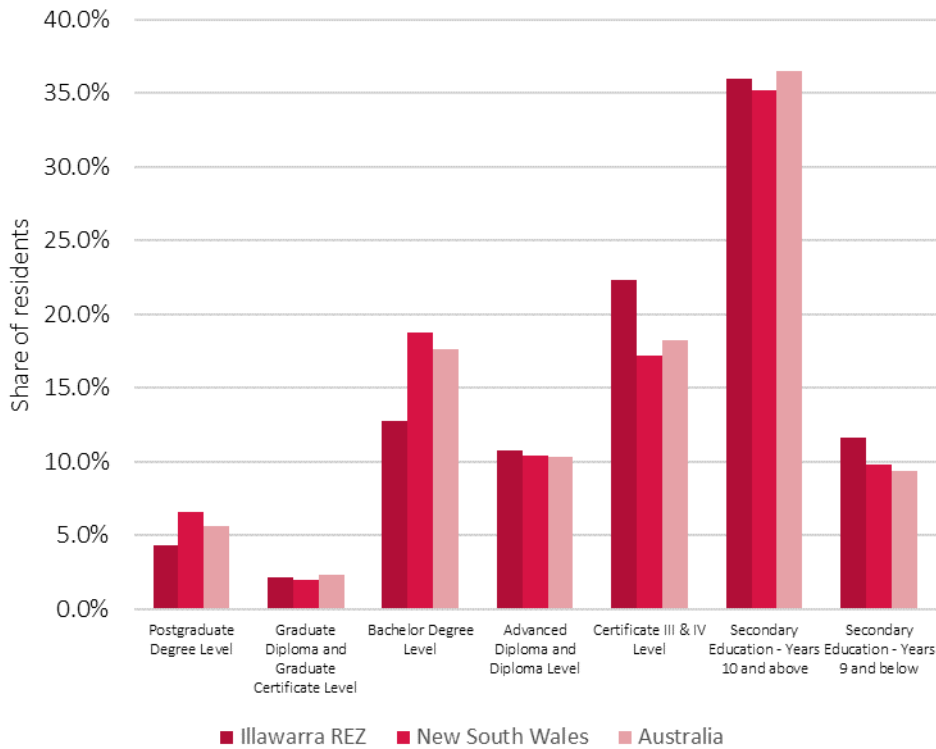
At the primary and secondary education level, there are opportunities to promote STEM skills as a way to grow the pipeline of talent for renewable energy industries. As major REZ infrastructure becomes

operational, there will also be opportunities to refine an applied learning approach whereby industry and REZ stakeholders help to facilitate student engagement outside of the classroom environment.

### Tertiary qualifications by share of all residents

The Illawarra region has a higher proportion of residents with Certificate III and IV qualifications and a lower proportion of residents with a Bachelor Degree than the rest of NSW and Australia.

Figure 71: Highest level of educational attainment, Illawarra REZ, 2016

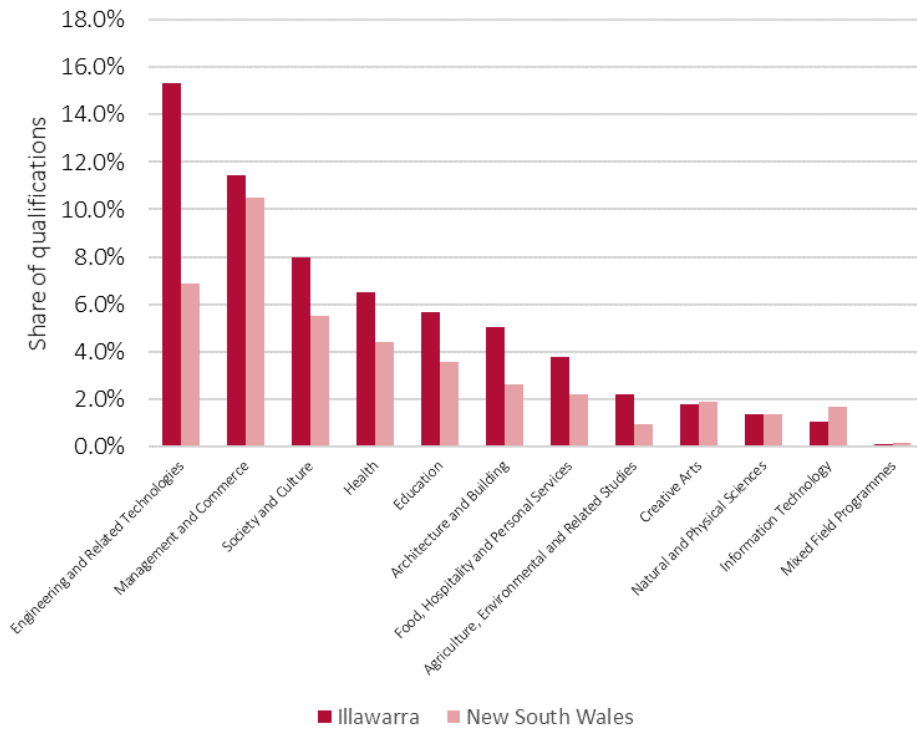


Source: ABS, Census 2016

Compared to regional NSW, the Illawarra region has a higher proportion of people who have completed Year 12 or equivalent and a higher proportion of people holding university qualification (REDS, 2018). In Wingecarribee, the labour market is well educated with a higher proportion working in skilled occupations.

The most common qualifications held by residents are engineering related. This is mainly due to the share of engineering related employment in manufacturing and construction activity in the area. The share of this is well above the NSW average (Figure 72). Management and commerce also make up a large share of qualifications in the area, with a higher share than the rest of NSW. This is common in almost all qualification types, with society and culture, health and education all making up a larger share of qualification in the Illawarra region compared with the rest of NSW.

Figure 72: Top 10 qualification areas compared with NSW, Illawarra REZ



Source: SGS Economics and Planning using 2016 census data

### Key barriers and constraints for REZ development

- The Illawarra region noted they are experiencing a significant skills and local supply chain shortage.
- The most important shortage within training is the lack of funding and resources within TAFE to be able to develop and deliver the appropriate courses. Hydrogen is an emerging technology in the region, however in addition to a lack of training opportunities; there is a limited supply network. The demands on local infrastructure because of the increasing scale of projects will require significant investment into infrastructure upgrades across the supply chain.
- There is a barrier regarding land use conflict due to increasing residential encroachment and densification. This may impact additional infrastructure upgrades and REZ developments as a whole.
- In regards to economic development, the region experiences conflict between energy retailers, network providers and renewables in the current grid. Finally, the pace of government funding approval is currently a barrier, as it requires increased pace and agility if the region and indeed the state is going to lead in the REZ space.

---

## Appendix 2: REZ workshop report

### Background

In July – August 2021, stakeholder workshops were undertaken online in five REZs by UTS ISF and SGS Economics, with 1-3 DPIE staff members observing (not included in participant numbers in Table 17 below). The project team used snowball sampling from the interview list to recruit participants. In alignment with UTS ISF ethics, each participant was provided with an information and consent form as well as the agenda prior to each virtual workshop. Attendance was voluntary with each workshop being recorded through zoom. The two virtual workshops were designed for participation and participant inputs into online Mural boards (see Figure 73).

Table 17: Workshop Participants

REGION	State and local Government	Non-Government	Total participant numbers
Central-West Orange	4	15	19
South West	2	13	15
New England	4	7	11
Hunter	3	9	12
Illawarra	4	9	13

Each workshop consisted of a brief introduction, including an overview of the workshop objectives, agenda, project context with some time for any questions from the participants (10 mins). Depending on the workshop numbers, participants were split into two or three online groups. Participants were then introduced to the mural board (5 mins).

- The first round of discussion explored the opportunities to increase local industry development and employment from the NSW REZs (40 mins).
- This was followed by questions regarding any barriers to realising these opportunities (20 mins).
- Participants were offered a brief break (5 mins) and the third session focused on actions needed to support local industry development and employment (20 mins).
- The groups returned into plenary for a report back and wrap-up (15mins).

The findings reported in this analysis brings together the outputs from each workshop (**Central-West Orange, South-West, New England, Hunter & Illawarra**) respectively. The findings are grouped into the three sections of the workshop - **opportunities, barriers and actions**.

- **Opportunities** are framed around the supply chains across the renewable energy sector: mining and material processing; manufacturing, distribution, construction, operation & management, reuse/recycling/end of life and other.
- **Barriers and actions** are aligned to key themes - skills/labour/training, supply chain, infrastructure, regulatory planning policy, economic development, finance and other.

The analysis of the workshop findings are presented for each of the regions followed by a short synthesis.



Figure 73 Example of Mural board used in virtual workshops



## Central-West Orana

### 1. Opportunities

#### Mining and material processing

- Adding value through **the development of local supply and processing facilities** of rare earth minerals and materials, increase capacity of Greentech in processing.
- Equally **local generation of clean, affordable energy** and/or Power Purchase Agreements (PPAs) for new and existing mines in the region was cited by many. For example, a critical metals manufacturer (ASM in Dubbo) is investigating building a 40MW hybrid power station at Toongi and creating an easement Toongi-Geurie to connect into grid (and in discussion referred to PPAs). The presence of the REZ enables an opportunity for minerals for renewable energy supply-chains to have net zero emissions and have a global advantage (in time expected to be a requirement for participating in renewable energy).
- **Maximising the economic and social development opportunities** that can be realised by the REZ, e.g., increased use of rail network e.g., hydrogen powered trains.

#### Manufacturing

- **Local manufacturing, innovation and maintenance** of original equipment manufacturers (OEM), panels, batteries, chemicals, turbines and/or component parts
- **Tapping into local manufacturing skills and expertise**, e.g. Horts, ASM
- **Net zero inputs of REZ is a globally significant market signal** and source of competitive advantage for exports.
- **Collaboration between similar local businesses** to complete required works

#### Distribution

- Use of large regional airports and rail infrastructure upgrades to **facilitate intermodal distribution, strengthen freight connection** to Newcastle
- **Distribution of cheaper, cleaner energy** to businesses locally
- **Storage and distribution of locally made components**
- **Training and skills development** for Aboriginal youths

#### Construction

- Work with local educational institutes **to develop local skills for all;** that include pre-employment courses and quality work placements across projects to gain 'real' experience and bring new skills to the region.
- **Long periods of construction** for local service providers to have time to establish
- **Local construction crews** rolling from project to project for job security
- Procurement **policies that support local businesses** e.g., smaller contracts.
- **Build strong supply chains** in Central REZ, innovative businesses that are engaged in new developments
- **Build a local hub** for maintenance and re-purposing of end-of-life assets based

#### Operation & Management (O&M)

- **Engage with RTOs to enhance and diversify skills** for O&M roles, placements for cadets and apprentices
- **Maintenance opportunities with OEMs** who may have large 'fleet' deployed in the REZ
- Attract lead companies into the region by providing **long term business opportunities**

- **Grazing partners** for solar farms
- **Share the skills and lessons learnt between proponents** as farms are developed to increase efficiencies and make projects more cost effective

#### Reuse/ Recycling/ End of Life

- **Local recycling plants** for solar, RE componentry, construction waste
- **End of project land rehabilitation** - First Nations roles
- **Re-use of critical minerals** is needed based on rapidly evolving technology and demand

#### Other

- **Sustainable, affordable housing** during and post-construction integrated into the community - construction camps – social problems can occur – some solar farms there have been problems with worker behaviour
- **Capacity at council to process** (e.g., Development Applications (DA) etc)
- **Establish a centre for innovation** or training hub linked to Unis focused on zero emissions mining and manufacturing to build skills locally, provide incentives for regional growth, cadetships and apprenticeships and avoid labour hire companies
- **Companies interested in doing trials on battery technology linked to universities** – pre-commercialisation struggle with little support in Australia
- **Underpin additional electricity needs of increased local industrial activity** (manufacturing or recycling) through PPAs with developers
- **Identifying shared benefits** through local stakeholder engagement critical – including benefits to agriculture, local businesses, local elders (cultural site survey, tours for workers), and the broader community
- **Address past poor industry practices** (e.g., OH&S, slow payment of local suppliers)
- **Include regional enhancement funds** and associated governance structures, include community energy
- **Targeted training programs for Indigenous people** – Beon energy eg p- engage with Local Aboriginal land councils and First nations people - Jobs at start and at the end. Employment for cultural tours for workers and projects – dedicated end of projects land rehabilitation. Local sacred sites. Awareness of land.
- Community benefits at a regional scale.

## 2. Barriers

### Skills/labour/training

- **Lack of staff** due to competition in the labour market between sectors, lack of migration; also, competition between REZs e.g. critical minerals project– if our project gets under construction 400-1000 jobs over 2 years – Electrical engineers. Complex chemical engineering. Local skill mapping needed. We might not have the people to do the work. If Covid keeps going, how do we keep our workforce engaged. Normally FIFO. Now you couldn't do that. Workforce will have to come here and stay.
- **Lack of appropriate skills** and effective RTOs, inability of VET sector to respond quickly
- **Lack of understanding about which skills are needed** and when, requires planning and coordination
- **Attracting and retaining workers** to the region and providing support in getting them to relocate with their families
- **Retaining staff at SMEs** rather than leaving for larger organisations with greater opportunities
- **Discrimination** - long term unemployed, gender, First Nations, new Australians, ex-inmates

- **Engagement with low skilled labour to upskill**, young people and Aboriginal cohort, reluctance to undertake training and jobs programs
- **Gap for electricians** – suitably skilled people to work and maintain the sites. TAFE in Dubbo does electrical course but with all the other construction there is a lot of pressure – not enough boots on the ground to deliver projects.

### Supply chain

- **Transport bottlenecks and disruptions**, road upgrades, rental vehicle availability, out-of-hours transportation movements
- **Lack of raw materials and warehousing facilities**
- **Suitably zoned land** for industry development and investment
- **Capital requirements exclude small businesses** from major projects
- **Attracting OEM to relocate** to the region and use local businesses
- **Lack of skills and expertise** in the region
- **COVID-19 impacts** on materials supply and potentially labour supply
- **Engagement with local contractors** is lacking; local contractors don't always know the requirements including the tender process, contractual obligations; when small businesses are engaging with Tier 1 companies there can be a knowledge gap

### Infrastructure

- **Housing availability in the community** (medium and high density, short and long term) and associated infrastructure (roads, schools, energy, IT, etc)
- Challenges around **supply of construction and other materials**, currently at capacity

### Regulatory, planning, policy

- **Planning and development of community infrastructure** for increased population, council will need more capacity
- **Planning and development for REZ** – process, sustainability, environmental impacts, etc
- **Perceived lack of benefit sharing**, especially social benefits and social licence
- **Distribution network challenges** i.e. rules, slow approvals process with Essential Energy
- **Lack of community engagement** in defining the planning rules
- **Understanding of contractual requirements** for local business to engage in large scale and state significant projects

### Economic development, finance

- **Lack of a skilled workforce** pushing up labour costs, competition between regions
- **Lack of coordination** between different levels of government
- **Contracted commitment to local employment** and use of local suppliers for multiple projects
- **Financial support for business** to diversify into REZ opportunities, also for farmers, tourism, etc.
- **Community is unclear** of the opportunities, potential backlash.
- **Increased costs of housing**
- **Access to energy is becoming an issue** – strategic minerals zone proposal

### Other

- Councils need mechanism to share in benefits of REZ

- Lack of collaboration with councils and community to share local knowledge, social licence lacking
- Climate change and natural hazards
- Transport to/from job locations
- Attractiveness of moving to CWO - housing, health services, amenities etc.

### 3. Actions

#### Skills/labour/training

- **Map all the projects**, timelines, to get idea of the skills shortages and feed into training
- **Determine skills required locally and employ locals** – engage with local businesses, review RDA Orana skills research re roles and "skills" for the future, ensure Government is aware of demand for labour in the region, work with VET sector to provide timeline of skills requirements.
- Work with schools/RTOs/VET/Unis to **develop courses and provide skills** in metals, mining, renewables etc
- Develop partnerships between universities and industries to create internships and cadetships – civil construction, project management, engineers (civil, structural, electrical) – offer to local/regionally based are more likely to stay local
- Development of a **centralised/regionally based opportunities (jobs) board** to assist with skills attraction and engagement
- Include **broader employment opportunities** e.g. retail and tourism to support population growth
- **Targeted marketing** into high unemployment area's to attract key skills with a focus on opportunities, continuation of work and lifestyle in the region
- Industry/EnergyCo build **meaningful relationships with Local Land Councils**, Traditional Custodians to create targeted & culturally appropriate jobs programs for First Nations people
- Other more **tactical solutions** such as a new regional visa for itinerant, semi-skilled labour; transport for workers; relocation assistance; shorter shifts; apprenticeships as part of project commitments.
- Require **local participation and jobs** in planning approval/EIS
- EnergyCo coordination of projects to allow **rolling work crews**
- Research & action into **retention of workforce**
- **Engage with low-skilled labour to move them up and then fill from the bottom** – engaging them and getting them into work – e.g., Wellington LGA – Indigenous community – cultural and historical barriers – programs in Dubbo that could be used.
- **Programs to target Indigenous community** - Good eg's in rail – training to get workers ready for rail access and civil work targeted at the Aboriginal community

#### Supply chain

- Work with Invest Orana/O2N to identify and communicate opportunities and timeframes and deliver capacity building workshops to the business community throughout the region
- Government incentives for diversification of supply chain to support change in industry
- Opportunity for local industry collaboration for larger scale projects

#### Infrastructure

- **Review transport links** and review need for upgrade (road/rail/air)

- **Review current industrial zones** and consider what might be required moving forward.
- **Develop a housing strategy** for short, medium and long term to address the identified need and make it diverse to cater for all types of works and encourage families to live here, not single DIDO type workers
- **Eco-mining village** close to town to be used for tourism afterwards; Engage with developers with respect to longer term housing needs; investigate construction camp for Dubbo or Toongi
- Need **SAPs/precincts** that facilitate **co-location** of manufacturing, clean energy and hi-tech.
- Undertake **key pilot projects** linking new power supply to major local industry
- Start a **regional fund**, establish clear guidelines for developer contributions and include in access provisions.
- Encourage a **battery provider** into the REZ as well as a recycling facility for PV/batteries.

