Employment, Skills and Supply-Chains: Renewable Energy in NSW – Summary Presentation

Prepared for Department of Planning, Industry and Environment by Institute for Sustainable Futures, University of Technology Sydney and SGS Economics and Planning

October 2021

ISF is an independent research institute within the University of Technology Sydney. We conduct transdisciplinary, project-based research in line with our vision of creating positive change towards sustainable futures.

SGS Economics and Planning is a public policy advisory business informing important policy and investment decisions for more sustainable cities and regions

Contact: Chris Briggs, e: Chris.Briggs@uts.edu.au
Institute for Sustainable Futures
University of Technology Sydney
PO Box 123 Broadway, NSW, 2007
www.isf.uts.edu.au

Contact: Jeremy Gill, e: JGill@sgsep.com.au
SGS Economics and Planning Pty Ltd
ACN 007 437 729
www.sgsep.com.au

ISF and SGS acknowledge and respect the Aboriginal and Torres Strait Islander custodians of Australia and the Traditional Owners of the land upon which we live and work. We pay our respect to their Elders past, present and emerging.

Contents

01

Introduction

Scope and project context

About the project

The New South Wales Department of Planning, Industry and Environment (NSW DPIE) commissioned the Institute for Sustainable Futures (ISF), University of Technology Sydney and SGS Economics and Planning (SGS) to identify and assess renewable energy sector employment and regional development opportunities, including existing and potential local supply chains.

The focus of the study is the electricity infrastructure to be constructed under the NSW Electricity Infrastructure Roadmap, including the establishment of NSW Renewable Energy Zones (REZs).

The primary objective of this project was to provide advice to the NSW Renewable Energy Sector Board (RESB). The RESB was established to prepare a plan for the Minister for Energy and Environment on how to cost-effectively maximise local industry development, employment and opportunities for apprentices and trainees in the course of developing and operating the NSW REZs.

Project aim

- develop a detailed understanding of renewable energy supply chains, employment and skills
- develop an understanding of opportunities that exist to build local capacity and employment and the barriers to realising the opportunities
- recommend actions to realise the opportunities

Project components

- analysing the workforce and skill requirements across the project lifecycle including inputs, construction, operation and maintenance, decommissioning/recycling and training and education capacity
- developing a baseline for each REZ on the current state of their involvement in the entire renewable energy supply chain, as well as their industry, training and labour market capacity
- mapping the opportunities across renewable energy supply chains from ‘cradle to grave’ - including raw material supply and processing (for example, cement, steel and copper), manufacturing and construction of electricity infrastructure, and the ‘back-end’ of the supply chain (such as recycling)
- assessing the opportunities, barriers and strategies to increase local industry development, employment and training

Scope exclusions

Excluded from scope (or lightly touched on):

- renewable energy industrial precincts (focus of the NSW Net Zero Industry program)
- hydrogen (focus of the NSW Net Zero Industry program)
- distributed solar and storage

Research methods

Method	Description
Desktop research and analysis 	Review of data, literature and modelling to inform: • Mapping renewable energy supply chains, including the value breakdown between activities and phases, and a profile of employment in renewable energy, transmission and storage • REZ baseline analysis, including labour market and workforce structure, training, education, and skills development offerings, and a summary projection of employment and population
Stakeholder Engagement 	Interviews: June-July, 27 semi-structured interviews with 42 stakeholders including members of the RESB and other renewable energy sector experts. Explored stakeholder views on opportunities, barriers and actions. Survey: July- August, Online survey targeting local businesses with current or future capacity to engage in renewable energy supply chains, distributed through relevant peak organisations and local networks. 200 complete surveys and a further 57 partial responses. Regional stakeholder workshops: July-August, one workshop in each of the five REZs , with a total of 70 participants. Workshops explored stakeholder views on renewable energy supply chain opportunities, barriers and actions.

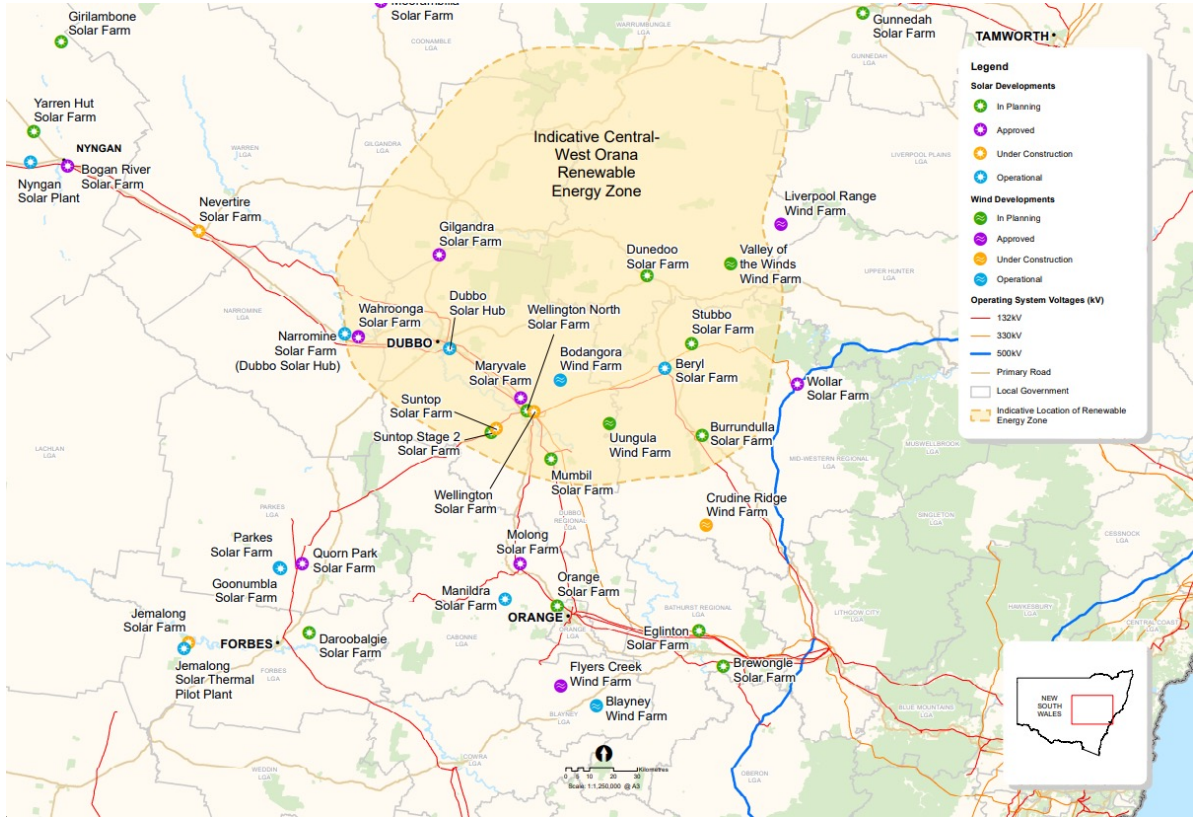
Desktop research and stakeholder inputs were synthesised to inform the analysis of barriers, opportunities and recommended actions.