#### **Regulatory, planning, policy**

- **Clear, coordinated planning guidelines** for development in the REZ especially as it relates to the existing planning controls (esp. NSW Wind Environmental Planning and Assessment Act).
- **Review population growth expectations** which can then feed into a review of local infrastructure
- Develop coordinated position on **benefit sharing/social impacts** (VPAs, community benefits, etc.) which is consistent with the REZ and not Council
- **Single biodiversity offsetting** coordinated at the REZ level
- **Local Councils work with developers** to predict & manage job 'booms' plan ahead
- **Regulatory: State to work with local gov** to map an ideal version of the REZ (in space and time)

#### **Economic development, finance**

- **Support development of Orana Opportunity Network (O2N)** and the zero-innovation centre that includes incubation and acceleration services
- **Develop tools** for proponents to assist in breaking contracts down to a size that enable local businesses can participate
- **Pursue sovereign wealth funding** or other green funds
- **Extensive, inclusive and participatory community engagement** together with council to support industrial development and diversification

#### **Other**

- Establishment of a collaborative, empowering community engagement model for the CWO REZ
- Ongoing knowledge sharing of learning and opportunities with local businesses, industry groupings, NGOs, VET, future REZs,
- Exploration of agriculture, tourism, education

## South -West

### 1. Opportunities

#### Mining and material processing

- **Partner with local manufacturers** to process rare earth metal such as nickel, cobalt and scandium to minimise logistics.

#### Manufacturing

- Smaller companies to have **direct access to project developers** rather than having to navigate through Tier 1 companies
- **Opportunities for scientists and engineers to work locally** on solar cell product development and advanced manufacture
- **Sourcing hardware onshore**
- **Green hydrogen** is a key govt priority - placing plants near the green energy production will be important

#### Distribution

- **Utilising inland rail** to get materials to/from the REZs, reverse logistics for circular supply chain
- **Leverage SAPs as distribution hubs**, road and rail link between Melbourne and Brisbane
- **REZs allow for diversity** of regional economies susceptible to drought.

#### Construction

- **Local sourcing** of contractors
- **Adopt waste management/circular economy principles** during construction phase to minimise impact on local landfills
- **Identify full pipeline of renewable projects** to allow local companies to plan and the workforce to properly respond
- **Coordination between projects** to allow local workforce to move from one project to the next

#### Operation & Management

- **Local Employment** and extending the life of asset
- Support organisations through O&M phase to **minimise impact on local waste facilities**
- **Cross -Industry collaboration** i.e. Agri-solar

#### Reuse/ Recycling/ End of Life

- **Impact of REZs on solar circular economy, support of local firms needed.**

#### Other

- **Promotion of upcoming projects** to assist with attraction of workers.
- **Education and upskilling of local workforce** to be able to provide the services
- **More renewable energy on grid supply** to decrease the emissions of PV manufacture
- **Foreign Investment** - Green Hydrogen / Green Ammonia

### 2. Barriers

#### Skills/labour/training

- Housing shortage

- Labour shortage, esp. for highly skilled workers for O&M
- Attracting skilled labour and their families to regional towns
- Availability of long-term work
- **COVID impact** on Foreign Labour - 457 / 482
- **Competition for labour** from other industries
- **Limited local higher education training in renewables**

#### Supply chain

- Maximising efficiency of reverse logistics
- Potential supply chain disruption from Asia

#### Infrastructure

- **Energy storage opportunities; network capacity**

#### Regulatory, planning, policy

- Timeframes for storing of waste/impact of landfill levy
- Certainty around government's RE objectives, plans and support resources available
- Ability to keep updated with regulatory changes and capacity of SMEs to manage

#### Economic development, finance

- Potential to **export energy generated in REZs** through hydrogen or other stored sources.
- **Access to funds** harder compared to other jurisdictions

#### Other

### 3. Actions

#### Skills/labour/training

- **Develop local training courses** and pathways for engineering, procurement, logistics, etc.

#### Supply chain

- Develop efficient solutions to transport product and minimise cost

#### Infrastructure

None listed

#### Regulatory, planning, policy

- Provide feedback to state government on **waste storage policy**
- **Include WM performance KPIs in contracts**
- **Product stewardship or equivalent**
- **Battery trial / incentives** (i.e. Empowering homes)

#### Economic development, finance

- **Better access to Australian super investment** (regional areas only 0.3% of \$2.7billion funds)
- **ESG Funding**

#### Other

- **Local jobs noticeboard** (<https://www.uworkin.com/>)



## **New England**

### **1. Opportunities**

#### **Mining and material processing**

- Quarry supply – for concrete & roads
- Utilising local quarries

#### **Manufacturing**

- Increase local manufacturing component of RE projects

#### **Distribution**

- Opportunities for local distributors, including bus companies
- Freight & logistics, courier services, supply chain – materials and components
- Upgrades to local roads

#### **Construction**

- **Local supplier/contractor engagement using the existing experienced workforce** (civil, electrical, fabrication, plumbing, supply of temporary facilities, inspections, survey, plant hire, surveying, piling, labour hire, first aid supplies, office supplies, courier services, training, accommodation and food services)
- **Local employment opportunities** – skilled/semi-skilled labour, professional employment, consultancy and short-term assignments
- Utilising existing skills available in the area
- **Avoid boom & bust**
- **Develop local skills** well in advance of construction phases to provide career and employment opportunities
- Ensure that **construction companies have local employment quotas**
- **Improve road access for oversize** vehicles/components
- Concrete supply / civil materials
- Offsite road upgrades and development
- Geotechnical investigations
- Mechanical works

#### **Operation & Management**

- **Long term training & employment** opportunities in O&M and local engineers; avoiding fly-in-fly out response
- **Provision of support services and maintenance** such as civil/road maintenance, weed spray, electrical services, landscaping construction facilities
- **Train and retain staff** in the region, engage UNE and TAFE for training provision

#### **Reuse/ Recycling/ End of Life**

- Investment into circular economy waste management processing infrastructure will develop existing recycling facilities in the region (e.g., local council), can assist with end of life disposal/ waste minimisation of solar and wind infrastructure
- Establishment of local solar panel recycling facility?

#### **Other**

- Armidale **works proactively with Indigenous community**, 7% of population. We work with employment agencies and others to positively influence employment opportunities for Indigenous, Ezidi and other ethnic groups. Also strong emphasis on attracting women into the sector at all levels
- **Attract new industries** following the establishment of cheap reliable electricity generating industry
- **Local virtual power networks** and/or virtual power plants
- **The catering** sector may develop
- **An appropriate schedule of work/projects** would allow for increased planning for training opportunities (trainees, apprentices, transitioning skills for the RE sector)
- New **specialised companies** may move into the area e.g., enhancing digital procurement

## Barriers

### Skills/labour/training

- **Uncertainty regarding the timing of projects is an issue**; clarity is needed in order to close the skills gaps before they are needed to be employed
- **Relevant training courses not available** at local education providers; **content needs to be developed** (e.g., TAFE); the sector is currently under resourced; in addition **local training** provision will be essential, especially for Indigenous Australians
- **Continuous learning** from previous projects (including other REZs) should be applied to further projects, however there are barriers in sharing these experience – especially learning from failures
- **There is a lack of experience** in the region, and lack of personnel with relevant qualifications locally because no prior requirement for these qualifications. There have not been previous projects similar to learn from and transfer skill across.
- **Local suppliers / contracts need to be upskilled** in commercial risks and cash flow risks to execute large contracts.
- **Efforts need to be made to improve attractiveness of the regions for highly skilled workers**, e.g. attractions such as NE rail trail, so that these individuals and their skills can be embedded in the region, beyond construction phases

### Supply chain

- **Project plans need to be shared in a timely manner** to allow for supply chains to align with project needs; **industry briefings** are essential
- There is a possible **shortage of suitable housing stock (land supply not an issue)**; **local roads** (including bridges and tight corners) may not be adequate for construction and maintenance phase including firefighting access. **Community services will need additional support** to ensure that projects do not oversubscribe existing local resources.
- **Accommodation** for projects to be built with 'affordable housing' outcomes for lower SES groups, after the project construction phase is finished
- **Government stimulation** needs to move to the REZ regions
- Wind developers are keen to understand and contribute to REZ opportunities.

### Infrastructure

- There are limitations in regional rail network
- In order for the projects to plan appropriately, cumulative effects, residential needs, ecological considerations should be provided (by Councils) to proponents prior to planning/site design/landholder negotiations

### Regulatory, planning, policy

- There needs to be regulatory backing for whole of life material recycling and rehabilitation of sites
- Resourcing for LGAs to assist procurement and community engagement with corporate investors.

#### **Economic development, finance**

- None listed

#### **Other**

- None listed

#### **Actions**

##### **Skills/labour/training**

- **Positive network development initiatives with Indigenous groups**, combined with pre-employment and RE training opportunities should be prioritised
- A regional calendar of operations for different phases of construction/operation, linked with training delivery programs
- **Within the education and training space**,
  - develop University (e.g., University of New England), TAFE and local training suppliers capacity to upskill locals for both direct and indirect (e.g., Doctors) skills, Create / add relevant courses in the necessary domains.
  - When **developing skills within the workforce**, explore opportunities for **skills transfer** (e.g., from mining to renewable resources and establish strategic training plan for Renewables skills development.
  - **Up skill** lower tier contractors on contract / commercial requirements as well as activities such as procurement.

##### **Supply chain**

- Study **quarry supply pipeline** capacity and associated road upgrade needs
- **Work with local suppliers** to promote real opportunities of supplying materials to site, e.g., smaller components may be the bigger opportunities to the local suppliers

##### **Infrastructure**

- Collaboratively work with authorities on approvals for strategic **infrastructure upgrades**
- Explore both **Federal and State investment** into local waste management processing capability for construction and O&M phase to ensure project whole of life and circular economy outcomes
- Prioritise the **development of IT communications connectivity** in proposed development areas.

##### **Regulatory, planning, policy**

- Promote the projects to the community to ensure social license
- Develop application fees that go direct to Councils at minimum cover costs for State Significant Developments
- Outline clear and consistent policies in support of renewable energy; this includes Government backed, whole of life warranties for renewable energy material

##### **Economic development, finance**

- Intercity public transport
- Attract and retain workers to the region and providing support in getting them to relocate to these areas; incentives may include discounted electricity supply for the regions under regional and local PPAs to encourage residency and investment

- Community investment by developers quantified for whole of project (not just % in early stage which is likely to be significantly reduced in O&M phase through restructuring of companies)
- Encourage greater collaboration between Asset Owners and local businesses
- 'Identification of 'shovel ready' sites for investment

## Hunter-Central Coast

### Opportunities

#### Mining and material processing

- **Value-adding to export products** with reduced energy costs inputs and emissions based RE
- **Extract materials for RE technology and process locally** (e.g., minerals associated with existing or energy battery technology)
- **Low or zero emission resources** for export
- **Established workforce** with mining skills and capabilities

#### Manufacturing

- Focus on **net zero emissions** local manufacturing, this will enhance the reliability of materials across the supply chain. The combination of increased scale of renewables and local content proportions to drive supply chain opportunities.
- Additional **energy sources** to provide lower emissions and/or lower cost inputs
- Battery manufacturing/ assembly supply OEMs (original equipment manufacturers)
- There is **strong grid connection** in the Hunter for the import of REZ power for renewable manufacturing
- **CEFC-style provision of capital** to manufacturing to encourage innovation
- **Public investment/support** for pilots to establish hydrogen capacity
- There is the **availability of well-connected industrial land**, close to the port in the region

#### Distribution

- There are opportunities to **import and distribute project components**, and also for export of renewable fuels
- **Supply renewable energy** to local businesses for reduced costs
- Establish **export infrastructure** for energy (e.g. fuels) and assist in the development of **Green EV and Hydrogen** transportation systems

#### Construction

- **Renewable project design services** (both electrical & civil) and keep it local. Do the design in the Hunter - have the courses for engineers available locally. Design zero carbon buildings
- **Aboriginal land development** i.e. work with Crown Lands and Aboriginal groups to develop low-carbon (including renewable energy industry and agriculture etc) economy
- Focus on long term job sustainability, think beyond the construction of infrastructure and assets

#### Operation & Management

- NZE operations
- There are minor opportunities associated with maintenance of wind turbines
- Utilise data analytics, e.g., Smart Cities and Regions

#### Reuse/ Recycling/ End of Life

- **Land remediation** - (in mining) and integration of green/natural infrastructure and resources

- **Integration of circular economy** (Strategy being developed right now by Hunter JO and other agencies) with REZ (and Hydrogen Hub), reuse of PV cells at end of life and the recovery of mineral assets for use in high value manufacturing

#### Other

- **Training programs** to allow regional SME's to participate in tender processes for large scale development and construction opportunities as well as jobs and skills building for communities in transition (coal areas, youth, Aboriginal groups)
- There is an opportunity for the Hunter to be **world leader** - even at a small scale (i.e. built around the REZ and Hydrogen Hub) it can be a "good news transition" example. The Hunter is being FORCED through a transition of some sort ... (we have no choice) ... the opportunity is then what we do with it (how do we react)
- **Employees are local** and sticky (stay with you) people want to stay and work in the Hunter. Region has **residential capability** for this
- Increasing demand for energy; green hydrogen production could be an option

#### Barriers

##### Skills/labour/training

- **Lead times for training** in key skills to match delivery of 'specific projects'; the short time span of construction projects for renewables is difficult to match with **training needs**. This will impact **local procurement**, being able to match projects and the location of skills - e.g. local workers working on local projects. **Providers don't always have the capacity and resources to deliver training**.
- **Engagement programs** to improve workforce pipeline is challenging; this is compounded by the **difficulties in the retention of trained staff** / migrating out of area when no projects are happening
- **Finding champion employers to lead the way with skill gap analysis**. There is currently a lack of clarity regarding what future skillsets and qualifications will be required.
- **There is a lack of knowledge around Circular Economy**
- **Smaller SME's** see investment in training as a relatively high risk activity
- **Poor funding model for apprentices** there is also a poor perception by industry that graduating apprentices are poorly skilled.
- We have well established TAFE and Uni systems here in the Hunter. These can be further adapted to meet future needs. However there is **a slow process in approving new and innovative qualifications**
- The **labour demand locked** in to currently flourishing but risk prone sectors such as thermal exports. There is currently skilled migration restrictions due to the pandemic

##### Supply chain

- **Un-diversified port** - it is constrained by imposed tariff (currently in court being challenged)
- **Limited capacity for manufacturing** or others to engage with RE project developers
- **Absence of industry led consortium/ association** to handle supply chain issues

##### Infrastructure

- Lack of renewable energy generation projects
- Non-suitability of the region for RE projects like solar and wind
- Easy to find 'maps' of where the electrical grid is, and how strong it is; Newcastle and the Hunter is well connected to the grid, for import/export of renewable electricity

##### Regulatory, planning, policy

- **Loss of first mover advantage** - no state H2 strategy yet.

- **Transparency and consistency of policy and support** / direction (from federal and state governments); current planning process a barrier in and of itself. This is compounded by **short term thinking** and policy position by governments past have made business nervous with regard to investment

### **Economic development, finance**

- Lack of clarity regarding the **local benefits retained** in the community
- **Lack of clarity regarding investment** (e.g., are projects self-sustainable without government support? in a distributed energy system - how are costs of the grid maintained?)
- Lacking scale in new sectors
- Capital and investment shifting away from regional industries (ESG drivers etc not bringing it back in for diversified investment). Currently we are outcompeted by other states/regions/overseas regions in investment attraction; the competitive advantages less clear-cut in new sectors than current/past basic sectors. The scale of individual investment opportunities are small. These need to be aggregated to attract capital inflows

### **Other**

- **Land use competition**; Land availability for 30 yrs projects. Unclear availability of, and barriers to acquiring access to industrial land
- **More information and clarity** regarding the REZ is needed, particularly related **to timing and phasing**. In other REZ an EOI has gone out and orgs can register ideas. When will EOI round be in the Hunter, and when will it become public?
- Early adopters of industrial PV was a poor experience, we don't want that to be replicated.

### **Actions**

#### **Skills/labour/training**

- Establish a **regional plan that identifies priority skills**; undertake a skills mapping (what are the current transferable skills from our engine industries that feed into this workforce). Develop skill sets to roll out 2022 that may include micro-credentials (Be careful around micro-credentials - could end up with RTO issues all over again). Consult with Training Services NSW about funding opportunities and consult with providers who can deliver training
- **Supply more resources for TAFEs** to speed up approvals of new qualifications; additional resources to TAFE/VET to increase ability to work with industry
- Review the **apprentice funding model** for smaller SME's Funding needs to be front ended

#### **Supply chain**

- Describe what the opportunities are for local companies
- Regarding the Port of Newcastle - how do we make more use of this asset?

#### **Infrastructure**

- allow/support diversification of port (allow market to grow if/as able)

#### **Regulatory, planning, policy**

- Government to regulate circular economy principals to increase take up
- Remove restrictions on container movement in Port of Newcastle

### **Economic development, finance**

- **Identify what the community wants** and ensure community knows what is happening - are they aware and can they prepare
- Confirm commitment from **NSW government to financially support a large Hydrogen project** in the Hunter Region
- Need to find better ways for the Hunter to **compete for funding**

#### Other

- Regional "**salespeople**" for **prospective industry developers** (i.e. investor information /concierge service able to broker and "sell" the opportunities)
- **Increased specificity of projects, transparency regarding timings.**
- Develop **grants and incentives** to make projects more viable and attractive to communities
- **Develop stronger networks**, meetings with industry and educational sector need to be encouraged

## Illawarra

### Opportunities

#### Mining and material processing

- Locally manufactured clean steel can be used to build wind turbines (e.g., Bluescope Steel Long term plan to be manufacturing Hydrogen or Green Steel by 2050)

#### Manufacturing

- **Development and training at TAFE** or other imperative to the needs of the unfolding industries, a whole rethink of the education packages that are required to supplement the technologies
- **Hydrogen technology** and the supposed interest of H2X vehicle manufacturing, any progress in both the commitment to manufacture vehicles and or Hydrogen Hydrolyzers
- **Access to low/no emissions energy** has the potential to provide a strategic advantage for local manufacturing with growing need for 'green' supply chains

#### Distribution

- **Port will allow both export and import** of materials that support renewables locally and globally.
- Currently the region has good **connectivity** to state and national **highway and rail networks**. Existing heavy road and rail transport industry can be transitioned to hydrogen fuel, creating demand for **clean hydrogen production**

#### Construction

- **Large scale renewable energy projects** will be needed to support the hydrogen hub this can bring jobs to the region (e.g., offshore wind, hydro, bioenergy and medium scale solar, construction of hydrogen electrolyzers and hydrogen fuelling stations for vehicles is a real opportunity). New community battery hubs for all sectors. The take up of small scale solar on homes and businesses to fuel clean hydrogen production
- Hydrogen hub and REZ will require **improvements in energy distribution** infrastructure providing jobs during construction

#### Operation & Management

- Large scale renewables projects will provide **ongoing jobs for operation and maintenance**
- Hydrogen hub and REZ will require **improvements in energy distribution infrastructure** providing ongoing jobs in operation and maintenance



## Reuse/ Recycling/ End of Life

- Develop a recycling industry for solar PV panels
- Biomass and energy production from sewage are an opportunity

## Other

- Potential synergies with co-located industries, businesses - circular economy concept
- Benefits of being on the coast - access to high winds, water, offshore wind etc
- New Low Carbon Industry and precincts program and associated funding for a roadmap is an opportunity to bring these opportunities together
- The region is exposed to the transition risk associated with a global shift to net zero. The region will build its resilience to these risks through embracing the transition to net zero.
- Opportunities for skills, jobs growth development in new processes/industries - needs to be supported by right skills training
- Collaboration between government and industry to reduce energy demands
- Three Ports SEPP allows for an increased amount of exempt / complying development at PK removing some regulatory barriers

## Barriers

### Skills/labour/training

- Above all **funding for TAFE** to adapt training courses to the clean energy future needs; the lack of TAFE funding means that the renewable electives aren't being taught due to lack of resources and materials. In addition, there is a lack of "buy-in" from TAFE/training providers to help to **develop the new training packages** that are needed. This is probably also due to lack of funding. As we encourage investment in our region in regards to renewables, unless the training packages aligned to those industries are readily available, there may be reluctance for the industry to transition.

### Supply chain

- **Market for 'Green' supply chains** is not yet sufficient to drive the shift to low emissions across the supply chain

### Infrastructure

- H2 britalisation will limit the amount of **hydrogen** that can be added to gas supply network
- Demands will be placed on infrastructure as a result of **increasing scale of projects** i.e. 100m wind blades etc

### Regulatory, planning, policy

- Instead of investing in local jobs, government often wants the **cheapest option**
- Currently these initiatives are uncoordinated this **challenges investment**; potential for duplication but also gaps
- **Existing land use rules** and regulations were not written with new technology in mind. Major review is needed.
- **Land use conflict**. There is increasing residential encroachment / densification in close proximity to potential Hydrogen / Gas facilities i.e. PK.
- Current Federal policy environment is **hindering investment in renewables**

### Economic development, finance

- **Conflict** between energy retailers/network providers and renewables in the grid

- Need **faster processes** for government funding approval and more agility. NSW Government slow and missing opportunities, leading to other states getting the upper hand.

## Actions

### Skills/labour/training

- **TAFE funding needs significant boost and short and long term planning** for capital and labour investment. Government can assist by ensuring TAFE management are participating in local stakeholder coordinating bodies. Partnerships (training packages) between industry and TAFE, supported by adequate funding. Identify how industry can support skills development and training. Guaranteed TAFE funding including a project to create new packages to deliver renewable courses

### Supply chain

- **Heavy rail use of hydrogen** on a hybrid basis (hydrogen injection into diesel engines) would kick start demand within the transport industry
- Government contract need to preference **local products** over cheaper overseas options; ensure an **integrated vision** of renewable energy future with local manufacturing capacity needs to be adopted and a long term funding/regulatory commitments by Government to support these.

### Infrastructure

- A **large scale off shore wind project** would act to kick start considerable action in other areas such as manufacturing, TAFE upskilling, regulation changes and above all economic development

### Regulatory, planning, policy

- Remove restrictions on container movement in Port of Newcastle
- Consistency between and within state government departments. Ensure strategic alignment across siloed government departments. Coordination and implementation of a regional roadmap that brings together all the programs, opportunities and stakeholders and identifies the opportunities and investment required to deliver it
- Planning decisions need to account for the potential of a site in its zoning to contribute rather than the fact it may currently be vacant (i.e. PK Copper site)
- Provide official commitment to invest in local jobs and manufacturing

### Economic development, finance

- Establish a **proof at scale showcase** for clean energy technology and new energy market models within the Illawarra (e.g., Bluescope Steel took some initiative to invest 20 million into renewable technologies in the Illawarra, 10 Mil into itself and its processes, and 10 million into attracting other businesses to the Illawarra).
- **Local and state governments** should also, if not already be introducing some sort of **incentive. Collaboration** between local and state governments to fund projects of regional significance (not just infrastructure but also staff resources).
- Submit an EOI for funding to support development and delivery of a low carbon precinct roadmap for the Illawarra

### Other

- Prioritise private and public sector involvement

## Synthesis

Across the REZs there were some similar opportunities, barriers and actions. Each region saw that the REZ may be a great opportunity for the region to grow, develop a skilled workforce and increase infrastructure and support. However, these activities require coordination within and across the region/s, to ensure that existing short, medium and long term projects can leverage and positively link into the REZ. Key findings in terms of barriers, opportunities and opportunities across the REZs can be found in Table 18,

Table 19 and Table 20 below.

A number of the REZs reported to currently be at capacity with existing projects pushing current services (e.g., schools, hospitals, housing, and transport) to their limit. Any additional workforce moving to the region may negatively impact current residents. Every effort will need to be made to ensure that regional development is undertaken in an inclusive manner.

Many of the REZs noted that there is a significant opportunity to increase manufacturing in their region, as well as connecting green manufacturing into circular economy principals. This includes considerations from cradle to cradle, along the supply chain to include impacts from minerals and mining, to end of life recycle and reuse (e.g., local recycling of solar panels etc).

Barriers across the REZs included a high demand for additional infrastructure, including affordable housing and associated community services to accommodate a growing population, a lack of coordination and transparency regarding alignment of projects (including REZ phasing), and community needs. This was apparent when it came to the development of training materials that may be provided by RTOs and TAFE locally. Local training was the preferred approach, however the educational sector (inc TAFE) is currently highly under-resourced across the state. Increased funding and collaboration between government, industry and the educational sector will be required to overcome this challenge. Land use conflict was noted in a number of regions, which included issues regarding urban sprawl, rezoning of industrial land, current pressures on agricultural land as well as the need to balance carbon and biodiversity offsetting and protections.

A number of actions were identified across the regions including the development of strong networks and collaborative relationships between government, industry, training and education. This is required across the supply chain of skills/labour/training, supply chain, infrastructure, regulatory planning policy, economic development, finance. In order to ensure that jobs remained local, it was noted that businesses may require additional training to be able to respond appropriately to local procurement opportunities.

Investment in infrastructure was noted as a requirement across the REZs including affordable housing, road, rail and airport upgrades as well as increased investment to support a growing community base (e.g., hospitals, nurses, schools, childcare, etc).

Participants noted that there would need to be a phased delivery of work to insure not only the infrastructure investment was available to the influx of new residents, but also ensure that the existing local markets were not forced into reactionary changes (e.g., boom & bust, property market fluctuations etc).

A greater focus on community engagement was recommended to ensure that the public are aware of the changes occurring within their region, the co-benefits of the development and ensure that social licence is developed prior to the project commencing.

Table 18: Cross-cutting Opportunities across 5 Renewable Energy Zones (REZ)

OPPORTUNITIES					
CROSS CUTTING \ REZ	Central-West Orana	New England	South-West	Hunter	Illawarra
Mining and material processing					
- Local training & employment		X		X	X
- Local mining rare earths	X	X (concrete)	X	X	X (steel)
Manufacturing					
- Local manufacturing of renewable energy materials (e.g., panels, batteries & components)	X	X	X		
- Development of appropriate training resources for emerging industries through TAFE, university and industry partners	X	X		X	X
Distribution					
- Utilizing regional airports	X				
- Existing port infrastructure				X	X
- Existing heavy road infrastructure		X			X
- Existing rail infrastructure			X		X
- Alternate fuel infrastructure (e.g., electric vehicles, hydrogen)				X	X
Construction					
- Community battery stations					X
- Construction of hydrogen electrolyzers and hydrogen fuelling stations					X
- Local supplier/contractor engagement to ensure local procurement (inc. civil, electrical, fabrication, plumbing, temporary facilities, inspections, surveys, first aid supplies, office supplies, courier services, training)	X	X	X		
- Collaborate with local training providers and local industries to identify transferable skills	X		X		
Operation & Management					
- Long-term ongoing jobs in the region		X		X	X
Reuse/ Recycling/ End of Life					
- Solar / Wind/ Battery recycling opportunity	X	X		X	X
- Land remediation (ex mining)				X	
- Biomass opportunity					X
Other					
- Circular Economy principles embedded in supply chain		X	X	X	X
- Existing skilled workforce				X	X
- Existing housing availability in region	-			X	

OPPORTUNITIES					
CROSS CUTTING \ REZ	Central-West Orana	New England	South-West	Hunter	Illawarra
- Jobs and skills building for communities in transition (focus on youth and Indigenous communities)		X		X	
- Potential to export energy generated in REZs through hydrogen and other stored sources			X		

Table 19: Cross-cutting Barriers across 5 Renewable Energy Zones (REZ)

BARRIERS					
CROSS CUTTING \ REZ	Central-West Orana	New England	South-West	Hunter	Illawarra
Skills/labour/training					
- Lack of staff due to competitive market	X		X	X	
- Lack of migration (short term COVID-19)	X		X	X	
- Under-resourced educational sector (e.g., TAFE)				X	X
- Currently don't have sufficient workforce in the region	X	X			X
- Lack of transferrable skills (linked to lack of transparency regarding timing for transitioning a workforce)		X		X	X
- Barriers to retrain skilled staff within SMEs	X		X		
- Difficulty engaging unemployed cohort and reluctance to undertake training to upskill	X				
- Lack of transparency regarding timing of projects to plain training/ up-skilling / skills transfer appropriately.				X	
- Limited higher education training in renewables			X		
Supply chain					
- Transport disruption (inc road upgrades, rental vehicle availability, lack of public transport etc)	X				
- Un(der)developed market for shift to "Green" supply chains				X	X
- Potential supply chain disruption from Asia			X		
- Under-diversified Port (restrictions on container movements)				X	
Infrastructure					

BARRIERS					
CROSS CUTTING \ REZ	Central-West Orana	New England	South-West	Hunter	Illawarra
- Insufficient infrastructure to support scale of projects (e.g., roads, housing, services)	X	X	X	X	X
- Barriers accessing building supplies	X				
Regulatory, planning, policy					
- Land use conflict	X			X	X
- Lack of transparency (e.g., timings) to be able to implement training (etc) that these large projects require				X	X
- Lack of community engagement including lack of social licence, uncertainty regarding regional benefits	X			X	
- Negative impacts on the environment	X			X	X
- Focus on cheapest option rather than local jobs					X
Economic development, finance, etc.					
- Lack of coordination between government departments	X				
- Difficulties accessing funds / being competitive			X	X	
Other					
- Limited expertise in Circular Economy principles				X	X
- Climate change impacts and natural hazards	X				
- Attractiveness to move to regional area	X				

Table 20: Cross-cutting Actions across 5 Renewable Energy Zones (REZ)

ACTIONS					
CROSS CUTTING \ REZ	Central-West Orana	New England	South-West	Hunter	Illawarra
<b>Skills/labour/training</b>					
- Develop Partnerships and networks between industry and TAFE, supported by adequate funding, to develop appropriate training packages / micro-credentials		X	X	X	X
- Develop early intervention regarding skills development to target new training				X	
- Develop network with Indigenous groups, combined with pre-		X			

ACTIONS					
CROSS CUTTING \ REZ	Central-West Orana	New England	South-West	Hunter	Illawarra
employment and RE training opportunities					
- Develop opportunities for skills transfer (eg mining to renewables)		X		X	
- Determine skills required locally and employ locally	X				
- Research and intervene to encourage workforce retention	X				
- Funding: Consult with Training Services NSW about funding opportunities / review apprentice funding model for smaller SME's				X	
Supply chain					
- Work with local groups (e.g., Invest Orana/O2N others) to identify and communicate opportunities and timeframes	X			X	X
- Heavy rail use of hydrogen could kick-start the transport systems transition					X
Infrastructure					
- Increase transport infrastructure (road, rail and air)	X	X		X	X
- Increase (affordable) housing availability and supporting community services (e.g. doctors, schools etc.) to support a growing local workforce	X	X		X	X
- Review current industrial zones	X				
- Develop a housing strategy to address needs					
Regulatory, planning, policy					
- Develop government backed whole of life warranties for renewable energy materials					
- Remove restrictions on Port of Newcastle regarding container movement				X	X
- Single biodiversity offsetting coordinated at the REZ level	X				
- Develop coordinated position on benefit of sharing social impacts at the REZ level	X				
- Greater coordination between State government, Local Council and industry for greater coordination and leveraging maximum benefits; to manage job “booms” etc	X				X
- Product stewardship – circular economy principles embedded			X		

ACTIONS					
CROSS CUTTING \ REZ	Central-West Orana	New England	South-West	Hunter	Illawarra
Economic development, finance, etc.					
- Undertake community assessment to ensure community needs are met and social license is achieved	X			X	
- Intercity public transport		X			
- 'Identification of 'shovel ready' sites for investment		X			
- Encourage regional development, attracting workforce who will live and thrive in the region on a permanent basis		X			
- Pursue sovereign wealth funding / green funds / superfunds / public and private investment	X		X		X
Other					
- Increased collaboration across government, industry, educational sector, and community to ensure transparency, transition and social licence	X			X	X
- Employ regional spokespersons to for prospective industry developers (ie a investor information /concierge service able to broker and "sell" the opportunities)				X	
- Increase the specificity of projects in each REZ and provide greater transparency regarding timings.				X	
- Develop stronger networks between government, industry and education				X	



---

## Appendix 3: Survey results

Please see PowerPoint supplied separately.

## Appendix 4: Full Opportunity Evaluations

### Wind Tower Manufacturing

- There was significant interest in the opportunity to develop wind tower manufacturing through the REZ build-out across a range of stakeholders interviewed for the project.
- There are currently two wind tower manufacturers in Australia - Keppel Prince, Victoria is the largest facility and there is a smaller facility in Tasmania.
- NSW has steel manufacturing facilities with the capacity to make the rolled plate for on-shore wind towers but investment would be required in a new facility to develop wind tower manufacturing capacity in NSW.
- A significant portion of the build-out of the REZs would need to be supplied through the new facility to make it viable. It was reported the minimum viable scale for a new facility is approximately 250MW p.a. and the optimal scale around 500MW p.a. If half of the 12GW of new generation for the REZs is wind energy and the build-out occurs over 10 years, that is 600 MW p.a. In other words, close to half the new wind towers would need to be supplied locally.
- New investment would be needed for manufacturing capacity to make the steel plates for offshore wind towers which are thicker to withstand the ocean environment. A wind tower manufacturing facility could however be designed to ensure it could manufacture offshore wind towers in the future. There could also be opportunities to manufacture pipes for pumped hydro energy storage.

VIABILITY FOR NSW		WIND TOWER MANUFACTURING
Criteria	Rating	Notes
How significant are the advantages of local supply and proximity?	High	<ul style="list-style-type: none"> <li>• Local supply is quicker to market than imported towers.</li> <li>• Local capacity would reduce supply chain risk, especially in the context of China's pre-eminent position in wind tower manufacturing.</li> </ul>
Are there local sources of comparative advantage or resources?	High	<ul style="list-style-type: none"> <li>• Local steel manufacturing capability</li> <li>• Co-located production with steel reduces transport costs by around 20% (around \$200/tonne) and reduces product damage. Steel was estimated to be around 50% of the cost of the tower. Keppell Prince stated wind towers would be cheaper to produce in NSW than Victoria.</li> <li>• Stakeholders estimates on the overall cost premium for local towers ranged between 15/20-50%</li> </ul>
Can the industry and workforce be scaled to realise the opportunity?	Medium	<ul style="list-style-type: none"> <li>• No major barriers were identified with the local industry or workforce. A manufacturer interviewed by MBB stated: "We know at least four fabricators that have said if they have the funding or investment, they would be able to start production on wind towers as soon as possible." A new facility could be established within 12 months.</li> <li>• Skills required are welding, plate rolling, blasting, painting, non-destructive testing. Wider shortages have been identified in some related trades such as welding.</li> <li>• Keppel Prince train workers from a variety of backgrounds through a mix of TAFE and accredited on-the-job training (a certificate 3 level course in painting and blasting).</li> <li>• Wind towers are highly steel-intensive, requiring around 120 tonnes of steel per MW. Consequently, if half of the 12GW of new generation for the REZs is wind energy, that equates to around 720,000 tonnes of steel. For context, Australia produces around 5.6 million tonnes of steel per annum.</li> <li>• Multiple sources referred to the constraints that occurred in Victoria because Keppel Prince was the only local tower supplier that could be sourced from to meet local content requirements, highlighting the importance of avoiding production booms driven by the REZs if local supply is to be achieved.</li> </ul>

VIABILITY FOR NSW		WIND TOWER MANUFACTURING
Criteria	Rating	Notes
Is the scale of local market volume sufficient to support new investment?	Green	<ul style="list-style-type: none"> <li>The minimum viable scale was reported to be approximately 250MW p.a. and the optimal scale around 500MW p.a.</li> <li>If half of the 12GW of new generation for the REZs is wind energy and the build-out occurs over 10 years, that is 600 MW p.a.</li> <li>There may be opportunities to supply turbines into other states (Victoria, Queensland)</li> <li>Stakeholders also noted there was transferability of manufacturing capacity to hydro pipes</li> </ul>
Are there market entry barriers to realise the opportunity?	Orange	<ul style="list-style-type: none"> <li>Global Original Equipment Manufacturers have existing supply chains which are generally preferred</li> <li>Local producers must comply with OEM quality standards</li> <li>\$20m - \$50m to establish a new facility. Uncertainty of production and market volumes would need to be addressed.</li> </ul>

Note: Green = positive rating for viability in NSW; Orange = a mix of positive and negative factors but still could be viable; Red = significant barriers to viability in NSW.