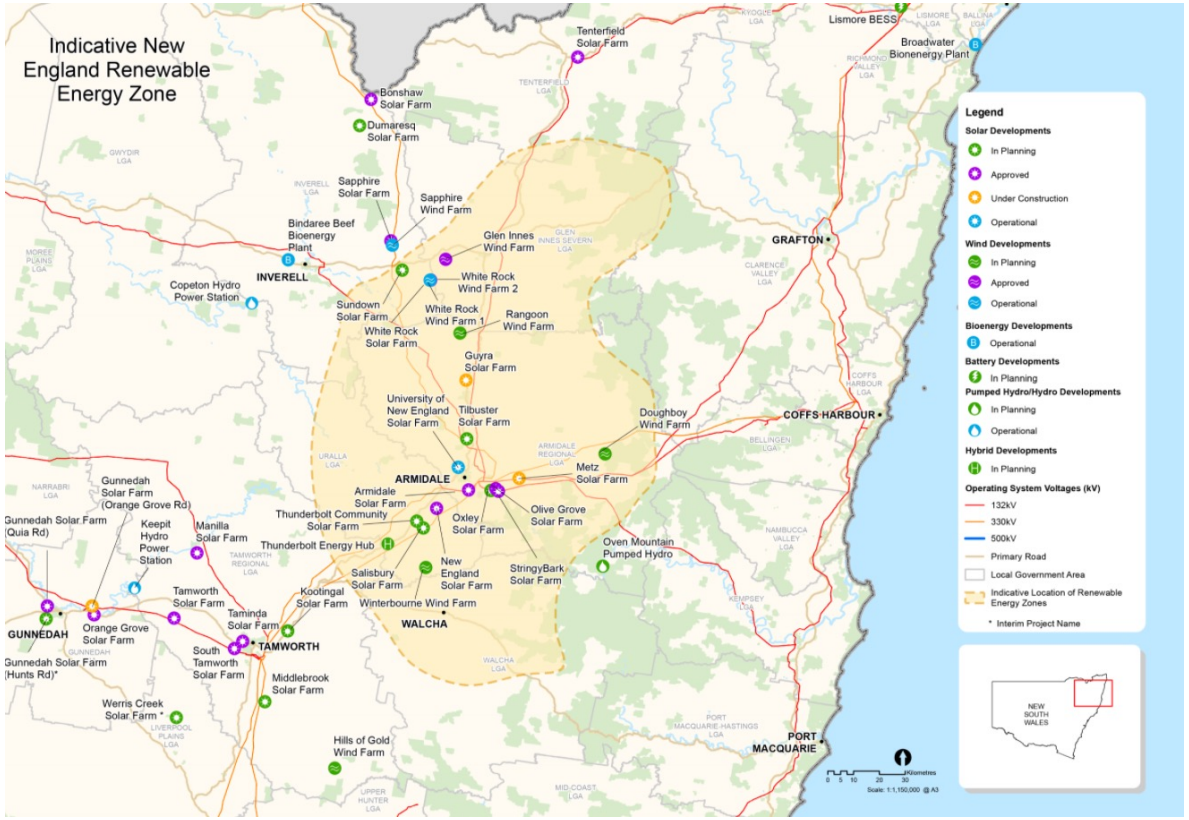
Key deliverables

- July: Progress report – results of initial desktop research and interviews, draft framework for evaluation of opportunities and preliminary opportunities list
- September: Summary presentation in PowerPoint (this presentation) – summary of research findings, analysis of barriers and opportunities [NOTE: recommended actions are under consideration by the NSW RESB and are not included in this presentation]. As this presentation is a summary of the full report, it contains high level findings and does not include references. Further details and references are included in the final report.
- October: Final report – full report of research findings, analysis of barriers and opportunities and recommended actions

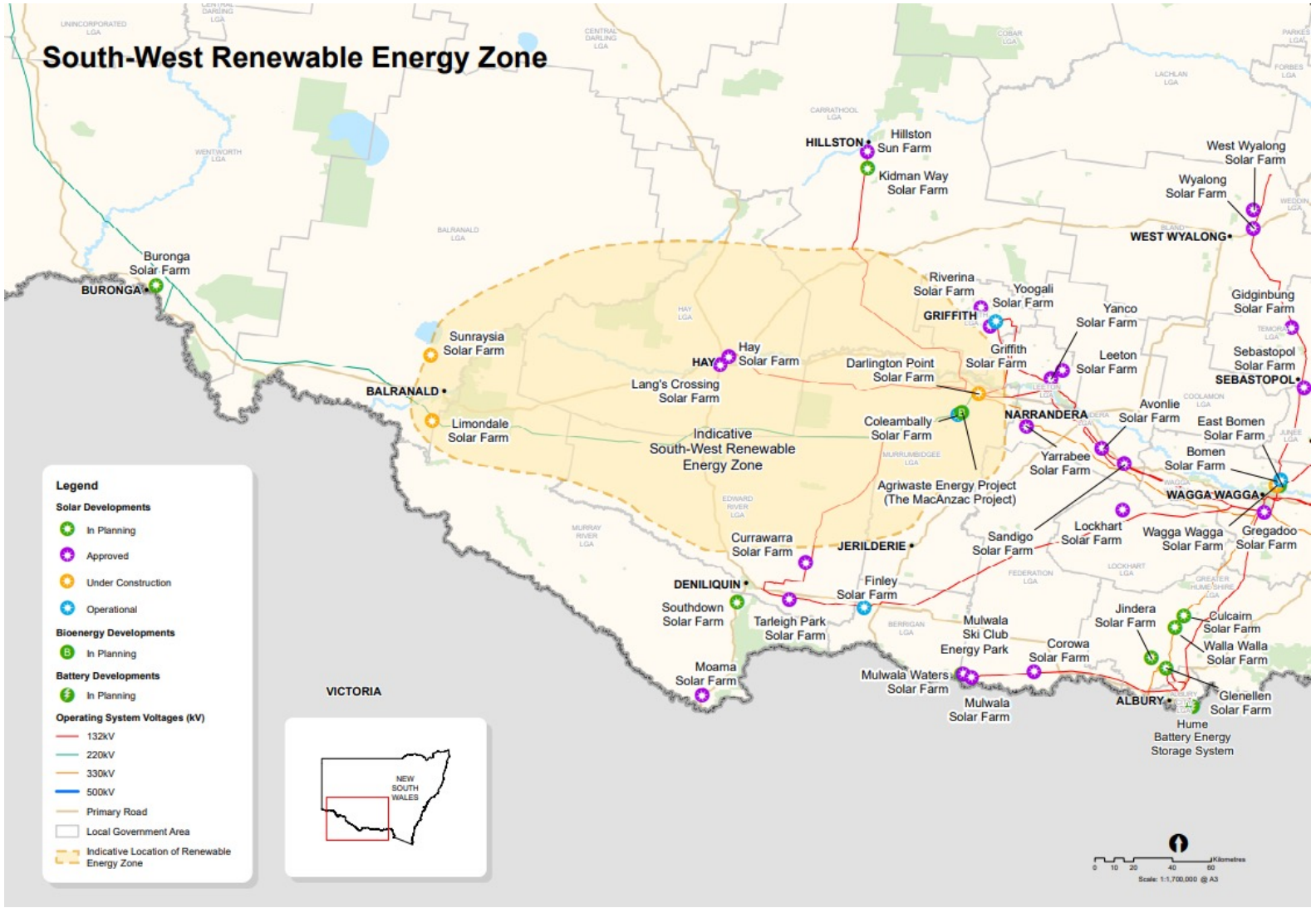
Renewable Energy Zones: indicative location maps

Note: maps are not yet available for the Hunter-Central Coast and Illawarra REZs as these zones are at an earlier stage of planning