VALUE OF OPPORTUNITY		WIND TOWER MANUFACTURING
Criteria	Rating	Notes
What is the scale of the opportunity (employment, revenue)?	Orange	<ul style="list-style-type: none"> <li>A minimum scale wind tower factory was reported as employing 175-200 workers. This estimate is consistent with previous ISF analysis. It does not include supply chain jobs in steel manufacturing.</li> </ul>
Is it likely to be a sustainable, longer-term source of employment?	Green	<ul style="list-style-type: none"> <li>There is a 10-15 year build out of wind farms within the NSW REZs. Under 'energy superpower' scenarios in which there are multiples of the existing generation fleet required to supply power for opportunities such as green steel, there would be significant on-going demand for wind towers. There may be opportunities to supply towers to neighbouring states.</li> <li>There is a medium-term opportunity for offshore wind towers and potentially pumped hydro pipes through the same facility.</li> </ul>
How many jobs will be net to existing jobs in the region?	Green	<ul style="list-style-type: none"> <li>As the jobs are semi-skilled which enables labour to be sourced from a wide range of backgrounds through on-the-job training, there is a good prospect for jobs to be net to existing jobs in the region through increased labour force participation</li> </ul>
What are the multiplier effects for other industries in the region?	Green	<ul style="list-style-type: none"> <li>As a steel-intensive product, there would be significant employment in steel manufacturing and supply chain. Detailed modelling is beyond the scope of this project. Based on modelling commissioned and provided by Bluescope, 3000MW of wind towers would lead to just under 2000 direct jobs and just under 1000 indirect jobs in steel manufacturing and associated industries.</li> </ul>
What is the potential to reduce unemployment over the longer-term?	Green	<ul style="list-style-type: none"> <li>Mostly semi-skilled jobs (with some specialised trades) that could reduce unemployment.</li> </ul>

OPPORTUNITY COST		WIND TOWER MANUFACTURING
Criteria	Rating	Notes
What is the impact on RE project costs?		<ul style="list-style-type: none"> <li>Stakeholders estimates on the overall cost premium for local towers ranged between 20-50%</li> <li>Wind towers account for approximately 10% of the project cost of an onshore wind farm.</li> <li>If half of the wind towers for the REZ build-out were manufactured locally, that would add approximately 1 – 2.5% to project costs.</li> </ul>
What level of investment is required to facilitate the opportunity?		<ul style="list-style-type: none"> <li>No major infrastructure requirements were identified through stakeholders, although this would be dependent on location. There were some different views about the optimal location of a facility. Co-location with steel manufacturing facilities were considered to have production efficiencies. Some stakeholders consider there would be some cost and logistic advantages to locating a facility in a regional setting such as in the South-West REZ if it were to also service pumped hydro pipes, as well as opportunities for the scaling of employment opportunities in regional centres.</li> </ul>
What is the cost to government?		<ul style="list-style-type: none"> <li>The primary action from Government to facilitate this opportunity relates to local procurement rules.</li> <li>However, in view of the certainty required to facilitate investment in a new facility, there could be some additional support required to facilitate investment.</li> <li>Bluescope has committed to providing space near production facilities for manufacturing linked to steel production.</li> </ul>

### Transmission Tower Manufacturing

- Transmission towers have been imported to date, in particular from China which has purpose-built fabrication plants.
- However, the large-scale build-out of new transmission capacity creates the potential for local manufacturing. A factory is being established in South Australia to integrate fabrication and galvanisation of transmission towers co-located with a steel mill by Ferretti International. This evaluation draws on interviews conducted for this project but also an interview conducted for a previous project for Infrastructure Australia with Ferretti International.

VIABILITY FOR NSW		TRANSMISSION TOWER MANUFACTURING
Criteria	Rating	Notes
How significant are the advantages of local supply and proximity?		<ul style="list-style-type: none"> <li>There are significant local advantages from proximity such as reduced transportation costs and the capacity to provide local assembly offsite – but even with those factors it was estimated by industry sources that there is a cost differential of around 20-25% against imported content.</li> </ul>
Are there local sources of comparative advantage or resources?		<ul style="list-style-type: none"> <li>NSW facilities with capacity for transmission tower steel fabrication. ASI has more than 85 steel fabrication members in NSW, of which 12 have indicated as part of their member profile that they have the capability to manufacture transmission towers or tower capability.</li> <li>The key factor to improving cost competitiveness of local transmission tower manufacturing is a modern, automated facility which integrates fabrication/processing and galvanisation to remove additional handling and transport cost. Ferretti International, which is establishing a facility in South Australia, states that a feasibility study found that with an automated factory the cost reduced from \$2800/t to \$2200/t which was comparable to the imported price (2019 prices).</li> </ul>

VIABILITY FOR NSW		TRANSMISSION TOWER MANUFACTURING
Criteria	Rating	Notes
Can the industry and workforce be scaled to realise the opportunity?	Green	<ul style="list-style-type: none"> <li>Bluescope production facility can manufacture steel for a monopole design but not a lattice tower design. Tower design varies depending on site conditions but lattice is the dominant tower type. Liberty Primary Steel/Infrabuild Steel have capacity for lattice tower designs.</li> <li>No capacity or workforce capacity issues were identified in stakeholder interviews. The skillsets used in the factory being established by Ferretti International include logistics and handling, chemical controls, electronic and mechanical maintenance.</li> <li>Once the Ferretti International facility scales up to a 3-shift operation, a throughput of 36,000 tonnes of steel is projected. To manage fluctuations in demand from transmission construction projects, Ferretti is planning on doing 2-shifts at lower production times and supplementing with other fabrication business.</li> </ul>
Is the scale of local market volume sufficient to support new investment?	Yellow	<ul style="list-style-type: none"> <li>Ferretti International estimates 158,000 tonnes of steel throughput will be required under the ISP over the next decade. [Melita to add ISF estimate]. Detailed feasibility assessment would be required to confirm market volume is sufficient for a second factory in NSW.</li> </ul>
Are there market entry barriers to realise the opportunity?	Yellow	<ul style="list-style-type: none"> <li>Established supply chains can represent a barrier to local suppliers. The steel industry reports dumping and narrowly written tender specifications to create the perception that local content is not viable as concerns.</li> </ul>

VALUE OF OPPORTUNITY		OPPORTUNITY NAME
Criteria	Rating	Notes
What is the scale of the opportunity (employment, revenue)?	Yellow	<ul style="list-style-type: none"> <li>Direct employment in an automated transmission tower manufacturing facility is around 80 according to Ferretti International with a further 20 jobs in transport and logistics. There would be additional employment with the steel manufacturing.</li> </ul>
Is it likely to be a sustainable, longer-term source of employment?	Green	<ul style="list-style-type: none"> <li>Transmission tower construction will occur over the next 15 years at least. Other fabrication activities can be undertaken in same facility. There will also be an ongoing requirement for distribution towers.</li> </ul>
How many jobs will be net to existing jobs in the region?	Yellow	<ul style="list-style-type: none"> <li>There is evidence of transmission construction engaging the unemployed and therefore some of the jobs are net to existing jobs.</li> <li>As transmission construction moves depending on the location of lines, the workforce is generally mobile and not confined within a single region.</li> </ul>
Are there likely to be multiplier effects for other industries in the region?	Yellow	<ul style="list-style-type: none"> <li>Detailed modelling is beyond the scope of this project. Based on modelling commissioned by Bluescope, the volume of steel processed could create around 300 direct jobs in steel manufacturing in addition to the employment associated with the transmission tower factory.</li> </ul>
What is the potential to reduce unemployment over the longer-term?	Green	<ul style="list-style-type: none"> <li>Transmission construction can create opportunities for the unemployed through entry-level construction jobs. With on-going training, these workers can develop trades.</li> </ul>

OPPORTUNITY COST		OPPORTUNITY NAME
Criteria	Rating	Notes
What is the impact on RE project costs?	Yellow	<ul style="list-style-type: none"> <li>Ferretti International says with the operation of a purpose-built facility transmission towers will be cost-competitive with imported towers.</li> </ul>

OPPORTUNITY COST		OPPORTUNITY NAME
Criteria	Rating	Notes
What level of investment is required to facilitate the opportunity?		<ul style="list-style-type: none"> <li>No additional infrastructure investment requirements were identified for the NSW Government. However, it was noted by one proponent with a long-term project with a workforce relocating to the region that housing availability was proving difficult.</li> </ul>
What is the cost to government?		<ul style="list-style-type: none"> <li>Ferretti International stated a \$60m capital upgrade was required for the establishment of the new factory. A Federal grant was provided and a State loan is in process of being applied for. This will cover almost 50% of funding needed. The balance of the funding will be from commercial financing tools.</li> </ul>

## Wind farm manufacturing (non-tower)

There were some other manufacturing opportunities raised in the course of stakeholder engagement. There is some additional information below than the opportunity evaluation in the body of the report but a more detailed evaluation was not undertaken for these opportunities. Typically, the information provided was at a higher level by stakeholders because they are considered less viable and were not therefore a major focus.

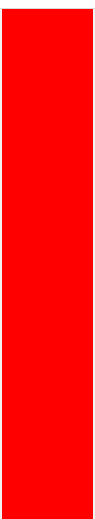

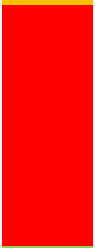


The other manufacturing opportunities discussed by stakeholders were:

- **Wind blade manufacturing:** blade manufacturing accounts for 20 per cent of the capex and 15 per cent of the total project cost so it is a high-value opportunity. However, Australia does not have any blade manufacturing facilities. Establishing a facility would require a scale beyond NSW and high levels of investment certainty.
- **Wind assembly manufacturing:** nacelle componentry manufacturing is highly unlikely to occur within Australia but there could be assembly manufacturing which occurred under VRET with less capacity over a shorter timeframe. Around 34 per cent of the capex is in nacelle manufacturing and around one-quarter of the project cost. Based on NREL (2019) analysis in the US, around 2/3 of the value in nacelle manufacturing is in various assembly functions – nacelle structural assembly (5%), drivetrain assembly (9%), nacelle electrical assembly (8%), yaw assembly (2%).
- **Reinforced steel and concrete foundations, anchor cages:** the Australian Steel Institute notes there are some imported product but considers the local product to be cost competitive.
- **Wind technology maintenance:** in the survey undertaken for the Clean Energy Council (Briggs et. al. 2020), a NSW gearbox manufacturer was identified that was undertaking maintenance on wind turbine gearboxes. The business noted that the volume of activity was growing strongly and therefore renewable energy industry stakeholders were engaged on other opportunities.

There are some other manufacturing opportunities identified:

- **low-voltage cables** were considered a potential opportunity (MBB).
- **Transport equipment manufacturing:** in the survey undertaken for the Clean Energy Council (Briggs et. al. 2020), one of the major wind transport companies undertook specialised equipment manufacturing associated with transportation of wind turbines

In general, there are significant barriers to the expansion of manufacturing in most of these areas but there could be opportunities for local industry development with concerted industry engagement, procurement incentives and other forms of government support.

<b>Viability for NSW</b>		<ul style="list-style-type: none"> <li>• For <b>wind blades</b>, there are variations in design between different types of blades. This is a major barrier to the scale required for local manufacturing (although there was one known international firm that manufactures multiple blades identified).</li> <li>• VRET includes NSW as 'local'. Stakeholder engagement raised the potential for market engagement by the NSW and Victorian Governments on the basis that if demand for both markets were serviced by a facility on the border this could stimulate industry interest.</li> <li>• One of the recommended actions for the RESB to consider is for the NSW Government to investigate collaboration with other state governments. Blade manufacturing is one of a number of opportunities which could be pursued through inter-state collaboration, but overall it must be considered a low probability.</li> </ul>
		<ul style="list-style-type: none"> <li>• For <b>nacelle manufacturing</b>, firms are often co-located with fine divisions of labour for different componentry. Nacelle componentry manufacturing is unlikely to be viable for Australia.</li> <li>• However, local assembly could be viable. Drive train and hub assembly occurred under VRET for example. Multiple stakeholders identified assembly as a potential opportunity for NSW as there are advantages to local assembly to reduce transport costs and supply chain risk. It was noted this was most likely to occur if it was co-located with ports and existing manufacturing capability. However, a more detailed study might find locational advantages to local assembly, especially if there are for example transport infrastructure bottlenecks.</li> </ul>
		<ul style="list-style-type: none"> <li>• For <b>maintenance</b>, there is growing onshore manufacturing identified for gearbox repair but the industry reports that major components are serviced in a central global repair centre offshore with specialised expertise and equipment that requires scale to be cost-effective. Consequently, some local growth in repairs and maintenance can be expected but will be limited due to the scale and specialisation required for most repairs.</li> </ul>
<b>Value of Opportunity</b>		<ul style="list-style-type: none"> <li>• There is significant value in these other manufacturing opportunities.</li> <li>• Even securing an assembly function such as drive-train assembly would notably increase local content and value capture.</li> </ul>
<b>Cost of Opportunity</b>		<ul style="list-style-type: none"> <li>• Procurement criteria could assist in creating incentives for local manufacturing but are likely to be a necessary but not sufficient condition as there are established supply chains most of these opportunities likely to require significant engagement and additional facilitation and support.</li> <li>• The most prospective is clearly nacelle and hub assembly which could occur with the right mix of procurement incentives, engagement and facilitation.</li> <li>• Collaboration between projects could be encouraged within tender criteria. Additional forms of support may be required</li> </ul>

## Battery Energy Storage (BESS) Supply-Chain

The Future Battery Industries CRC recently released a major study (the 'CRC report') into the opportunities for developing a diversified supply chain for battery storage technologies in Australia (Future Battery Industries CRC, 2021). As it was a comprehensive report dedicated to the opportunity to develop a local battery supply chain, this opportunity evaluations draws heavily from the CRC study, along with information from stakeholder interviews and supply chain analysis undertaken during this project form the basis of this opportunity evaluation.

The CRC estimates there is a \$7.4bn market opportunity and 34,000 jobs for Australia from the development of an integrated battery supply chain.

- **Australia has sources of competitive advantage in mineral resources:** Australia is the only nation with all the local mineral deposits which is a significant cost advantage and higher political stability than most of the other nations with relevant mineral deposits. From this foundation Australia can develop materials refining and active minerals manufacturing capacity.
- **Australia has one of the largest domestic markets:** Australia is ranked fifth in the world by market size for Energy Storage Systems with demand forecast to reach 40-52GWh by 2030, the third largest market globally. Market scale can support local supply chain development. Rapid global market development also creates opportunities for export and scaling up.
- **Australia can be competitive in battery manufacturing:** labour costs are a lower proportion of production costs (10%) than traditional manufacturing. For the higher-skilled occupations required for advanced battery manufacturing, Australian wages are comparable with other OECD battery manufacturing locations. As material inputs account for 55% of the cost, developing an upstream supply chain can be a major source of competitive advantage in manufacturing. Accenture (2021) note 'availability of skill labour is likely to be a bigger barrier than cost'. The assessment of the CRC report is that Australia can 'probably' be competitive in battery pack assembly and 'possibly' competitive in cell manufacturing.
- **Energy costs are currently higher on average than competitors** but this can be addressed through the development of low-cost renewable energy within the REZs
- **Development of end-of-life sector can enhance the environmental performance and competitiveness** of a battery supply chain by looping back into mineral processing

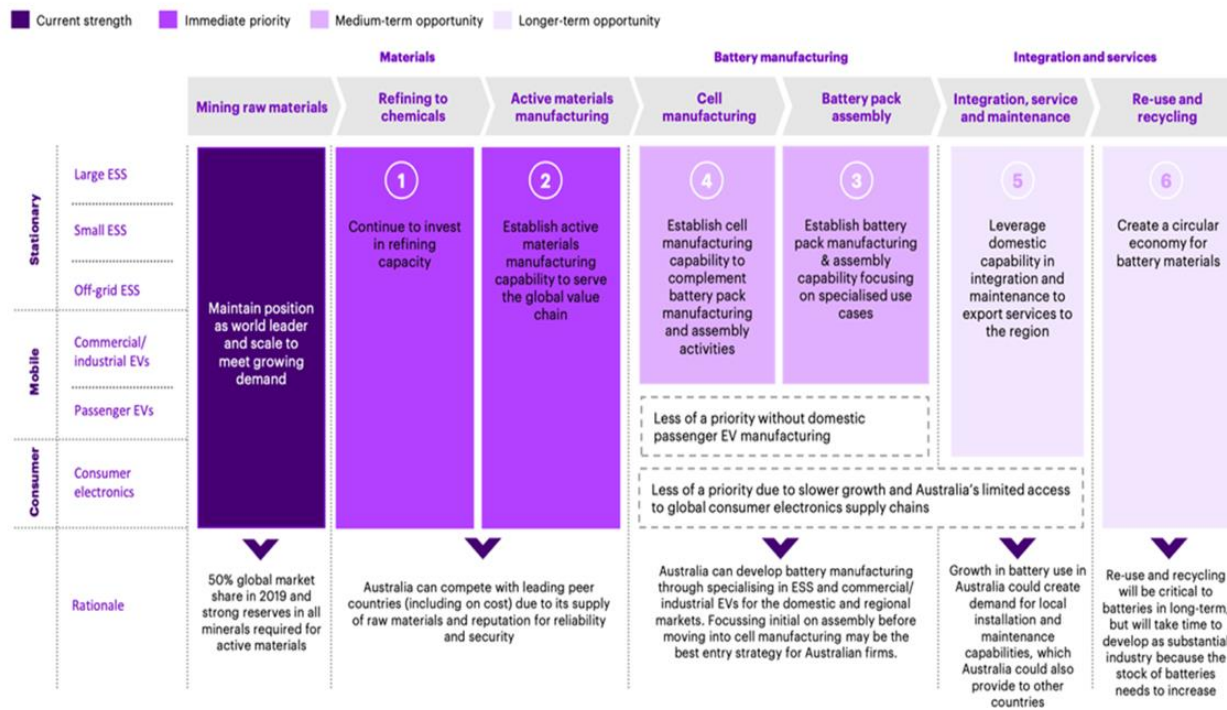


An overview of the assessment of the CRC Report is reproduced beneath.

In addition to the economic factors, it is notable that a series of OECD nations (e.g. [US](#), [UK](#) and [EU](#)) are establishing sovereign supply chains for economic and national security considerations (e.g. emerging supply chain capacity constraints, operational security concerns such as network cyber-security with international technology).

NSW has project development at all stages of the supply chain. In addition to up-stream supply chain development in mining and mineral processing (e.g. Sunrise Metals) and emerging logistics capacity in Central-West NSW, NSW has manufacturing facilities under development in battery pack assembly and cell manufacturing (Energy Renaissance, Tomago).

**Exhibit 18: Australia's opportunities for future battery industries by 2030**



VIABILITY FOR NSW		BATTERY MANUFACTURING
Criteria	Rating	Notes
How significant are the advantages of local supply and proximity?		<ul style="list-style-type: none"> <li>Supply chain security and risk is a very important consideration.</li> <li>Major sources of competitive advantage from co-location between mineral processing and manufacturing.</li> <li>Domestic manufacturing enables better end-of-life management of battery waste with cost and environmental benefits. Local manufacturing facilities will have the product knowledge to participate in or facilitate repowering, disassembly, and recycling. Imported batteries are currently a black box for the recycling industry, where it is impossible to distinguish battery chemistries at end-of-life, posing safety and environmental challenges.</li> <li>Local supply significantly reduces the carbon footprint and costs associated with transportation</li> </ul>
Are there local sources of comparative advantage or resources?		<ul style="list-style-type: none"> <li>NSW is an attractive investment destination.</li> <li>Australia and NSW have market scale (Australia is ranked fifth in the world by market size for Energy Storage Systems (with demand forecast to reach 40-52GWh by 2030. Projections also for a third of total demand to come from export markets in NZ and ASEAN (Future Battery Industries CRC, 2021).</li> <li>Significant domestic research and development capability (FBI CRC, ARENA, Industrial Transformation Training Centres and Research Hubs, and ARC Centres of Excellence).</li> <li>Market specialisation through geographical comparative advantage (Future Battery Industries CRC, 2021). NSW could develop specialised manufacturing capability in ESS products for extreme climates with a focus on safety and reliability. This will be particularly important technology not only for domestic markets, but also internationally, as environmental extremes driven by climate change demand more of our energy systems.</li> <li>The CRC identified higher construction costs in Australia as a factor (Future Battery Industries CRC, 2021), driven by high demand for the construction workforce and skill shortages in infrastructure.</li> <li>NSW has emerging project interest at all stages of the supply chain – mining in cobalt, nickel, lithium, mineral processing, two manufacturing facilities (Renaissance 1 battery cell <i>assembly</i> facility, Renaissance 2 battery cell <i>manufacturing</i> facility at Tomago), end of life (lead acid battery recycling that could be expanded to include other battery types, Enirgi Power Storage).</li> </ul>

VIABILITY FOR NSW		BATTERY MANUFACTURING
Criteria	Rating	Notes
Can the industry and workforce be scaled to realise the opportunity?		<ul style="list-style-type: none"> <li>Accenture (2021b) has noted that diversification into manufacturing would require addressing capital availability and expanding workforce and supply chain capability because of the small size of the manufacturing base.</li> <li>The CRC report identified high risks with Australia's dependence on migration to fill skills gaps. A consistent flow of graduates is required, particularly in chemicals, materials, electrical, and industrial engineering segments to establish a successful NSW advanced battery manufacturing sector (Future Battery Industries CRC, 2021).</li> <li>No major constraints to expansion were identified in stakeholder engagement with mineral processing, manufacturing and end-of-life businesses. Energy Renaissance (Tomago) has the capability to scale to 5.3GWh of lithium battery production per annum and reported 100 good candidates for each job advertised at the Tomago facilities. Energy Renaissance provide 1.5 years of training for workers from various backgrounds, no prerequisites needed. Energy Renaissance report lots of appetite from applicants wanting to move from the coal sector.</li> <li>The SAP at Parkes has a range of locational advantages for a battery hub but it was reported that the regional location of manufacturing facility viewed as a staff retainment risk due to perceived low liveability</li> <li>Significant development needed to scale lithium battery recycling to receive electric vehicle and stationary energy storage waste streams. If lithium battery recycling did develop, future NSW re-processing capability is planned for nickel and cobalt battery materials (via nickel and cobalt mine processing facilities – Sunrise Energy Metals) – however, no local capacity for recycling battery cell chemistries currently exists.</li> </ul>
Is the scale of local market volume sufficient to support new investment??		<ul style="list-style-type: none"> <li>In addition to the projections already noted for Australia to grow from 5<sup>th</sup> to 3<sup>rd</sup> largest market for energy storage systems, the NSW Electricity Infrastructure target is for 2GW additional long duration ESS in NSW by 2029 (in addition to Snowy 2.0)</li> <li>NSW is creating sufficient demand through the electrification of the state's bus fleet, Australia is set to lead the OECD average in electric bus registrations.</li> <li>The industry considers there to be missed opportunities from procurement to support local industry development but there is sufficient scale to underpin offtake agreements.</li> <li>Other sources of demand include micro-grids (which are being developed in remote and edge of grid locations) and a range of other opportunities for which little is currently known (ferries, office buildings, vans, trucks, industrial applications).</li> <li>It will take some time but the scope of the local market also creates the opportunity for a viable end-of-life sector. Lithium batteries have a lifespan of between 5-15 years and 5290 tonnes of lithium batteries reached end of life in Australia in 2018. There is a projected increase of 137000-180000 tonnes by 2036. Only 6% of these were collected for recycling, with the majority sent for offshore processing in South Korea, Singapore, Canada and Belgium.</li> </ul>
Are there market entry barriers?		<ul style="list-style-type: none"> <li>Demand is high and increasing exponentially both domestically and internationally – the view of industry is that there is a window of opportunity now to develop a local industry that is integrated into global supply chains as they are being formed.</li> <li>A mineral processing firm interviewed observed that an offtake from EV manufacturer is required to underwrite new capital investment but this is not how they have typically operated. They were broadly optimistic this would change but there is a change of operation required.</li> </ul>

VALUE OF OPPORTUNITY		BATTERY MANUFACTURING
Criteria	Rating	Notes
What is the scale of the opportunity (employment, revenue)?		<ul style="list-style-type: none"> <li>The Australian opportunity for manufacturing, integration and management services is in the magnitude of \$2.1b value added and 12,100 (direct) ongoing jobs (Future Battery Industries CRC, 2021).</li> <li>Energy Renaissance reported 700-800 jobs at the Tomago battery manufacturing facility</li> <li>Recycling: Projections of between \$603 million and \$3.1 billion of additional revenue could be achieved through better battery recycling in Australia by 2036 (FBI CRC). As a battery manufacturing hub, NSW would be well placed to make the most of this opportunity (Zhao et. al. (2021).</li> </ul>
Is it likely to be a sustainable, longer-term source of employment?		<ul style="list-style-type: none"> <li>Long-term employment opportunity for workers in battery manufacturing due to expected continued growth in global demand.</li> <li>Opportunity for continued employment in recycling due to battery repowering or replacement required every 5-15 years.</li> </ul>
How many jobs will be net to existing jobs in the region?		<ul style="list-style-type: none"> <li>Battery cell manufacturing has the potential to absorb workers from other sectors by reskilling via on-the-job training. Applicants for the Tomago facility have a mix of skill sets indicating the potential for net employment. However, a percentage of the workforce transfers from other industries such as the coal industry, warehousing industry, and other forms of manufacturing.</li> <li>Materials processing, electrochemical manufacturing, and some chemical and design focused areas of battery manufacturing require a percentage of the work force to be university-educated professionals (e.g., engineers, industrial metallurgists, and electrochemists). The sector could absorb up to 15% of Australian university graduates over the next decade if opportunities for a diversified supply chain are realised.</li> <li>Around 6000 (direct) workers are currently employed in the Australian battery workforce in 2020, this figure could increase to 30,000 (direct) jobs in Australia by 2030 (Future Battery Industries CRC, 2021).</li> </ul>
What are the multiplier effects for other industries in the region?		<ul style="list-style-type: none"> <li>Detailed analysis was beyond the scope of this report. Accenture (2021b) estimates the level of indirect jobs (20,000) is almost as high as the direct jobs (25,000).</li> </ul>
What is the potential to reduce unemployment over the longer-term?		<ul style="list-style-type: none"> <li>With the right industry development, the battery industry has the potential to absorb both recent university graduates, and unskilled/semi-skilled unemployed workers from industries in decline.</li> </ul>

OPPORTUNITY COST		BATTERY MANUFACTURING
Criteria	Rating	Notes
What is the impact on RE project costs?		<ul style="list-style-type: none"> <li>Detailed data was not available but the conclusion of the CRC Report is that Australia could be cost-competitive in a range of energy storage applications. If a local battery supply chain can be established, it is likely to reduce the risks and costs of local energy storage. Note it is not yet clear whether local capacity would develop in utility-scale battery storage as well as other areas (domestic scale, electric vehicles) where local industry development has emerged to date.</li> </ul>

OPPORTUNITY COST		BATTERY MANUFACTURING
Criteria	Rating	Notes
What level of investment in supporting infrastructure is required to facilitate the opportunity or support population growth?		<ul style="list-style-type: none"> <li>Investment in infrastructure (e.g. road/access route upgrades including raising power lines and improving logistical access routes) for the construction phase were raised in interviews.</li> </ul>
What is the cost to government?		The development of a local battery supply chain is likely to require pro-active industry development by the NSW Government (in collaboration with other levels of Government). A range of actions would support the development of a local supply chain including strategic procurement, infrastructure support, workforce development.

### Solar Farm Infrastructure

- Solar panels are imported from overseas and are either mounted on fixed angle frames or sun-tracking systems. The tracking system is integrated in Australia, but the components are predominantly manufactured in China. The mounting structures and the foundation piles, typically fabricated from steel or aluminium, are also predominantly imported.
- There is a range of supporting infrastructure for solar modules which could be locally supplied such as steel foundation piles, mounting structures and trackers (tubes and backing frames), component assembly (e.g. inverters) and telecommunications/ SCADA.
- Under VRET local content criteria, local content criteria led to infrastructure such as piles, trackers and cabling being sourced locally. Local supply of solar farm infrastructure in NSW (i.e. excluding panels) is currently generally low – concrete, fencing (steel), some trackers and frames and miscellaneous products (e.g. hold-down bolts). Consequently, there is an opportunity for local industry development.

VIABILITY FOR NSW		SOLAR FARM INFRASTRUCTURE
Criteria	Rating	Notes
How significant are the advantages of local supply and proximity?		<ul style="list-style-type: none"> <li>Local supply is quicker to market and more responsive to changes in project schedules</li> <li>Local supply-chain can reduce exposure to risks in global supply-chains (e.g. EPC's note risks around pricing and timing of contracts with Chinese suppliers, the cost and availability of transportation).</li> </ul>
Are there local sources of comparative advantage or resources?		<ul style="list-style-type: none"> <li>It was observed that local conditions were leading to some innovations (e.g. hollow steel tubes for sandy soils)</li> <li>The benefits of local supply are lower risk and speed as there is an established supply chain that is cheaper than local production.</li> <li>It was reported local supply for VRET was 20-30% more expensive. Industry has questioned these figures.</li> </ul>
Can the industry and workforce be scaled to realise the opportunity?		<ul style="list-style-type: none"> <li>No constraints on expansion were identified by stakeholders interviewed for this project</li> </ul>
Is the scale of local market volume sufficient to support new investment?		<ul style="list-style-type: none"> <li>Supplying solar infrastructure requires an expansion of existing capacity and the scale of the build-out is attractive for local producers.</li> </ul>

VIABILITY FOR NSW		SOLAR FARM INFRASTRUCTURE
Criteria	Rating	Notes
Are there market entry barriers to realise the opportunity?		<ul style="list-style-type: none"> <li>Established supply chains which project developers and EPCs prefer to use.</li> </ul>

VALUE OF OPPORTUNITY		SOLAR FARM INFRASTRUCTURE
Criteria	Rating	Notes
What is the scale of the opportunity (employment, revenue)?		<ul style="list-style-type: none"> <li>Racking and mounting is just under 9% of the project value. Cabling and wiring is 5%. Inverters are 4%.</li> <li>No data available on the level of employment for increasing market share for specific infrastructure types.</li> <li>ISF projects 1.55m tonnes of steel would be produced for solar farms in NSW from 2020 – 35.</li> <li>Regional SME's and local steel supply chain likely to be beneficiaries</li> </ul>
Is it likely to be a sustainable, longer-term source of employment?		<ul style="list-style-type: none"> <li>There could be opportunities for on-going employment in frames and local steel products such as posts.</li> <li>Other areas such as cabling are likely to exist for the duration of local content agreements</li> </ul>
How many jobs will be net to existing jobs in the region?		<ul style="list-style-type: none"> <li>Expansion of steel manufacturing will create opportunities for transition in industrial regions.</li> </ul>
Are there likely to be multiplier effects for other industries in the region?		<ul style="list-style-type: none"> <li>Steel supply chains generally have strong multiplier effects.</li> </ul>
What is the potential to reduce unemployment over the longer-term?		<ul style="list-style-type: none"> <li>Steel employs workers across a range of skill categories with good potential for entry-level jobs</li> </ul>

OPPORTUNITY COST		SOLAR FARM INFRASTRUCTURE
Criteria	Rating	Notes
What is the impact on RE project costs?		<ul style="list-style-type: none"> <li>Local supply for VRET was reported to be 20 – 30% more expensive. Steel industry stakeholders questioned this figure and if supply was compliant with trade and production standards.</li> </ul>
What level of investment is required to facilitate the opportunity?		<ul style="list-style-type: none"> <li>No additional infrastructure investment requirements were identified for government.</li> </ul>
What is the cost to government?		<ul style="list-style-type: none"> <li>Other measures to support participation of SMEs would be important to ensure supply chain participation but no significant costs identified.</li> </ul>

## Electrical balance of plant

VIABILITY FOR NSW		ELECTRICAL BALANCE OF PLANT
Criteria	Rating	Notes
How significant are the advantages of local supply and proximity?	Yellow	<ul style="list-style-type: none"> <li>Local supply is quicker to market and more responsive to changes in project schedules</li> <li>Local supply-chain can reduce exposure to risks in global supply-chains (e.g. EPC's note risks around pricing and timing of contracts with Chinese suppliers, the cost and availability of transportation).</li> </ul>
Are there local sources of comparative advantage or resources?	Red	<ul style="list-style-type: none"> <li>Beyond the advantages of proximity, there are no local sources of comparative advantage in balance of plant which is currently mostly imported.</li> <li>Local transformer manufacturing in Victoria would most likely be expanded if local content requirements led to a significant increase in electrical balance of supply.</li> </ul>
Can the industry and workforce be scaled to realise the opportunity?	Green	<ul style="list-style-type: none"> <li>No constraints on expansion were identified by stakeholders interviewed for this project. There is a modest range of businesses involved in supply of balance of plant equipment based on the business survey conducted for this project.</li> </ul>
Is the scale of local market volume sufficient to support new investment?	Red	<ul style="list-style-type: none"> <li>New investment is unlikely in balance of plant manufacturing – activity likely to be expansion of existing suppliers in areas like cabling and inverters or Victorian transformer manufacturing.</li> </ul>
Are there market entry barriers to realise the opportunity?	Red	<ul style="list-style-type: none"> <li>Established supply chains which project developers and EPCs prefer to use, especially without some of the benefits and strengths in other areas of local manufacturing.</li> </ul>

VALUE OF OPPORTUNITY		ELECTRICAL BALANCE OF PLANT
Criteria	Rating	Notes
What is the scale of the opportunity (employment, revenue)?	Green	<ul style="list-style-type: none"> <li>Electrical balance of plant is 5-10% of the value structure across a range of technologies.</li> <li>No data available on the level of employment for increasing market share for specific balance of plant activities</li> </ul>
Is it likely to be a sustainable, longer-term source of employment?	Red	<ul style="list-style-type: none"> <li>Without established manufacturing, it is unlikely to create employment opportunities beyond the duration or requirement of local content agreements. Only if new manufacturing facilities were established would it be likely to create longer-term opportunities.</li> </ul>
How many jobs will be net to existing jobs in the region?	Yellow	<ul style="list-style-type: none"> <li>Electrical balance of plant supplied by SMEs which have regional contractors.</li> </ul>
Are there likely to be multiplier effects for other industries in the region?	Red	<ul style="list-style-type: none"> <li>Detailed modelling is beyond the scope of this project but multiplier effects likely to be limited</li> </ul>
What is the potential to reduce unemployment over the longer-term?	Yellow	<ul style="list-style-type: none"> <li>Data limited on which to make an assessment of the contribution it could make to lower unemployment.</li> </ul>

OPPORTUNITY COST		ELECTRICAL BALANCE OF PLANT
Criteria	Rating	Notes
What is the impact on RE project costs?	Yellow	<ul style="list-style-type: none"> <li>There is a cost premium for local supply but no data was provided by stakeholders interviewed for this project.</li> </ul>

OPPORTUNITY COST		ELECTRICAL BALANCE OF PLANT
Criteria	Rating	Notes
What level of investment is required to facilitate the opportunity?		<ul style="list-style-type: none"> <li>No additional infrastructure investment requirements were identified for government.</li> </ul>
What is the cost to government?		<ul style="list-style-type: none"> <li>Other measures to support participation of SMEs would be important to ensure supply chain participation but no significant costs identified.</li> </ul>

## Transmission construction workforce

- A significant expansion in the transmission network is scheduled through AEMO's Integrated Systems Plan and the NSW Electricity Infrastructure Roadmap over the next decade and beyond. Major inter-connection projects are in development between NSW and South Australia (Energy Connect) and NSW and Queensland (QNI). Under the NSW Electricity Roadmap, new transmission infrastructure will be built within the CWO, SW and NE REZs.
- Skill shortages were identified through surveys and interviews with Transgrid and five of the six Engineering, Procurement and Construction (EPC) firms and training providers conducted by ISF in research for Infrastructure Australia<sup>1</sup>. Shortages covered multiple occupations and included professionals, trades and technicians and labourers. Specific shortages were identified in various categories of engineers (electrical, structural, mechanical, civil, telecommunications), construction managers, site supervisors, electrical commissioning specialists, line workers and riggers.
- There has not been much transmission network infrastructure construction in Australia in the past couple of decades, leading to a lack of experienced local personnel. Projects have therefore relied on international recruitment, which is a significant risk factor, particularly in times of COVID.
- The sector is scaling up rapidly. As one transmission industry participant noted, '\$100 million used to be a large contract, now a large contract would be \$1 billion'.
- All participants in the Infrastructure Australia interviews agreed there is a high risk of skill and labour shortages as transmission construction scales up. For example, one respondent stated:

*"The bit that really worries me is future demand for the same type of resources – all of these major projects that are in the final throes of approval. If they hit the ground at once there will be a shortage in the transmission industry. We don't have enough substation specialists, commissioning specialists or line workers across Australia. There are going to be huge substations that we haven't seen for quite a long time."*

- It is not just the volume of employment but also specialised skills associated with larger assets that create the potential for shortages.
- There are a range of barriers to local workforce development including attracting new workforce entrants, competition from other related sectors, and mis-matches between the length of apprenticeships and construction projects and market uncertainty about the timing and volume of labour demand. As one transmission EPC noted:

*'It's continuity of work, especially as projects are peaky and when the project finishes they sometimes move onto the next employer who has a project. The ability to retain workers is the issue facing the industry. We have all these big projects coming but what comes after that? The successful companies will be the one who work with the TNSPs to get smaller projects as part of their regulated projects - an outlet of work for 3,4,5 years. A lot of the projects are in the renewables industry and due to the lack of a coherent renewables*

<sup>1</sup> See Briggs, C., Rutovitz, J., Jazbec, M., Langdon, R & Nagrath, K. (2020) *Employment and Material Requirements for the Integrated System Plan: Electricity Generation and Transmission*.