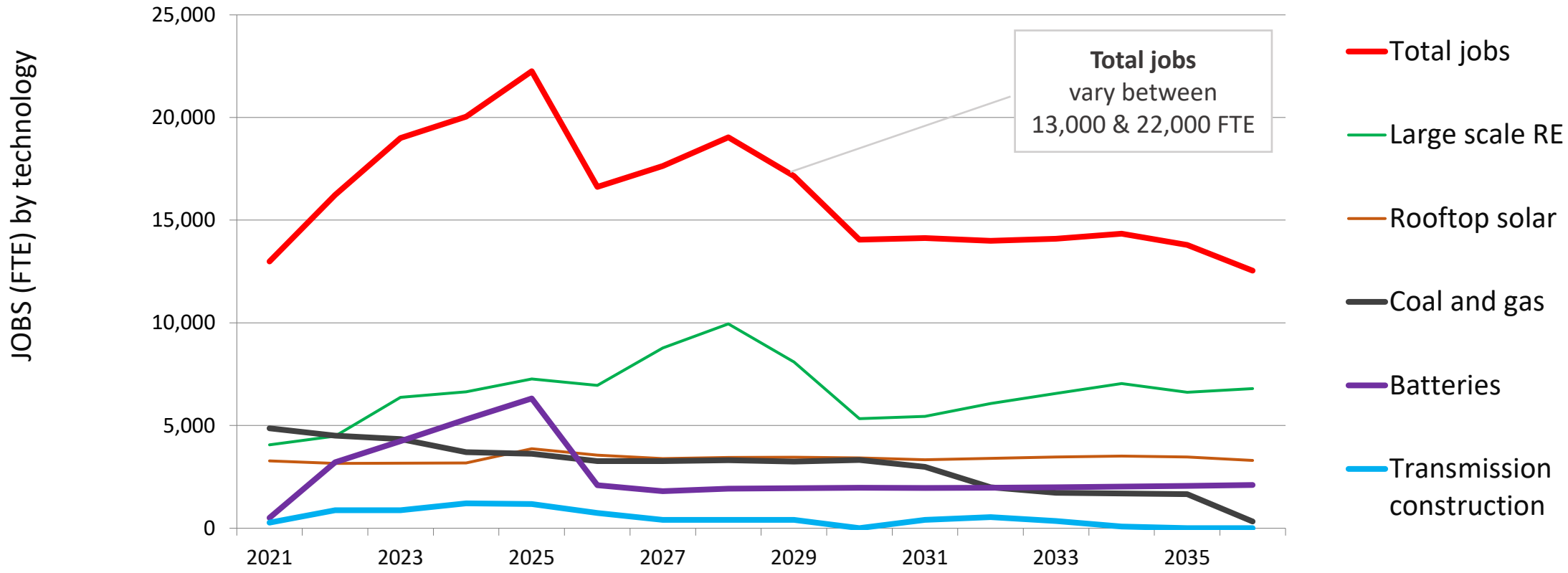
Renewable Energy Zones



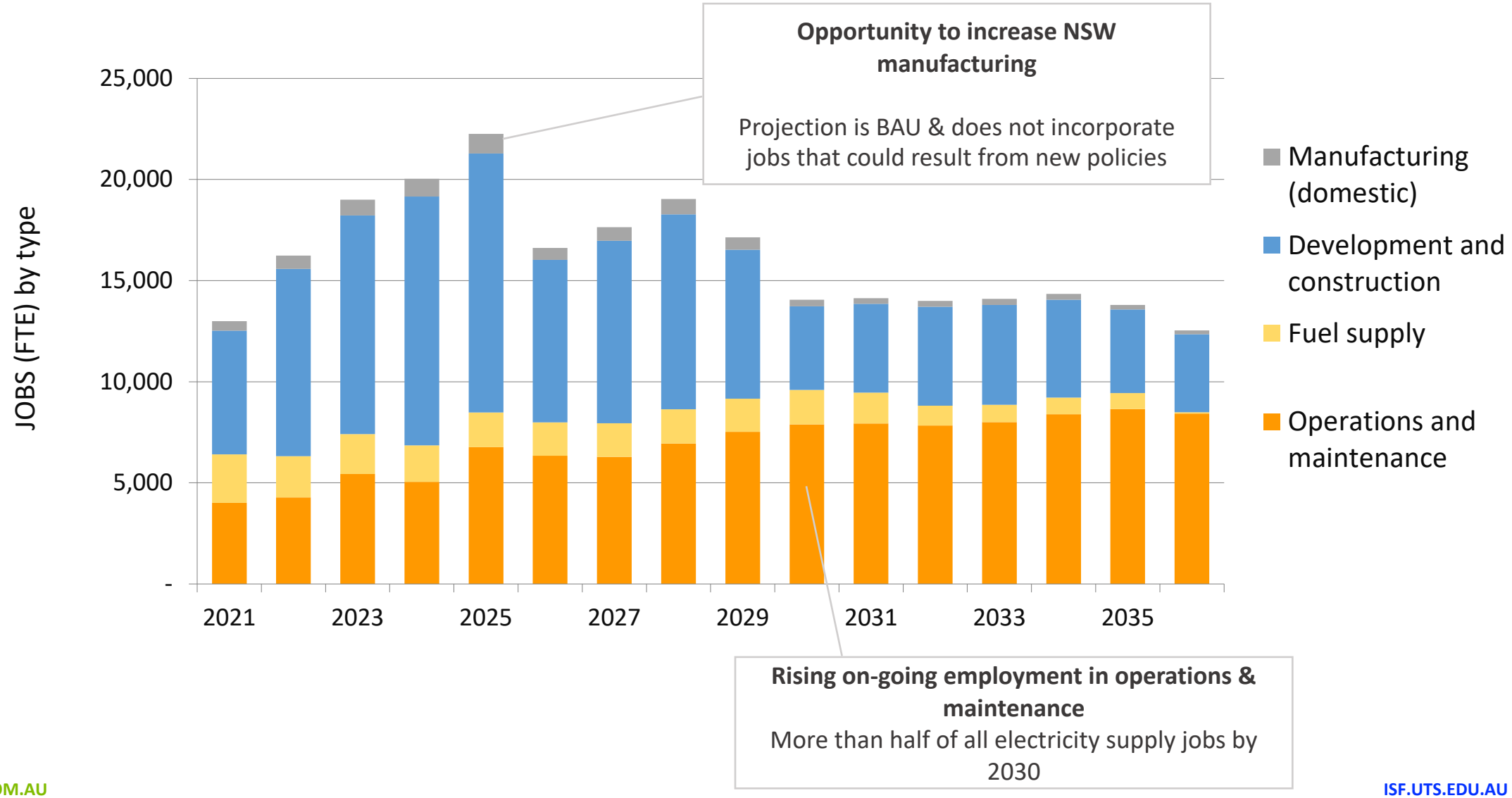
02

NSW-wide employment and material projections

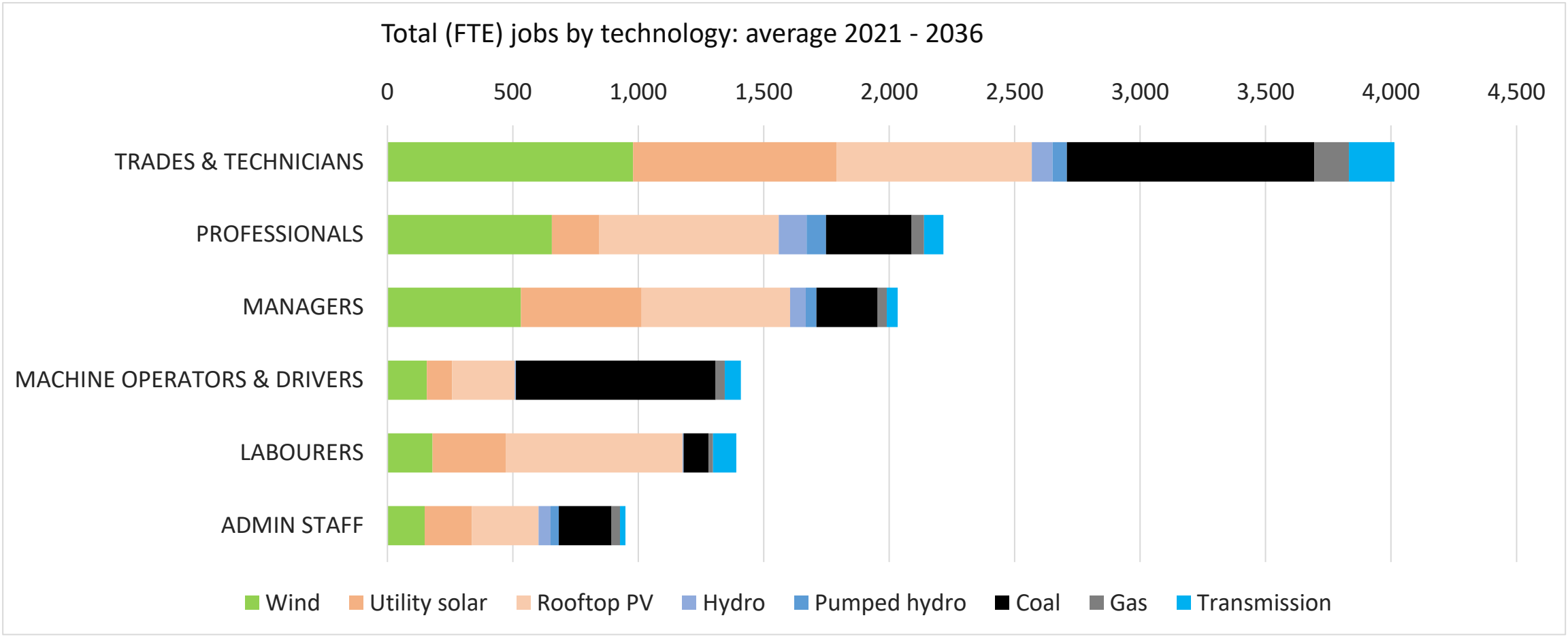
NSW Electricity Supply – Employment by Technology