*national strategy a lot of projects get delayed and delayed which makes people hesitant about bringing them (staff) on too early.'*

- Local workforce development can create additional regional jobs and reduce the risks and costs of the transmission build-out which is pivotal to the achievement of the targets under the NSW Electricity Infrastructure Roadmap.

VIABILITY FOR NSW		TRANSMISSION CONSTRUCTION WORKFORCE
Criteria	Rating	Notes
How significant are the advantages of local supply and proximity?		<ul style="list-style-type: none"> <li>The risks of international recruitment are significant under current circumstances (COVID). Increasing local supply would increase the resilience of the supply chain and reduce risks associated with transmission construction.</li> <li>Maintenance on specialised equipment has typically been done by international workers due to low volumes, however, a local workforce would offer time and cost advantages. Time advantages could improve reliability.</li> <li>Local capacity building in civil works, such as in the construction of foundations and electrical supply and control buildings can benefit other RE technologies, increasing the opportunities for ongoing employment. Skills acquired in transmission tower foundation, substation foundation, and substation building construction could be applied to wind towers, solar farms, and stationary battery storage technologies.</li> </ul>
Are there local sources of comparative advantage or resources?		<ul style="list-style-type: none"> <li>Lower recruitment costs</li> <li>Improved social licence which is a growing issue for transmission construction</li> <li>A strong civil construction workforce already exists across NSW REZs.</li> </ul>
Can the industry and workforce be scaled to realise the opportunity?		<ul style="list-style-type: none"> <li>In the medium-term, increasing the volume of apprentices is essential just to back-fill an aging workforce even before accommodating industry growth .</li> <li>Scaling up to meet industry growth in time would require transitioning workers from other sectors (for example, it usually takes four years to train a Certificate 3 line worker).</li> <li>The pathways for local workforce transition vary by occupation. Transmission line workers can be trained from other industries with shorter lead-times depending on the existing competencies of the worker: <ul style="list-style-type: none"> <li>Electrical distribution: 12 – 18 months (a distribution worker may hold as many as 14 out of 17 units for a Certificate 3 lineworker)</li> <li>Electricians take longer, as they hold much fewer of the 17 units.</li> </ul> </li> <li>For substation construction there is no formal qualification required, and electricians can learn through on-the-job training. Electrical commissioning is a specialised role, and while electricians can be retrained, significant time is required. An engineering firm survey respondent for the Infrastructure Australia project noted <i>'It would take 2-3 years to train someone for electrical commissioning, it's basically a trade. TNSPs [electricians] could do it in 12-18 months.'</i></li> <li>Civil construction labourers (e.g. riggers, crane operators) can move across more quickly if they are working on greenfield sites away from live lines. Industry sources said riggers take 1 – 3 years depending on experience level as transmission rigging has specialised skills.</li> </ul>
Is the scale of the local market sufficient to support new investment?		<ul style="list-style-type: none"> <li>The volume of the local market is sufficient but there is a question about the scale of workforce needed relative to the investment that would be required in training facilities. ISF's projection is for a peak workforce of 2500 across the National Electricity Market and over 1000 in NSW by 2024. A rapid scale-up is required to meet demand locally but the overall volume is not that large and geographically dispersed across the eastern states. However, NSW has the largest share, with around 43% of the NEM transmission construction jobs between now and 2035.</li> <li>In relation to some of the key occupations, the ISF projection is for a peak national workforce of around 500 transmission line workers, 250-300 transmission riggers</li> </ul>

VIABILITY FOR NSW		TRANSMISSION CONSTRUCTION WORKFORCE
Criteria	Rating	Notes
Are there market entry barriers to realise the opportunity?		<ul style="list-style-type: none"> <li>(with roughly double that figure across the renewable energy sector) and around 250-300 electrical engineers.</li> <li>In a workshop for the Infrastructure Australia project, it was suggested by industry stakeholders that an efficient solution could be for Transgrid to act as a trainer for the national transmission workforce. Transgrid has training facilities in Wagga Wagga and could expand to train for the wider market.</li> </ul>
		<ul style="list-style-type: none"> <li>No significant entry barriers</li> <li>Increasing local maintenance employment would require training in proprietary technology.</li> </ul>

VALUE OF OPPORTUNITY		TRANSMISSION CONSTRUCTION WORKFORCE
Criteria	Rating	Notes
What is the scale of the opportunity (employment, revenue)?		<ul style="list-style-type: none"> <li>ISF's projection is for a peak workforce of 2500 across the National Electricity Market and over 1000 in NSW by 2024.</li> </ul>
Is it likely to be a sustainable, longer-term source of employment?		<ul style="list-style-type: none"> <li>There are long-term employment opportunities, particularly on larger projects, but they may require moving to follow the work. In the South-West REZ workshop, a transmission EPC said the line construction could provide employment for up to 10 years.</li> <li>Transmission construction is often in remote areas and so line workers may need to move from project to project, or even on one project, both within and between states.</li> <li>Cross-sector opportunities could be developed for line workers (rail, distribution) and electrical commissioning specialists (transmission, generation).</li> </ul>
How many jobs will be net to existing jobs in the region?		<ul style="list-style-type: none"> <li>Net jobs can be created in regions, many are specialised roles and there are strategies to increase regional employment (e.g. pathways for unemployed) – but workers may need to move to other regions for work following the construction</li> </ul>
What are the multiplier effects for other industries in the region?		<ul style="list-style-type: none"> <li>Developing workforce capacity to participate in civil construction for transmission infrastructure will have a flow on effect for other RE technologies, particularly in foundation and building construction. Increasing local civil construction capacity for electrical applications can also benefit mining facilities and remote communities, by supporting future electrification endeavours, both on and off grid.</li> </ul>
What is the potential to reduce unemployment over the longer-term?		<ul style="list-style-type: none"> <li>There are opportunities to create pathways for school leavers and disadvantaged labour market groups. The ESI has just released a draft of a Certificate 2 for civil construction roles within transmission. The Certificate 2 could include units from a Certificate 3 and act as a step towards a transmission lineworker trade. Current transmission projects include targets for the employment of First Nations persons.</li> </ul>

OPPORTUNITY COST		TRANSMISSION CONSTRUCTION WORKFORCE
Criteria	Rating	Notes
What is the impact on RE project costs?		<ul style="list-style-type: none"> <li>Local workforce development and recruitment should have a modest positive impact on project costs.</li> </ul>
What level of investment is required to facilitate the opportunity?		<ul style="list-style-type: none"> <li>As with many of the growth opportunities, there may be a requirement for additional housing and associated infrastructure. A transmission EPC in the South-West REZ noted they were relocating 40 staff from a head-office to the region and were finding housing a challenge.</li> </ul>
What is the cost to government?		<ul style="list-style-type: none"> <li>Beyond infrastructure, there could also be costs associated with increased training to realise the opportunities (see actions).</li> </ul>

## Solar Construction Workforce

- There are opportunities to increase the volume and quality of employment in solar farms during the construction phase. In particular, civil construction, local electricians and lower-skill assembly roles to reduce the level of imported and FIFO employment.
- There are best-practice examples of solar farms that have achieved high-levels of employment amongst the unemployed and local First Nation communities in practice. For example, 15 per cent of the Bomen Solar Farm construction workforce in Wagga Wagga were First Nations persons. Of the 300 construction workers engaged for Karadoc solar farm (Victoria), there were 90 long-term unemployed 38 First Nation workers and 70 per cent of the workforce had not previously worked on a solar farm.
- Whilst the jobs are short-term construction roles (often 4-8 months), there are opportunities for longer-term employment either through redeployment to other projects or as bridge to other construction projects for the unemployed. Consequently, there is an opportunity to increase local employment and address social disadvantage through better employment practices.

VIABILITY FOR NSW		SOLAR CONSTRUCTION WORKFORCE
Criteria	Rating	Notes
How significant are the advantages of local supply and proximity?		<ul style="list-style-type: none"> <li>• A FIFO workforce will generally have more experience working on solar farms, but there are sufficient cases to demonstrate viability of local employment.</li> <li>• For remote projects, there may be limits to the capacity to employ locals but building up a regional workforce will still enable better outcomes than a FIFO workforce.</li> </ul>
Are there local sources of comparative advantage or resources?		<ul style="list-style-type: none"> <li>• Use of local workforce will improve the social licence of projects. There are persistent complaints about the use of FIFO workforces in regional communities by solar farms.</li> <li>• The use of FIFO workforce can have other social impacts, for eg on housing.</li> </ul>
Can the industry and workforce be scaled to realise the opportunity?		<ul style="list-style-type: none"> <li>• Regional unemployment levels are low in some areas. Remote solar farms may also not have sufficient population catchments</li> <li>• Generally, there is sufficient volume of workers who are unemployed, workers in low-skill jobs or school-leavers for the civil construction and assembly jobs.</li> <li>• There are shortages and constraints on electricians (addressed elsewhere).</li> </ul>
Is the scale of local market volume sufficient to support new investment?		<ul style="list-style-type: none"> <li>• n/a</li> </ul>
Are there market entry barriers to realise the opportunity?		<ul style="list-style-type: none"> <li>• n/a</li> </ul>

VALUE OF OPPORTUNITY		SOLAR CONSTRUCTION WORKFORCE
Criteria	Rating	Notes
What is the scale of the opportunity (employment, revenue)?		<ul style="list-style-type: none"> <li>• Peak construction labourer workforce of 500-600 across REZs</li> </ul>

VALUE OF OPPORTUNITY		SOLAR CONSTRUCTION WORKFORCE
Criteria	Rating	Notes
Is it likely to be a sustainable, longer-term source of employment?		<ul style="list-style-type: none"> <li>• These are short-term construction jobs which may be for up to 1-year (generally 4 – 8 months).</li> <li>• However, there are likely to be opportunities for work on other projects once their first job has been completed.</li> </ul>
How many jobs will be net to existing jobs in the region?		<ul style="list-style-type: none"> <li>• As the jobs are low-skilled, they offer an opportunity to add to the pool of jobs within the region.</li> </ul>
Are there likely to be multiplier effects for other industries in the region?		<ul style="list-style-type: none"> <li>• n/a</li> </ul>
What is the potential to reduce unemployment over the longer-term?		<ul style="list-style-type: none"> <li>• There is an opportunity to target initiatives to provide jobs for the unemployed and demonstrated cases of this occurring in practice. Given the potential for labour shortages, solar farm construction represents an excellent opportunity to increase the size of the workforce and reduce unemployment.</li> </ul>

OPPORTUNITY COST		OPPORTUNITY NAME
Criteria	Rating	Notes
What is the impact on RE project costs?		<ul style="list-style-type: none"> <li>• Modest improvement/no change with recruitment of local workers.</li> </ul>
What level of investment is required to facilitate the opportunity?		<ul style="list-style-type: none"> <li>• No additional infrastructure investment requirements were identified.</li> </ul>
What is the cost to government?		<ul style="list-style-type: none"> <li>• Hiring practices that engage greater local workforces should primarily be able to be incentivised through procurement guidelines and industry engagement and information sharing. There may be some funding support for initiatives to develop training capacity.</li> </ul>

## Wind Maintenance Technicians

- Over time, wind farm maintenance technicians will grow to [add figures]. Wind turbine maintenance require a mix of electrical and mechanical technicians to maintain the turbines, electricals and blades. Wind farms require higher maintenance than solar farms and therefore create more on-going jobs. Wind farm maintenance technicians are good quality blue-collar jobs with salaries of \$90,000+ before overtime.
- The wind industry reported skill shortages for wind turbine and blade technicians and the use of international recruitment during 2019-20. O&M contractors reported difficulties sourcing local workers as blade technicians. The barriers to recruitment of local technicians were identified as:
  - the lack of short training courses to transfer technicians from other sectors and the cost of pre-requisite qualification courses e.g. Working and Rescue at Heights) which makes it an expensive exercise;
  - Traditional apprenticeships were agreed not to work well – workers don't get the breadth of experience and could end up doing menial tasks;
  - No targeted courses for developing wind farm technicians.
- One O&M contractor stated: *"We have to try and get people from other industries and train them ourselves on the job and put them through the basic safety courses which is time consuming and expensive. There's nothing at all for blade technicians ... if there were basic courses tailored for the wind industry it would make it easier to employ local people. We could take people who have a background in*

*composites and repair and do a short course and get them on-board ... there are more technicians coming out to Australia every year to do blade technicians tasks than there are locals. There's opportunity for much more local jobs here" (O&M contractor).*

- A collaboration between a group of renewable energy companies (Vestas, Acciona, Tilt Renewables and Global Power Group) and Federation TAFE in Western Victoria with \$1.8 million of industry funding has led to the establishment of the first blade turbine apprenticeship and wind turbine maintenance training with a purpose-built tower.

VIABILITY FOR NSW		OPPORTUNITY NAME
Criteria	Rating	Notes
How significant are the advantages of local supply and proximity?	Green	<ul style="list-style-type: none"> <li>• Bringing in wind turbine technicians from outside the local area is more expensive.</li> <li>• Industry preference is for local workers due to cost, connection with community and logistics of workforce management.</li> </ul>
Are there local sources of comparative advantage or resources?	Green	<ul style="list-style-type: none"> <li>• As above</li> </ul>
Can the industry and workforce be scaled to realise the opportunity?	Green	<ul style="list-style-type: none"> <li>• Mechanical technicians can be recruited from a variety of industries in regional areas (e.g. fitters and turners, agricultural workers with a mechanical background).</li> <li>• There are wider skill shortages for electricians in regional areas which are considered a significant barrier by the industry. However, there is sufficient time for these to be addressed.</li> </ul>
Is the scale of local market volume sufficient to support new investment?	Orange	<ul style="list-style-type: none"> <li>• The most efficient and effective way to address the skill shortage needs further investigation – in particular whether it is viable and efficient to leverage inter-state training vs developing local training capacity (see cost to Government).</li> </ul>
Are there market entry barriers?	Green	<ul style="list-style-type: none"> <li>• There are variations in design (e.g. blades) but these can be learnt on-the-job through skills transfer</li> </ul>

Note: Green = positive rating for viability in NSW; Orange = a mix of positive and negative factors but still could be viable; Red = significant barriers to viability in NSW.

VALUE OF OPPORTUNITY		OPPORTUNITY NAME
Criteria	Rating	Notes
What is the scale of the opportunity (employment, revenue)?	Orange	<ul style="list-style-type: none"> <li>• Average of 300 jobs per annum over 2020-35 increasing over time.</li> </ul>
Is it likely to be a sustainable, longer-term source of employment?	Green	<ul style="list-style-type: none"> <li>• On-going jobs over lifetime of wind farms which require regular maintenance</li> <li>• Contractors often service a group of wind farms</li> <li>• If wind farms are refurbished with new turbines, the jobs would continue beyond the life of the existing turbines (~20 years)</li> </ul>
How many jobs will be net to existing jobs in the region?	Green	<ul style="list-style-type: none"> <li>• New category of on-going jobs that can be net to existing jobs</li> </ul>

VALUE OF OPPORTUNITY		OPPORTUNITY NAME
Criteria	Rating	Notes
What are the multiplier effects for other industries in the region?		<ul style="list-style-type: none"> <li>Limited multiplier effects beyond worker expenditure and local sourcing of parts</li> </ul>
What is the potential to reduce unemployment over the longer-term?		<ul style="list-style-type: none"> <li>Skilled technician jobs but they can be sourced from a wide range of sectors</li> </ul>

Note: Green = high value; Orange = moderate value; Red = low value

OPPORTUNITY COST		OPPORTUNITY NAME
Criteria	Rating	Notes
What is the impact on RE project costs?		<ul style="list-style-type: none"> <li>Workers from out of the region are more expensive due to allowances (\$700-\$800 per week was quoted by industry source) and other recruitment costs</li> <li>Local workforce would modestly reduce O&amp;M costs.</li> </ul>
What level of investment is required to facilitate the opportunity?		<ul style="list-style-type: none"> <li>No infrastructure requirements identified.</li> </ul>
What is the cost to government?		<ul style="list-style-type: none"> <li>New training infrastructure may need to be established, although there is the possibility of leveraging investment in blade apprenticeship and training facilities in Victoria which have been established to address the training and skills gap. The course has been designed with block training to make it easier for inter-state workers to attend.</li> </ul>

## End of life

### Summary:

- Local supply chain capability in reuse/repowering renewable energy technologies can result in significant advantages in terms of long-term employment opportunities in the operations and maintenance stages of the life cycle. Reuse and repowering extends the lifetime of RE infrastructure, reducing the waste and costs associated with redeploying new infrastructure. Increased skill capabilities in the servicing of technologies have the added benefit of potential skills transfer between the manufacturing sector and vice versa.
- Repowering can involve repairing, servicing, or replacing part of a RE technology component. For example, servicing wind farm nacelle hubs and motors increases the life and reliability of the technology over its lifetime and repairing wind turbine blades reduces the need for dealing with problematic wastes from composite materials.