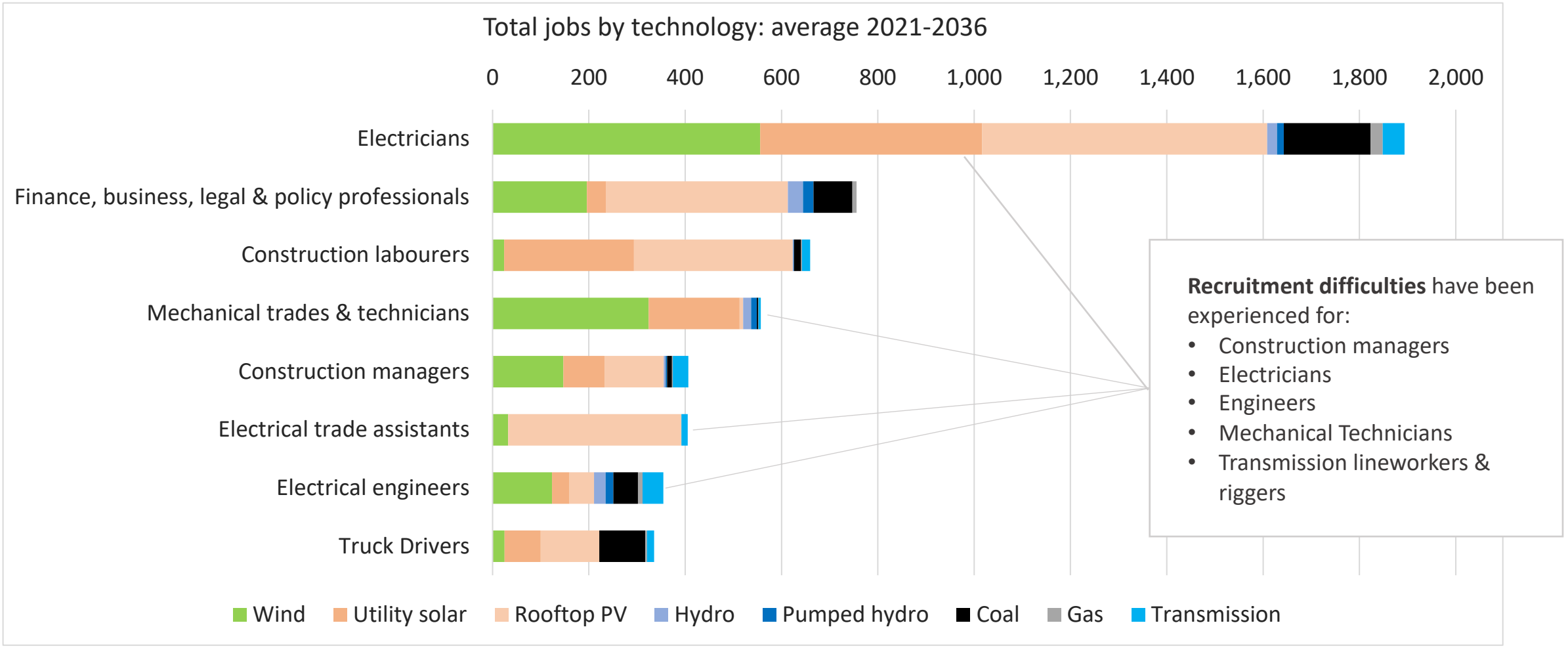
NSW Electricity Supply – Employment by Phase



Occupational employment - summary

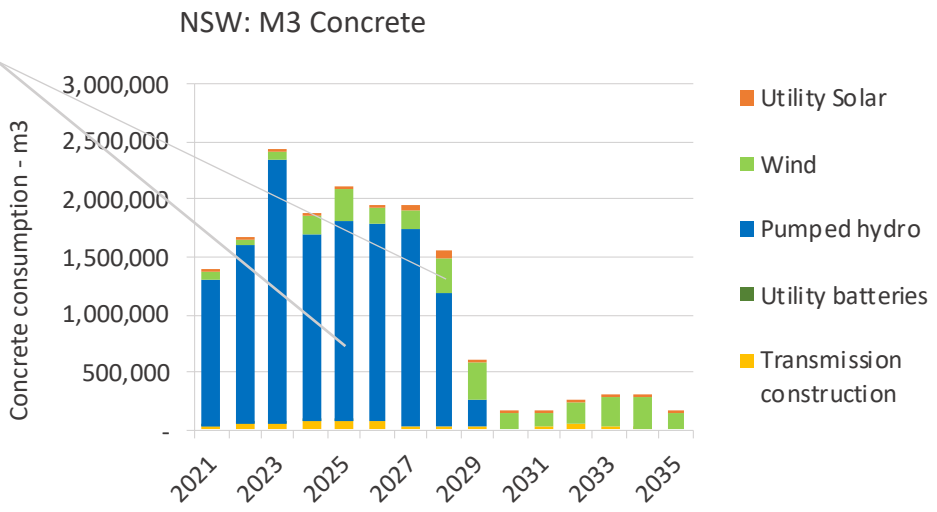


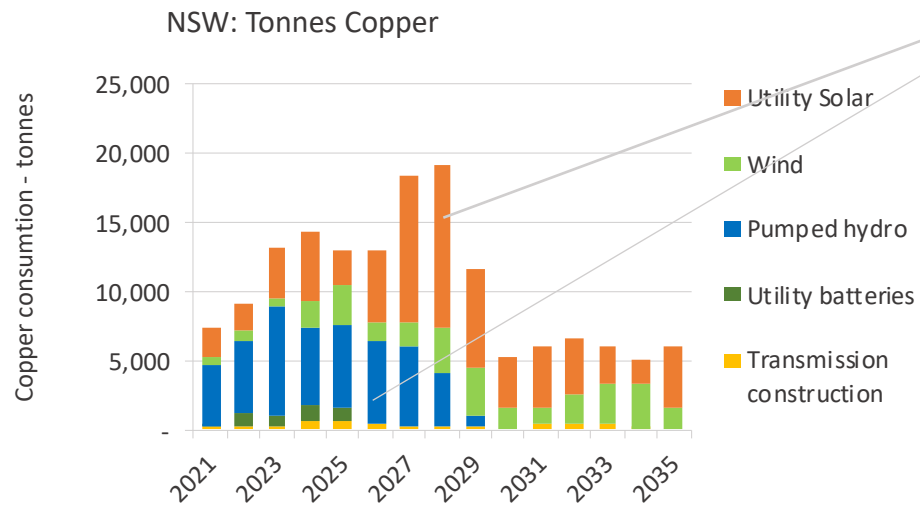
Occupational employment – key occupations



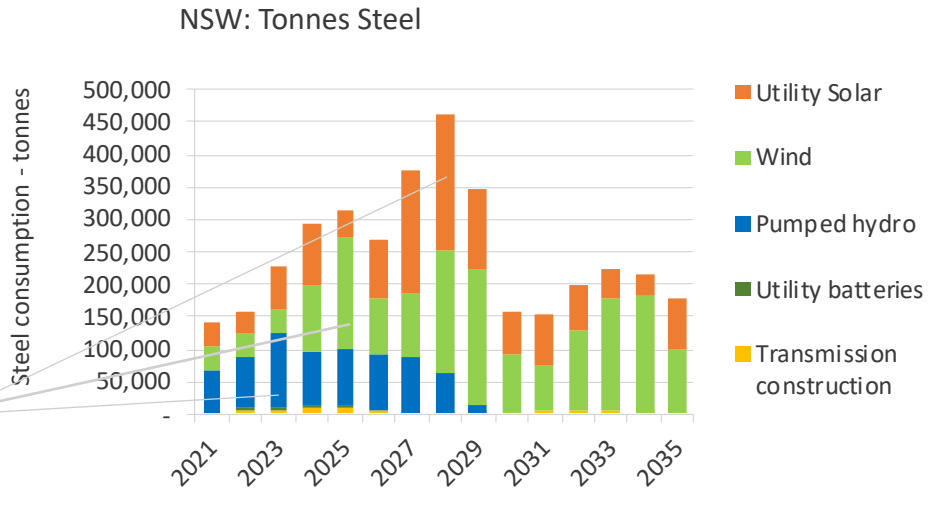
NSW Material Demand

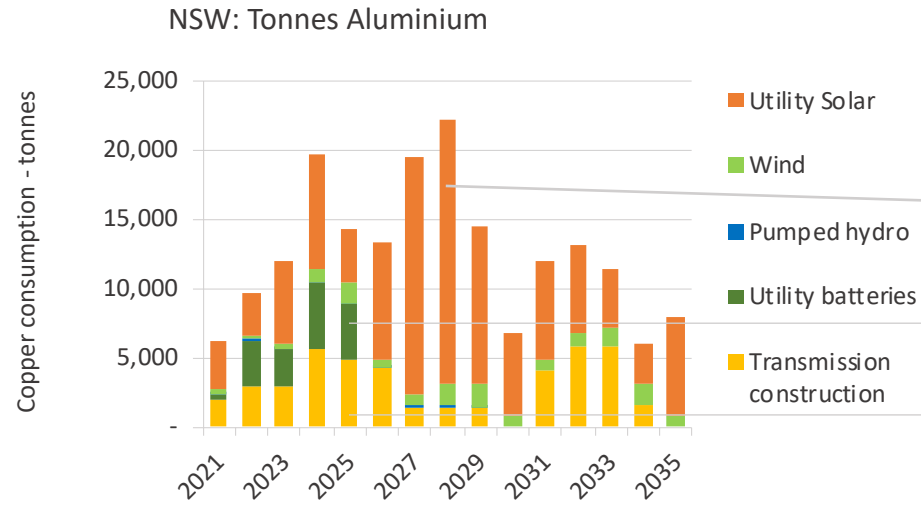
Hydro reservoirs & wind turbine foundations