VIABILITY FOR NSW		END OF LIFE
Criteria	Rating	Notes
How significant are the advantages of local supply and proximity?		<ul style="list-style-type: none"> <li>• Opportunities for <b>reuse and repair</b> are better supported when RE and transmission infrastructure components are locally manufactured and/or assembled. Assembly skills are often directly transferrable to disassembly skills at end-of-life and new local product manufacturers are already integrating product stewardship capability.</li> <li>• The benefits of local reuse and repair knowledge extends to the recycling stages at end of life, where correct treatment at disassembly can result in a higher percentage of high-quality salvageable material at the <b>recycling</b> stages.</li> <li>• Co-location of local recycling facilities, materials processing facilities, and manufacturing facilities (at least by dedicated transport routes) will aid in the facilitation of materials reprocessing, where materials re-enter the supply chain via new products, either through RE technologies or in other areas such as construction. If product is shipped for offshore processing, the risk of materials being lost to poor recycling practices and/or landfill are high. This increases the need for virgin material and places increase pressure on ecosystem services, both in extraction and waste management.</li> </ul>

VIABILITY FOR NSW		END OF LIFE
Criteria	Rating	Notes
Are there local sources of comparative advantage or resources?		<ul style="list-style-type: none"> <li>NSW has significant local capacity to build upon to develop end-of-life sectors in renewable energy technologies</li> <li>There is lead-acid battery recycling (Enirgi) with potential for knowledge sharing between lead-acid battery recycling and other battery chemistry recycling.</li> <li>A mature steel, aluminium and copper recycling supply chain already exists.</li> <li>The recycling of concrete material is heavily dependent on the location of the facility under decommissioning. If located in a regional area with no local crushing facility, high rates of concrete waste are sent to landfill.</li> <li>The introduction of local steel manufacturing capability for transmission towers would facilitate better end-of-life handling of transmission line infrastructure. Locally produced transmission towers are bound by Australian steel manufacturing standards. This not only provides quality assurance on steel durability, but also enables better assessment of steel tower components for disassembly and reuse.</li> </ul> <p>Opportunities varies by region:</p> <p><b>Central-West Orana:</b></p> <ul style="list-style-type: none"> <li>Parks SAP e-waste and plastics recycling, battery recycling and solar PV recycling</li> <li>Local recycling plants (solar, RE components, construction waste)</li> </ul> <p><b>South-West:</b></p> <ul style="list-style-type: none"> <li>Using inland rail and reverse logistics for end-of-life material and waste transport</li> <li>Use SAPs as distribution hubs</li> </ul> <p><b>New England:</b></p> <ul style="list-style-type: none"> <li>Investment in circular economy waste management processing infrastructure will develop existing recycling facilities in the region and assist with end-of-life disposal/waste minimisation of solar and wind infrastructure</li> <li>Establishment of local solar panel recycling facility</li> </ul> <p><b>Hunter:</b></p> <ul style="list-style-type: none"> <li>Land remediation (in mining) and integration of green/natural infrastructure and resources</li> <li>Integration of circular economy (Strategies being developed right now by Hunter JO and other agencies) with REZ (and Hydrogen Hub), reuse and PV cells at energy of life and the recovery of mineral assets for use in high value manufacturing</li> </ul> <p><b>Illawarra:</b></p> <ul style="list-style-type: none"> <li>Develop recycling industry for solar PV panels</li> <li>Biomass and energy production from sewage are an opportunity</li> <li>Synergies, co-located industries, businesses-circular economy concept</li> </ul>
Can the industry and workforce be scaled to realise the opportunity?		<ul style="list-style-type: none"> <li>Existing technology and recovery rates for solar panels are about 20% and require significant investment to increase recovery rates locally</li> <li>Current e-waste processing technologies only target AI frame recovery, causing stockpiling, need for specialised and dedicated equipment to fully process solar panels and scale up</li> <li>Need access and secure sufficient volumes of materials to justify investment in plant and equipment and technology.</li> <li>Little data on workforce and skill requirements.</li> </ul>



VIABILITY FOR NSW		END OF LIFE
Criteria	Rating	Notes
Is the scale of local market volume sufficient to support new investment??		<p><u>PV recycling<sup>2</sup></u></p> <ul style="list-style-type: none"> <li>PV waste generation in NSW is currently low (less than 2,000 t/y) but could reach 3,000 – 10,000 t/y by 2025 and 34,000-63,000 t/y by 2035.</li> <li>Till 2025 it is anticipated that PV waste will be from distributed systems and geographically located in Sydney, the central coast, and northern coastal regions but by 2035 both utility and distributed will be generating large share of waste.</li> <li>PV panels waste due to low quality panels entering the market, financial incentives to decommission the systems before end of life (factory life span of 20 years shorten to 15-10 years)</li> </ul> <p><u>Batteries<sup>2</sup></u></p> <ul style="list-style-type: none"> <li>Energy storage battery generation anticipated to be low till 2025 (&lt;1,000t/y), but could reach 6,500 – 8,200 t/y by 2035.</li> <li>Current projections anticipate use of pumped hydro for storage, but if batteries are used instead, there will be larger volumes of battery waste.</li> </ul>
Are there market entry barriers?		<p><u>PV panel reuse and refurbishment</u></p> <ul style="list-style-type: none"> <li>Cost-effectiveness and disincentives for use of second-hand panels remain the greater barrier to increased uptake</li> <li>Estimated needed cost for refurbishment in NSW to be economically viable was \$15/panel including transport (based on current panel cost)<sup>2</sup></li> <li>Exclusions in warranties decrease the capacity of systems to enter second-hand markets (e.g. warranties are voided if panel changes location)<sup>3</sup></li> <li>Refurbished panels exported as they cannot receive small scale technology certificates in Australia, cannot be installed on the roofs again, and do not come with the same quality assurance as a new panel<sup>4</sup></li> <li>Low cost for new panels also is proving to be a barrier in reuse of components to produce new panels.<sup>2</sup></li> <li>Export of solar panels in whole likely due to lacking local processing</li> </ul>

<sup>2</sup> Florin, N., Wakefield-Rann, R., Dominish, E. Dwyer, S., Gertsakis, J. and Hartford, N. Scoping study for solar panels and battery system reuse and recycling in NSW. Prepared for NSW Department of Planning, Industry and Environment by UTS Institute for Sustainable Futures and Equilibrium, February 2020

<sup>3</sup> Ecogeneration, 2016, Warranties and Insurance

<sup>4</sup>Gentilini, E, Salt, M (2020) Circular business models for Australia solar photovoltaics – Arup <https://www.arup.com/perspectives/publications/promotional-materials/section/circular-business-models-for-australia-solar-photovoltaics>

		END OF LIFE
Criteria	Rating	Notes
What is the scale of the opportunity (employment, revenue)?		<p><u>PV panels recycling – low recovery pathway (downcycling)</u></p> <ul style="list-style-type: none"> <li>80% of the waste recycled – crushed glass (~37,000t/y by 2035) – currently no revenue value and Al (11,500t/y by 2035) – 21% value of the revenue; Copper cables (190 t/y by 2035) – 2% value of the revenue</li> <li>Estimated capital cost \$1.5m for 1,500t/a capacity, gross margin \$5.70/unit or \$270/t (with \$14-\$15 gate fee).</li> </ul> <p><u>PV panels recycling – high recovery pathway</u></p> <ul style="list-style-type: none"> <li>90% waste recovered including high purity Si (1,900 t/y by 2035) – 46% value of the revenue and Ag (32 t/y by 3035) – 31% value of the revenue.</li> <li>Estimated capital cost \$7m for 4,500t/a capacity, gross margin \$10/unit or \$470/t (with \$14-\$15 gate fee)</li> </ul> <p><u>Decommissioning/disassembly/refurbishment and recommissioning</u></p> <ul style="list-style-type: none"> <li>Opportunity for new jobs, service industries, manufacturing, and new markets, with training needed to decommission safely and to achieve maximum value</li> <li>Mobile decommissioning facility – providing processing for materials beyond REZs (e.g., tyres, batteries, plastics, etc.)</li> </ul>
Is it likely to be a sustainable, longer-term source of employment?		<ul style="list-style-type: none"> <li>Transfer of skills from construction of renewable technology to decommissioning, disassembly and refurbishment or recommissioning</li> <li>Recycling and repair skills are likely to be a long-term employment</li> </ul>
How many jobs will be net to existing jobs in the region?		<ul style="list-style-type: none"> <li>It has been estimated that 9.2 jobs are created per 10,000 t of waste recycled compared to 2.8 jobs per 10,000 t of waste disposed.<sup>5</sup></li> </ul>
What are the multiplier effects for other industries in the region?		<ul style="list-style-type: none"> <li>Detailed modelling was beyond the scope of this report.</li> </ul>
What is the potential to reduce unemployment over the longer-term?		<ul style="list-style-type: none"> <li>Skills needed to assemble solar farm components are required for decommission as well during the lifetime and at end of lifetime of the panels.</li> <li>Skills required to install wind turbine are similar to decommissioning of wind turbine panels.</li> </ul>

OPPORTUNITY COST		END OF LIFE
Criteria	Rating	Notes
What is the impact on RE project costs?		<ul style="list-style-type: none"> <li>Most materials would integrate into components manufacturing internationally with no impact on prices. In the case of the battery supply chain, local materials processing could significantly reduce costs.</li> </ul>

<sup>5</sup> Deloitte Access Economics, Employment in waste management and recycling, 2009

OPPORTUNITY COST		END OF LIFE
Criteria	Rating	Notes
What level of investment in supporting infrastructure is required to facilitate the opportunity or support population growth?		<p><u>PV panels</u></p> <ul style="list-style-type: none"> <li>Existing infrastructure: utilisation of the current e-waste collection system for junction boxes, scrap metal collection for metal frames and crushed glass for road construction</li> <li>Collection logistics – handling that avoids breakage, high transport costs – is a barrier and requires support for scale up, one example could be mobile shredders.</li> <li>Need for specialised and dedicated equipment and facilities especially for high PV recovery rate pathway</li> </ul> <p><u>Wind blades</u></p> <ul style="list-style-type: none"> <li>On site processing to enable transport of wind turbine blades (wind turbine blades are large and require special transport, partial processing on site - e.g. cutting blades, enables the transport)</li> </ul>
What is the cost to government?		<ul style="list-style-type: none"> <li>There is a need for market intervention for the recycling technology and systems to get off the ground. Currently collection, reuse and recycling are not economically sustainable in NSW</li> </ul>

## Mining and materials

- NSW has deposits and proposed mining and production facilities for listed critical minerals including cobalt, zirconium, and a small deposit of lithium. Critical minerals are found in electronics, solar panels, batteries and electric vehicles and Australia’s resources of critical minerals rank in the top 5 globally. Central-West NSW contains the largest nickel and cobalt deposit outside the Democratic Republic of Congo, which are essential materials for lithium battery manufacturing.
- Australia and NSW have competitive advantages for mineral processing stages, especially for battery energy storage systems, due to its supply of raw materials and reputation for reliability and security – with opportunities to enhance its competitiveness through supply chain integration, development of low-cost renewable energy and circular economy linkages. The unique cobalt deposits found in NSW have attracted investment in innovative materials processing technologies with better environmental outcomes (Cobalt Blue proposed facility). Downstream purchasers are increasingly looking to source battery materials from mines that can assure a sustainable product, prompting the mining industry to invest in sustainability certification readiness. NSW, in combination with other mineral endowed states such as Western Australia, could play a major role in providing a blue-print for a sustainable, circular, battery supply chain, reducing the environmental and social impacts of production.
- Copper mines are also currently in operation in NSW, however downstream supply chain development is limited without smelting facilities.

VIABILITY FOR NSW		MINING AND MATERIAL PROCESSING
Criteria	Rating	Notes
How significant are the advantages of local supply and proximity?		<ul style="list-style-type: none"> <li>• There are substantial advantages from local supply and proximity.</li> <li>• Co-location with new nickel and cobalt mining operations significantly reduces the cost and waste associated with transporting bulk unprocessed ore material. Raw mined minerals undergo a processing stage, refining them to a material grade appropriate for battery chemistries. Currently most raw mined ores are mined in Australia and then shipped to overseas processing facilities. Where countries have developed processing capability, down-stream supply chain opportunities are enabled and supply chain benefits flow to manufacturing. 55% of the cost is in materials (Accenture 2021b).</li> <li>• Minerals processing facilities have the ability to reprocess recycled cathode chemistries. Co-location of materials processing facilities and recyclers could facilitate circular economy outcomes and reduce cost. A recycling facility can break down renewable energy technologies, especially batteries, into their relative components and materials and processing facilities can prepare materials ready for re-manufacturing. <i>“This would be a good fit for the Special Activation Precincts...once batteries are broken down to their cathode chemistries, we (materials processor) could process nickel and cobalt and other facilities could process other elements.”</i></li> </ul>

VIABILITY FOR NSW		MINING AND MATERIAL PROCESSING
Criteria	Rating	Notes
Are there local sources of comparative advantage or resources?		<ul style="list-style-type: none"> <li>Central-West NSW has the largest nickel and cobalt deposit outside the DRG. which are essential materials for lithium battery manufacturing. There are projects under development such as Sunrise Energy Metals (a nickel and cobalt mining and processing facility that will produce highly purified battery grade nickel and cobalt materials for cathode precursor production).</li> <li>Co-location of low-cost renewable energy generation can offer a further source of competitive advantage. Accenture (2021b: 40) estimates 17% of the cost is energy and that 'for this opportunity, Australia will require significant low-cost renewable energy'. As part of clean energy supply chains, energy intensive minerals processing facilities have identified that net zero operations are likely to become a requirement from contracting parties and are looking to source renewable energy.</li> <li>Given the resource endowments of NSW, integrating more value adding steps of the value chain via state or regionally based co-location of supply chain stages can generate significant benefits.</li> <li>There is R&amp;D capability through the Future Battery Industries Cooperative Research Centre (FBICRC) supporting the Australian development of mineral processing, battery manufacturing, deployment, reuse, and recycling/reprocessing.</li> </ul>
Can the industry and workforce be scaled to realise the opportunity?		<ul style="list-style-type: none"> <li>A significant workforce with skills relevant for mining and processing already exists in the CWO REZ. Interviews with future materials extraction and processing companies confirmed good skills crossover between current (coal and copper) and future (nickel and cobalt) mining and processing facilities. However, feedback during REZ workshops indicated that more efforts are needed to ensure university graduates are prepared with the skills required for materials processing.</li> <li>Workshop participants also indicated a need for more understanding on the skills required for a diversified supply chain, and for identification of training / courses to meet these requirements.</li> <li>For those workers transitioning from the mining sector that may need upskilling on different site practices, onsite safety training is provided by processing facilities for workers involved in the handling of hazardous substances.</li> <li>There is significant competition for labour between different resource, infrastructure and renewable energy projects that needs to be managed.</li> <li>The FBI CRC report highlighted higher wages at the construction phase contributed to elevated initial capital construction costs.</li> <li>Biproduct opportunities for other product markets. I.e., In the case of nickel and cobalt mining and processing scandium is a biproduct – used for strengthening aluminium alloys for military aircraft, lightweight vehicles, etc.</li> </ul>
Is the scale of local market volume sufficient to support new investment??		<ul style="list-style-type: none"> <li>Currently, there is no supply of mined or processed materials to a domestic renewable energy market. However, export markets are sufficiently mature, currently exceeding production capacity and projected to continue this trajectory. Cobalt demand is significantly driven by the production of lithium batteries. Currently, most materials for global renewable energy markets are being produced in WA, SA and QLD.</li> <li>A local material processing market could benefit from a local offtake agreement, potentially through government procurement with mandated local content requirements. In the absence of a local offtaker, demand for NSW battery materials will primarily be driven by overseas markets. Downstream supply chain stakeholders claim there is capacity for local battery manufacturers to become an anchor offtaker. <i>"Minerals need an anchor offtake agreement. Not too big – a small, doable order to get their business going, domestic to be safe."</i></li> </ul>

VIABILITY FOR NSW		MINING AND MATERIAL PROCESSING
Criteria	Rating	Notes
Are there market entry barriers?		<ul style="list-style-type: none"> <li>A large capex investment is required for materials processing capability which is a barrier for processing facilities. Project developers are seeking investment directly from overseas manufacturers which is a change in their modus operandi. However, progress is slow and a lack of government support and commitment to developing local supply chain capacity is seen as a barrier to encouraging investment.</li> </ul>

VALUE OF OPPORTUNITY		MINING AND MATERIAL PROCESSING
Criteria	Rating	Notes
What is the scale of the opportunity (employment, revenue)?		<ul style="list-style-type: none"> <li>The Future Battery Industry CRC study (2021) on the lithium supply chain found that adding another processing step to the mining stage increases value add by just over 5%, and if this is extended to electro chemical processing there is potential for an additional 36% of value added. Similar value-added could be achieved by extending downstream processing capability for the nickel, cobalt, and other materials industries in NSW.</li> <li>There are significant employment opportunities. The CRC report highlighted that under a diversified supply chain scenario, 9500 FTE jobs could be established Australia wide in materials processing alone by 2030; 4500 FTE jobs in refining minerals to chemicals, and 4800 FTE jobs in active materials manufacturing. In comparison, only 1500 FTE jobs are created if initiatives are focused only on mining development.</li> <li>As an illustration of the employment potential, if it proceeds Sunrise Energy Metals would engage 1200 FTE for the construction period (approx. 3 years), of which 10% is expected to be engaged locally, and 350 FTE roles during operation. Most workers are expected to be living in the local area permanently during operation.</li> </ul>
Is it likely to be a sustainable, longer-term source of employment?		<ul style="list-style-type: none"> <li>Global demand for battery materials is far exceeding supply capacity. Ongoing growth in demand is predicted as energy and transport sectors continue to electrify towards 2030 and beyond to meet Paris Agreement commitments. Expanding capacity in battery supply chains locally is expected to provide a sustainable source of employment.</li> <li>Again, Sunrise Energy Metals facility illustrates the regional permanent job potential. During the operational phase the facility would be run as a residential mine site with workers expected to live in the Condobolin, Parkes, and Forbes areas. If these workers are sourced from the local community, 350 ongoing FTE roles for the life of the mine.</li> </ul>
How many jobs will be net to existing jobs in the region?		<ul style="list-style-type: none"> <li>There is an opportunity to provide jobs for workers from the declining coal industry. It is expected that workers will be sourced from the established mining industry. Processing skills are specialised and there is an opportunity to draw on skillsets already acquired by workers coming from the coal industry.</li> </ul>
What are the multiplier effects for other industries in the region?		<ul style="list-style-type: none"> <li>Detailed modelling is beyond the scope of this report but the inter-connections between supply chains highlighted in the survey are indicative of potential for multiplier effects.</li> </ul>
What is the potential to reduce unemployment over the longer-term?		<ul style="list-style-type: none"> <li>As above, there is an opportunity to provide alternative employment as coal mining declines</li> </ul>