Electrical & wiring





Foundations
Wind towers
Hydro piping

Solar frame & rack
Battery rack & cells
Transmission cabling & components

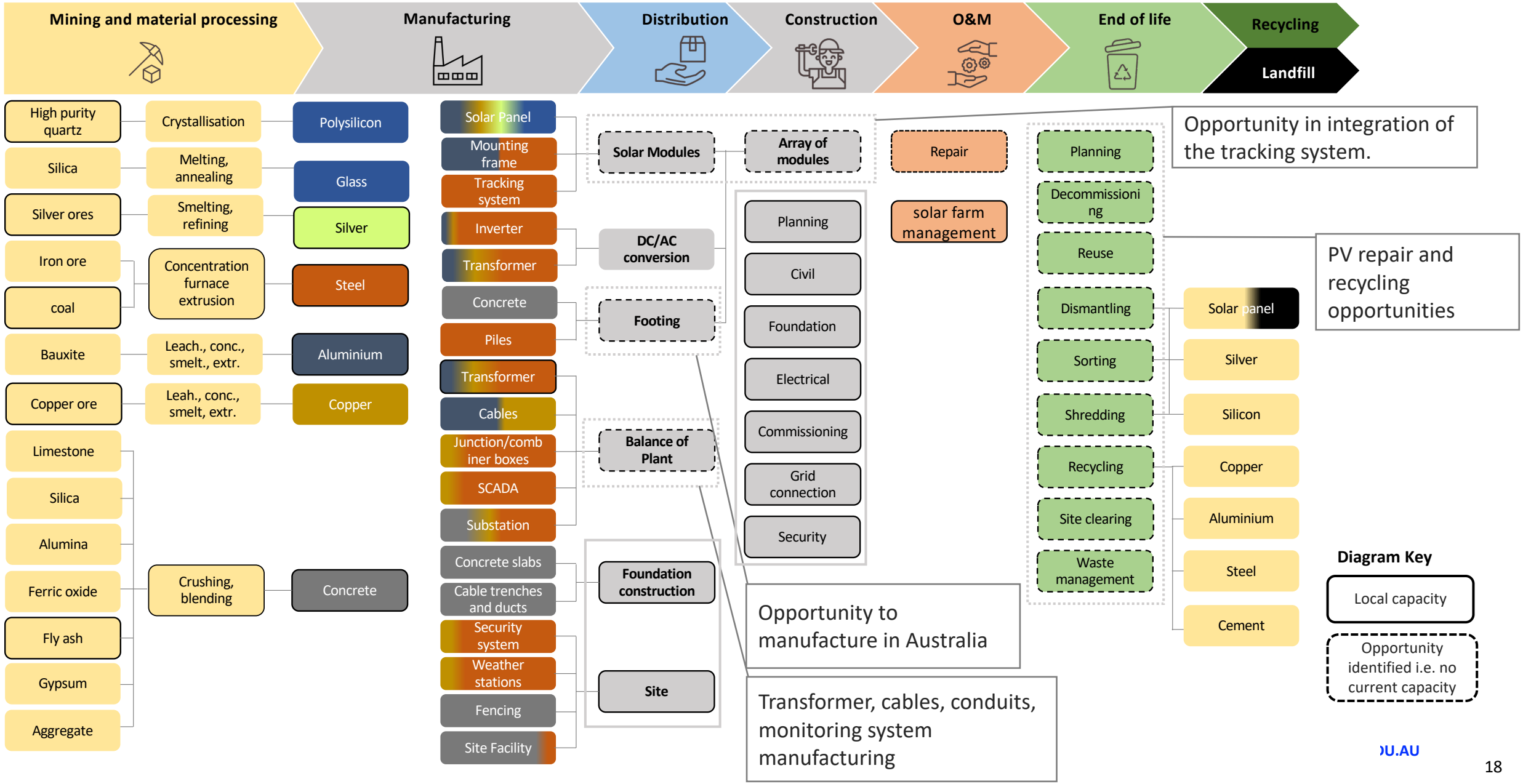
03

Renewable energy supply chains

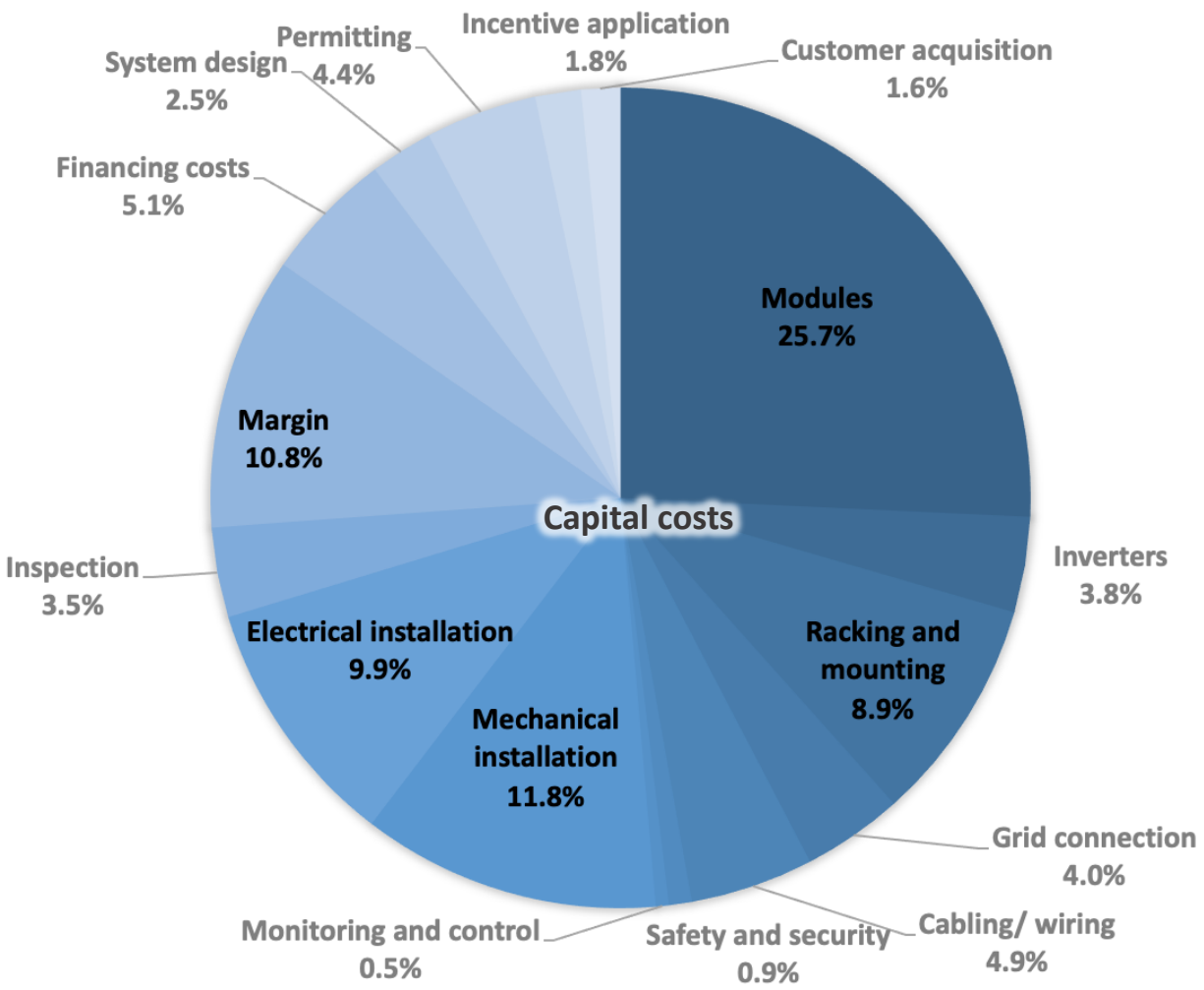
Introduction

- The supply chain for each technology has been mapped upstream of the projects from mining through mineral processing, to manufacturing, and downstream to include end-of-life processes.
- Within each supply chain map, the material inputs are identified as well:
  - Areas where there are existing NSW industry, and
  - Where there could be opportunities to develop NSW industry.
- Available data on the distribution of value across the supply chain is included (noting there are variations between technologies)
- Survey data on NSW business experience and capability within renewable energy supply chains.

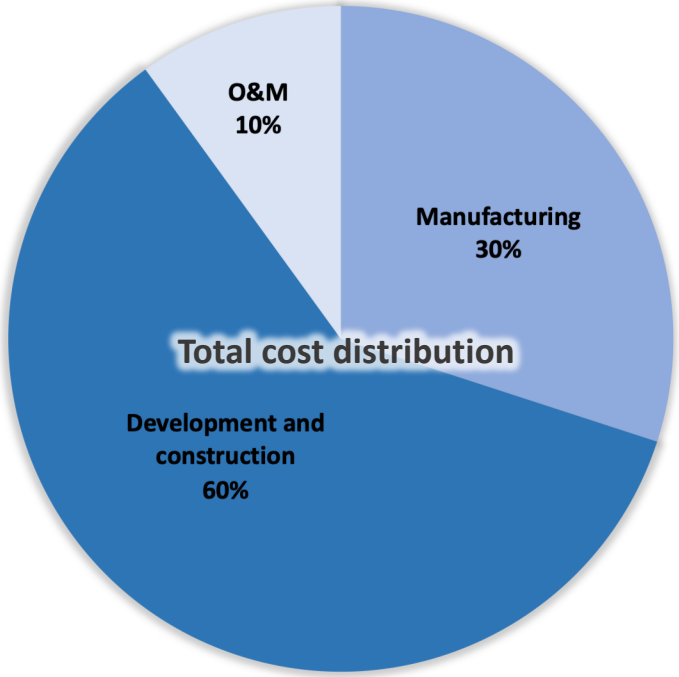
Solar supply chain



Solar supply chain

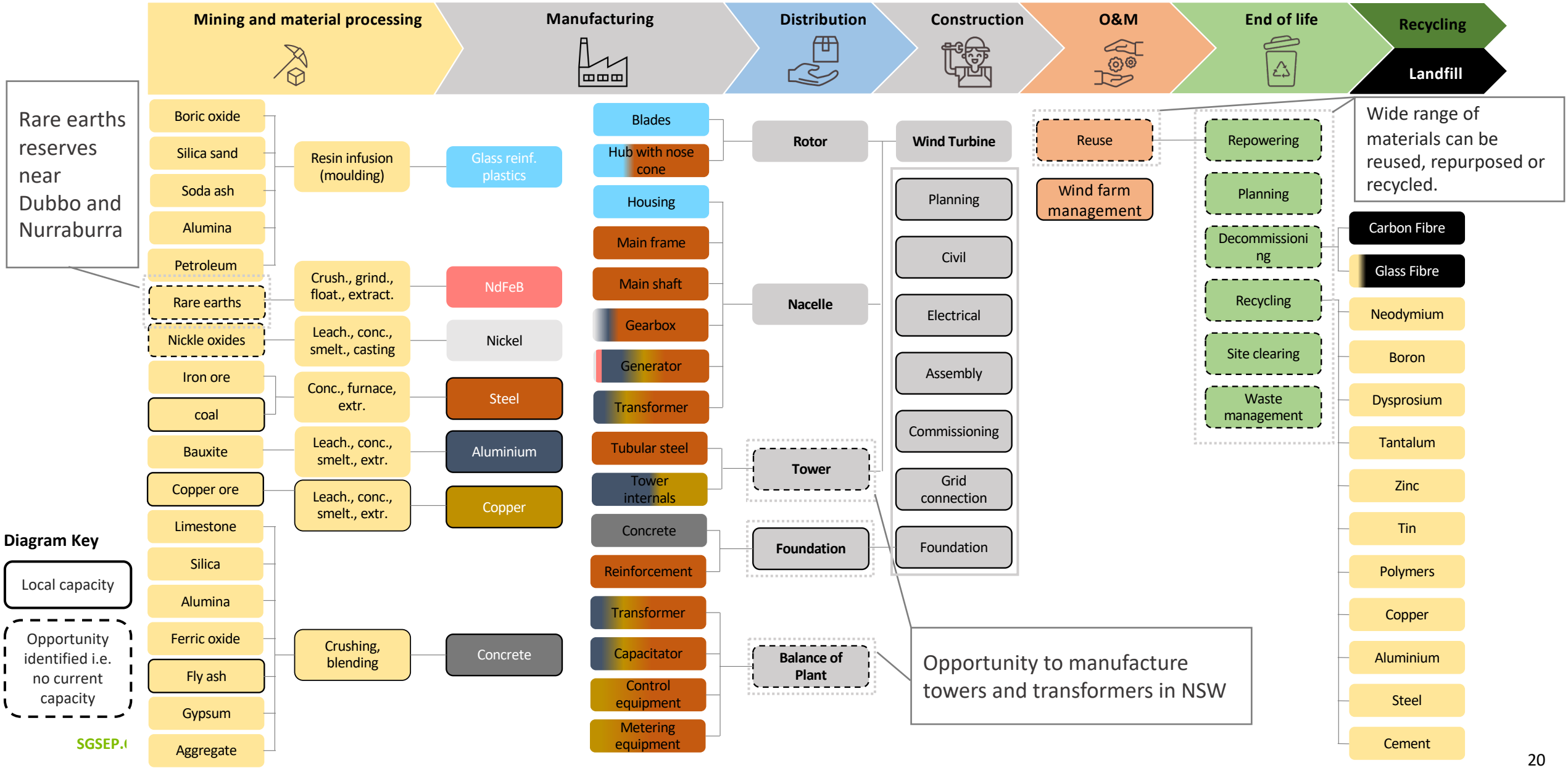


Source: International Renewable Energy Agency 2020

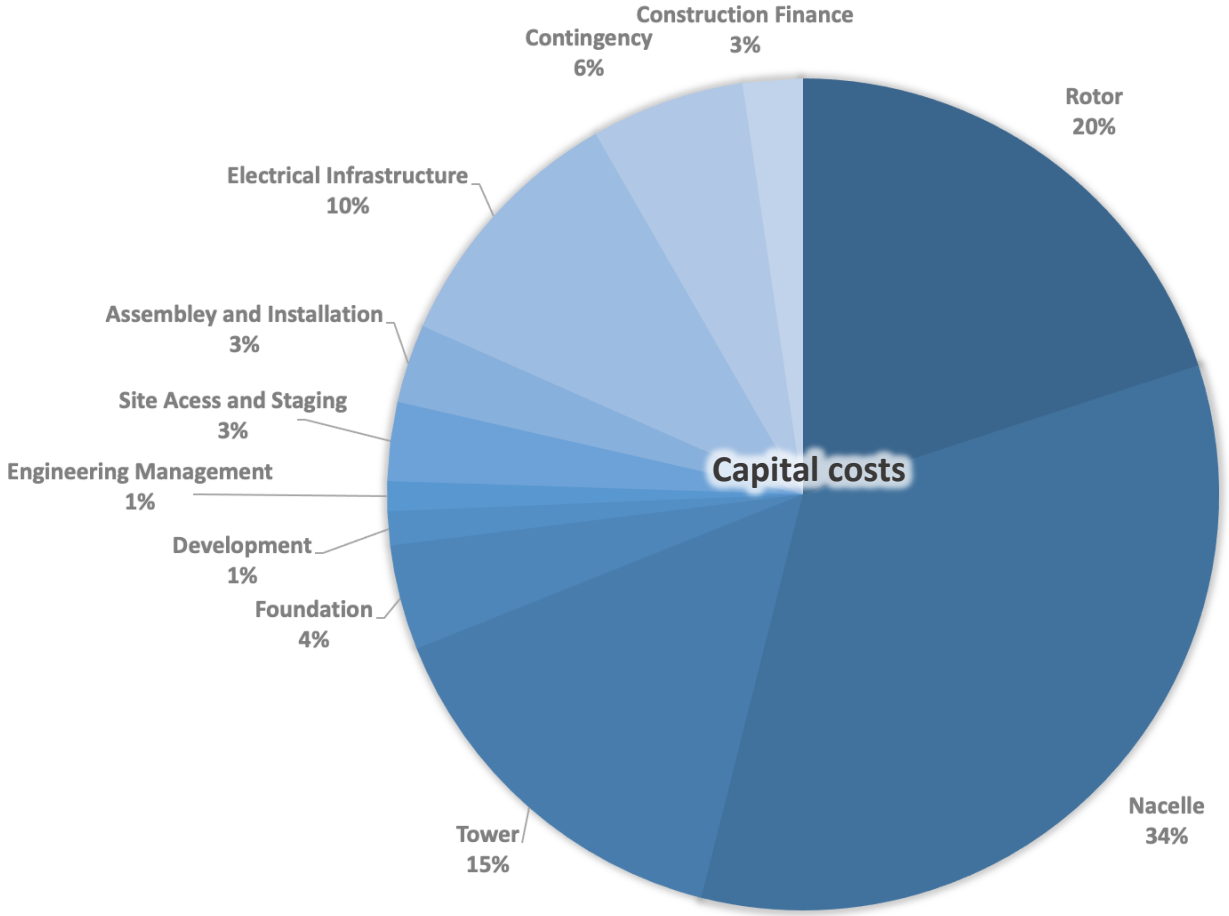


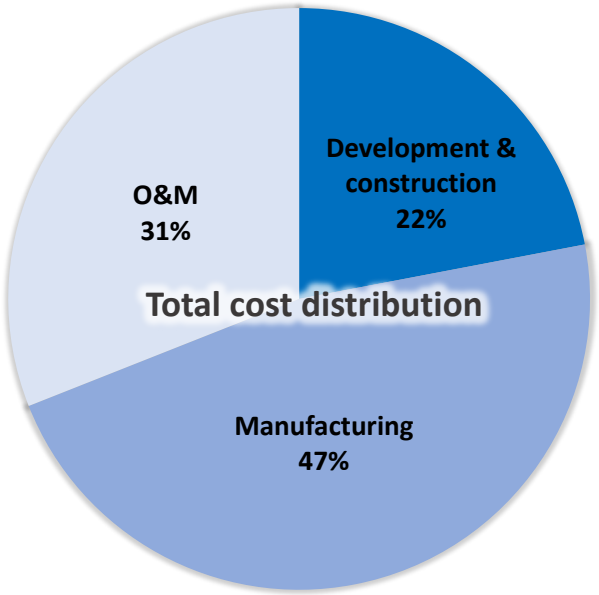
- Of the capex, imported modules (1/4), racking/ mounting (10%) are the major manufacturing components
- Electrical and mechanical installation account for over 1/5 of cost
- Once O&M is included using ARENA data (2020) (9-20% of the total project cost), manufacturing is just under 1/3 and development/construction just under 2/3 of total cost.