OPPORTUNITY COST		MINING AND MATERIAL PROCESSING
Criteria	Rating	Notes
What is the impact on RE project costs?	Green	<ul style="list-style-type: none"> <li>Minerals are generally embodied in the components of imported renewable energy technologies so there is no cost impact. Accenture (2021b) have highlighted the potential for cost-competitive battery supply chain that would reduce the risk and cost of battery storage.</li> </ul>
What level of investment in supporting infrastructure is required to facilitate the opportunity or support population growth?	Yellow	<ul style="list-style-type: none"> <li>There are some infrastructure needs (e.g. logistics routes need to be altered during the planning phase to allow for oversize loads during construction for transportation of processing facility segments from port to construction site). However, once transport infrastructure has been upgraded, future manufacturing/processing facilities in the same location can benefit from the shared oversized vehicle access route.</li> </ul>
What is the cost to government?	Green	<ul style="list-style-type: none"> <li>A taskforce to develop battery storage supply chain opportunities is recommended.</li> <li>Accenture (2021b) has recommended the use of royalty incentives to incentivise new mines,</li> </ul>

## Offshore wind

- Offshore wind was not originally included in the identification and evaluation of the REZs by AEMO but has now been flagged for inclusion in the 2021 Input, Assumptions and Scenario report. The development of offshore wind globally, increasing scale and falling costs and new floating wind turbines which can open up access to deeper waters are increasing the viability and interest in offshore wind in Australia. There are several projects at an early stage under development off the coast of Newcastle and Illawarra REZs.
- A study on offshore wind potential has recently been conducted by ISF with CSIRO, funded by the Blue Economy CRC and a group of trade unions (ACTU, AMEU, ETU, MUA), which included consultation with offshore wind developers. The evaluation is drawn from the study findings.
- The construction and operations and maintenance work are locally sited but as with other types of renewable energy there could be variations in the level of imported workers depending on local workforce skills and supply.

VIABILITY FOR NSW		OFFSHORE WIND
Criteria	Rating	Notes
How significant are the advantages of local supply and proximity?	Yellow	<ul style="list-style-type: none"> <li>• The advantages of location vary depending on phase and function. A locally-based construction and maintenance workforce has cost and social licence advantages. Co-location with port facilities will be advantageous.</li> <li>• There are benefits for local production of towers.</li> <li>• It is likely that supply-chains will develop significantly in South-East Asia in response to the large project pipeline there which will be an attractive option for offshore wind projects in Australia.</li> </ul>
Are there local sources of comparative advantage or resources?	Yellow	<ul style="list-style-type: none"> <li>• The UK has been pro-actively implement industry and local content policies through auctions in recent years and has achieved around 25 per cent local content.</li> <li>• Some of the supply chain opportunities include tower manufacturing, port facility development and operations through the construction and maintenance phase (especially for floating wind installations where much of the assembly occurs onshore), vessels (e.g. primarily smaller survey and maintenance vessels), electrical balance of plant (transformers, cables), steel manufacturing (towers and other smaller elements of steel e.g. ladders on towers), cement manufacturing for foundations.</li> <li>• Co-located tower production with steel reduces transport costs by around 20% (around \$200/tonne) and reduces damage. Steel was estimated to be around 50% of the cost of the tower. Keppell Prince stated wind towers would be cheaper to produce in NSW than Victoria.</li> <li>• A better understanding will emerge from the Star of the South project (currently engaging with local suppliers to test scope for local content) and a more detailed supply-chain evaluation project currently being commissioned by one of the NSW developers.</li> </ul>
Can the industry and workforce be scaled to realise the opportunity?	Green	<ul style="list-style-type: none"> <li>• Workforce retraining and relocation would be required to develop the local workforce.</li> <li>• Major pathways internationally for the workforce have been from offshore oil and gas, energy industries and cross-sector skills (e.g. finance). Offshore oil and gas expertise is concentrated in Western Australia and Victoria. Opportunities should exist for transition of the coal workforce within the Illawarra and Hunter</li> <li>• A new wind tower facility can be 'future-proofed' to make the thicker towers for offshore wind projects but new investment would be required in steel manufacturing processes. Developing supply-chains for onshore wind could increase the local content of future offshore wind projects.</li> </ul>



VIABILITY FOR NSW		OFFSHORE WIND
Criteria	Rating	Notes
Is the scale of local market volume sufficient to support new investment?		<ul style="list-style-type: none"> <li>• There are multiple large-scale offshore wind projects under development off the coast of Illawarra and Newcastle. Whilst early-stage, there is over 10 GW of projects under development in these areas which offer the scale for local industry development.</li> <li>• The scale of the local market depends significantly on the realisation of 'energy superpower' scenarios in which large-scale electricity requirements are needed for green hydrogen production (offshore or at port-based export facilities), local heavy industry (e.g. 'green steel'), mass electrification and as a transport fuel. Offshore wind is currently more expensive than onshore wind and solar which will dominate the profile of new generation in coming years. However within the National Hydrogen Strategy, the volume of electricity required for hydrogen production is as high as four and a half times the size of the current National Electricity Market (COAG Energy Council, 2019, 87) and AEMO has stated modelling for offshore wind should be expanded for hydrogen superpower scenarios. Under scenarios where not only does the existing generation fleet need to be replaced but also scaled up multiple times, offshore wind could become a valuable resource.</li> </ul>
Are there market entry barriers to realise the opportunity?		<ul style="list-style-type: none"> <li>• Global Original Equipment Manufacturers have existing supply chains for onshore wind which are generally preferred</li> <li>• Large-scale offshore projects in South-East Asia over the next decade will establish supply chain businesses.</li> </ul>

VALUE OF OPPORTUNITY		OFFSHORE WIND
Criteria	Rating	Notes
What is the scale of the opportunity (employment, revenue)?		<ul style="list-style-type: none"> <li>• Employment modelling was undertaken by ISF for the Blue Economy CRC report. Four scenarios were produced to generate employment estimates based on a range in labour intensity (a high and low employment factor) and local content (high and lower share of local manufacturing – 25% and 10% respectively). In the lower scenario, employment across Australia scales up to between 3,000 – 4,000 jobs annually from 2030 and in the higher scenario to 5,000 – 8,000 jobs each year. Increasing local manufacturing from 10% to 25% increases jobs per year by 1,000-1,500. The modelling assumed a scale up in offshore wind from around 2030 onwards to reflect growth in hydrogen, green manufacturing and electrification.</li> </ul>
Is it likely to be a sustainable, longer-term source of employment?		<ul style="list-style-type: none"> <li>• Offshore wind is similar to onshore wind insofar as there is short-term construction workforce peaks, a smaller but long-term on-going maintenance workforce and uncertainty over the level of local manufacturing. Like onshore renewable energy, there is scope to create long-term employment with a pro-active industry development and training strategy.</li> </ul>
How many jobs will be net to existing jobs in the region?		<ul style="list-style-type: none"> <li>• Offshore wind can create forms of employment that build on and expand current industry in the Hunter and Illawarra REZs</li> </ul>
Are there likely to be multiplier effects for other industries in the region?		<ul style="list-style-type: none"> <li>• As with onshore wind, there is the potential for significant multipliers through the steel supply-chain in particular</li> </ul>
What is the potential to reduce unemployment over the longer-term?		<ul style="list-style-type: none"> <li>• Onshore wind could play a useful role in providing alternative employment as the coal sector declines through job creation in port assembly, local manufacturing, electrical and construction installation and maintenance. Offshore wind can also diversify the business profile of ports.</li> </ul>

OPPORTUNITY COST		OFFSHORE WIND
Criteria	Rating	Notes
What is the impact on RE project costs?		<ul style="list-style-type: none"> <li>It is too early to assess any implications without consideration of detailed local content mechanisms. It is likely that similar considerations will apply as in onshore wind.</li> </ul>
What level of investment is required to facilitate the opportunity?		<ul style="list-style-type: none"> <li>Investment in upgrading port facilities to accommodate offshore wind will be required. Significant port infrastructure upgrades have occurred internationally, which also represents an opportunity.</li> </ul>
What is the cost to government?		<ul style="list-style-type: none"> <li>The development of offshore wind is at too early at a stage to meaningfully assess potential costs to government.</li> </ul>

---

## Appendix 6: References

- AAC Australian Aluminium Council. (2021). *Recycling*. Retrieved October 18, 2021, from <https://aluminium.org.au/australian-industry/recycling/>
- Andrenacci, N., Chiodo, E., Lauria, D., & Mottola, F. (2018). Life cycle estimation of battery energy storage systems for primary frequency regulation. *Energies*, 11(12). <https://doi.org/10.3390/en11123320>
- ARENA (2018) *ARENA's large scale solar program: A look at levelised cost of energy*  
<https://arena.gov.au/assets/2018/12/large-scale-solar-program-a-look-at-levelised-cost-of-energy.pdf>
- ASSDA Australian Stainless Steel Development Association. (2005). *Recycling*. Retrieved October 18, 2021, from <https://www.assda.asn.au/technical-info/environment-health-and-safety/recycling>
- Australian Energy Market Operator (2020) 2020 Inputs and Assumptions Workbook (Dec20)  
<https://aemo.com.au/en/energy-systems/major-publications/integrated-system-plan-isp/2022-integrated-system-plan-isp/current-inputs-assumptions-and-scenarios>
- Australian Trade and Investment Commission. (2018). *The Lithium-Ion Battery Value Chain – New Economy Opportunities for Australia*.
- Australian Steel Institute (2020), *Capabilities of the Australian steel industry to supply major projects in Australia*  
<https://www.steel.org.au/getattachment/About-Us/Our-industry/Australian-steel-industry-capability-and-capacity/Steel-Industry-Capability-document-131020.pdf?lang=en-AU>.
- Benzoil. (2021). *Transformer oil*. Retrieved October 18, 2021, from <https://benzoil.com.au/products/transformer-oil/>
- Black & Veatch (2012) *Cost and performance data for power generation technologies*, NREL.
- Briggs, C., Hemer, M., Howard, P., Langdon, R., Marsh, P., Teske, S & Carrasco, D. (2021) *Offshore Wind Energy in Australia*, Blue Economy CRC.
- Briggs, C., Rutovitz, J., Dominish, E., Nagrath, K. (2020) *Renewable Energy Employment in Australia*. Prepared for the Clean Energy Council by the Institute for Sustainable Futures at the University of Technology Sydney.  
<https://www.uts.edu.au/sites/default/files/2020-06/Renewable-Jobs-Australia-ISF%20F.pdf>
- Briggs C., Rutovitz J., Jazbec M., Langdon R., Nagrath K., University of Technology Sydney with Infrastructure Australia. (2021) *Market Capacity for Electricity Generation and Transmission Projects*. A report from Infrastructure Australia's Market Capacity Program
- Buckley, H., Wills, R., & Prentice, N. (2018). *A lithium industry in Australia - A value chain analysis for downstreaming Australia's lithium resources*. [www.futuresmart.com.au](http://www.futuresmart.com.au)
- Cement Concrete & Aggregates Australia. (2008). *Use of Recycled Aggregates in Construction* (Issue May).
- Cement Concrete Aggregates Australia (2018). *Australia's concrete industry reports record production year*.  
[https://www.ccaa.com.au/documents/271118\\_NAT\\_FIGURES\\_REVEAL\\_BIG\\_BOOM\\_IN\\_HEAVY\\_MATERIALS.pdf](https://www.ccaa.com.au/documents/271118_NAT_FIGURES_REVEAL_BIG_BOOM_IN_HEAVY_MATERIALS.pdf)
- COAG Energy Council (2019) National Hydrogen Strategy, <https://www.industry.gov.au/sites/default/files/2019-11/australias-national-hydrogen-strategy.pdf>
- Cobalt Blue. (2021). *Broken Hill Cobalt Project*. Retrieved August 30, 2021, from <https://cobaltblueholdings.com/broken-hill/broken-hill-cobalt-project/>
- CSIRO Futures. (2016). *Australia 2030: navigating our uncertain future*. Retrieved 28 October 2021 from [https://www.csiro.au/~media/Do-Business/Files/Futures/FUTURES\\_Australia2030\\_Report\\_web.pdf?la=en&hash=9612D5EC9C7998DC660269E1BDCE4F52B512C9E7](https://www.csiro.au/~media/Do-Business/Files/Futures/FUTURES_Australia2030_Report_web.pdf?la=en&hash=9612D5EC9C7998DC660269E1BDCE4F52B512C9E7)
- Department of Employment (2017) *Skill Shortages Research Methodology*,  
<https://docs.employment.gov.au/documents/skill-shortage-research-methodology-0>
- Department of Planning, Industry and Environment. (2020) *NSW Electricity Infrastructure Roadmap: Building an Energy Superpower*,
- Edis, T. (2021) 'DER Final Projection FRG meeting, April 2021'. Green Energy Markets.
- Energy Renaissance. (2021). *Australia's first battery factory location - Renaissance One will call the Hunter home*. Retrieved Oct 18, 2021, from <https://renaissanceone.com.au/battery-factory-calls-the-hunter-region-home/>
- Geoscience Australia (2016) *Aluminium* <https://www.ga.gov.au/education/classroom-resources/minerals-energy/australian-mineral-facts/aluminium>
- Gonski, D & Shergold, P. (2021) *In the Same Sentence: Bringing Higher and Vocational Education Together*, March.

- Healy, J., Mavromaras, K & Sloane, P. (2015) 'Adjusting to Skill Shortages in Australian SMEs, *Applied Economics*, 47 (24): 2470-2487.
- IRENA (2020) *Renewable Power Generation Costs in 2020* <https://www.irena.org/publications/2021/Jun/Renewable-Power-Costs-in-2020>
- Minerals Council Australia (2017) *Copper. Making the future possible.*  
[https://www.ccaa.com.au/documents/271118\\_NAT\\_FIGURES\\_REVEAL\\_BIG\\_BOOM\\_IN\\_HEAVY\\_MATERIALS.pdf](https://www.ccaa.com.au/documents/271118_NAT_FIGURES_REVEAL_BIG_BOOM_IN_HEAVY_MATERIALS.pdf)
- NREL (2019a) *Cost of Wind. Energy review.*
- NREL (2019b) *Expanding the Photovoltaic Supply Chain in the United States: Opportunities and Challenges*
- NSW Government (2018) *High-tech metal resources of NSW*  
[https://www.resourcesandgeoscience.nsw.gov.au/\\_data/assets/pdf\\_file/0008/836954/high-tech\\_map.pdf](https://www.resourcesandgeoscience.nsw.gov.au/_data/assets/pdf_file/0008/836954/high-tech_map.pdf)
- NSW Government (2021) *Copper. Opportunities in New South Wales, Australia*  
[http://www.resourcesandenergy.nsw.gov.au/\\_data/assets/pdf\\_file/0008/541457/copper.pdf](http://www.resourcesandenergy.nsw.gov.au/_data/assets/pdf_file/0008/541457/copper.pdf)
- NSW Productivity Commission (2021) *White Paper 2021: Rebooting the Economy.*
- Productivity Commission (2020) *National Agreement for Skills and Workforce Development Review*, Study Report, December.
- Rutovitz, J., Briggs, C., Dominish, E., Nagrath, K. (2020) *Renewable Energy Employment in Australia: Methodology.* Prepared for the Clean Energy Council by the Institute for Sustainable Futures at the University of Technology Sydney.  
<https://www.uts.edu.au/sites/default/files/2020-06/RE-Employment-methodology-FINAL.pdf>
- Sandia National Laboratories. (2016). *On the Role of Power Electronics and Power Conversion Systems in Grid- Energy Storage.*
- SGS. (2020). *SATC facility: Demand assessment for new TAFE NSW facility*
- Tasmanian Energy and Industry Workforce Advisory Committee (2020), *Tasmanian Energy Industry Workforce Development Plan 2020 to 2027.* available at:  
[www.skills.tas.gov.au/\\_data/assets/pdf\\_file/0007/274903/Workforce\\_Development\\_Plan\\_for\\_the\\_Tasmanian\\_Energy\\_Sector\\_Stage\\_1.pdf](http://www.skills.tas.gov.au/_data/assets/pdf_file/0007/274903/Workforce_Development_Plan_for_the_Tasmanian_Energy_Sector_Stage_1.pdf).
- Tomago (2021) <https://www.tomago.com.au/about-us/our-story>
- Victorian Government (2019) *Wind and Solar Facilities: Victorian Business Supply-Chain Directory,*  
[https://business.vic.gov.au/\\_data/assets/pdf\\_file/0007/1877542/Victorian\\_Wind\\_and\\_Solar\\_Facilities\\_Victorian\\_Business\\_Supply\\_Chain\\_Directory.pdf](https://business.vic.gov.au/_data/assets/pdf_file/0007/1877542/Victorian_Wind_and_Solar_Facilities_Victorian_Business_Supply_Chain_Directory.pdf)
- Zhao, Y., Ruether, T., Bhatt, A. I., & Staines, J. (2021). Australian Landscape for Lithium Ion Battery Recycling and Reuse in 2020 - Current status, gap analysis and industry perspectives. In *FBI CRC* (Issue February).



Institute for  
Sustainable  
Futures



**SGS**  
Economics  
& Planning