Wind supply chain



Wind Supply Chain - Cost distribution

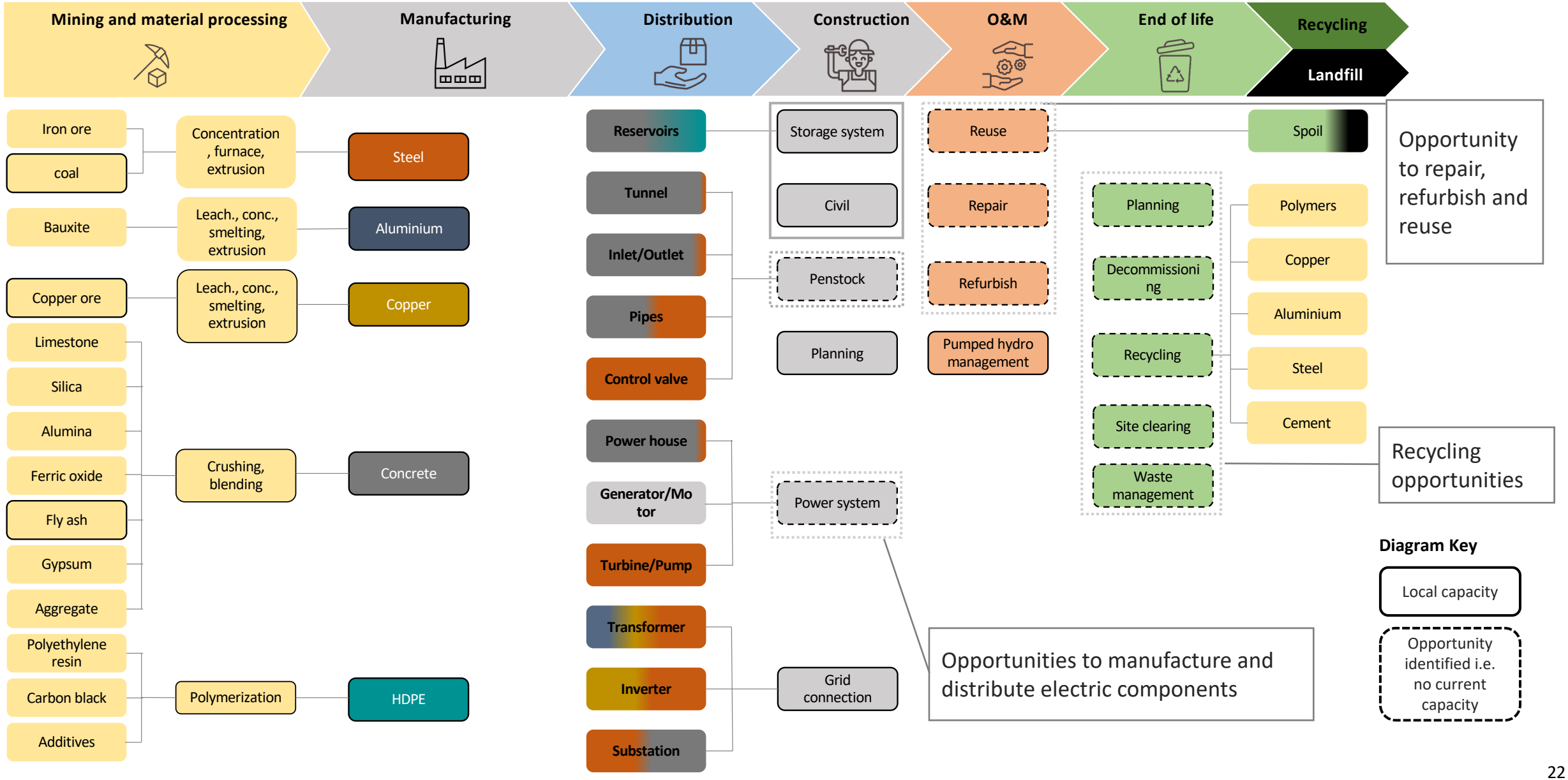




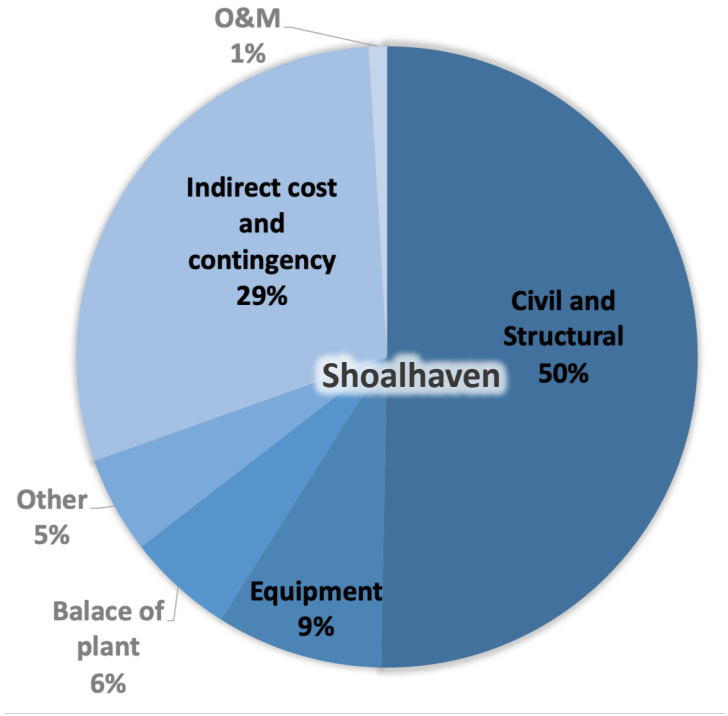
- For the 25 year life span of the wind farm, O&M accounts for about a third of the cost relative to just under half for manufacturing
- Cost of imported nacelle and blades account for 55% of capex and 40% of total cost (once O&M is included)
- The value of the towers account for 15% of capex and 10% of total cost. Tower is predominantly comprised of steel, which is 50% of the cost of the tower

Source: NREL, 2019 Cost of Wind Energy Review

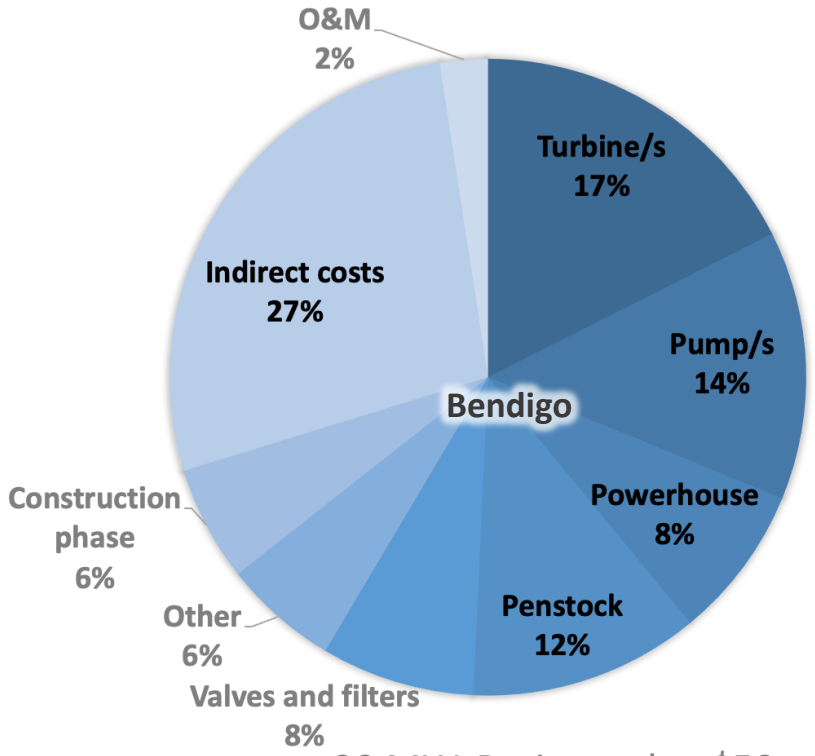
Pumped hydro supply chain



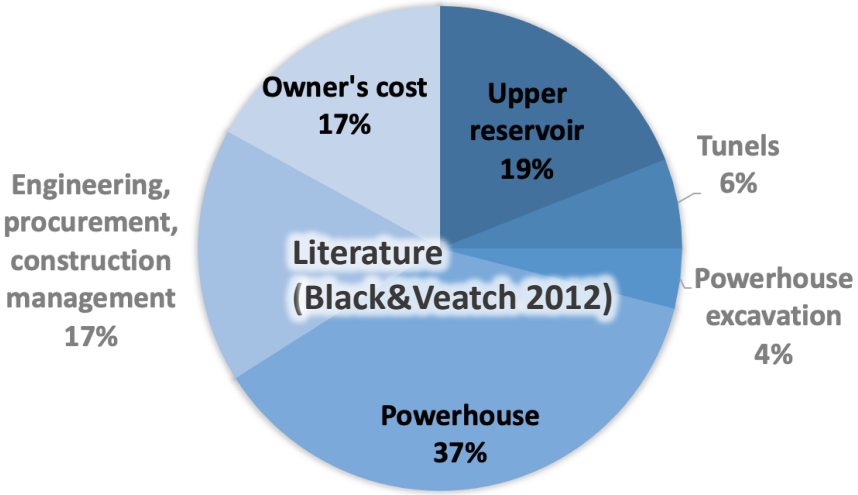
Pumped hydro supply chain cost distribution



235 MW, Project value $576m



30 MW, Project value $50m



500 MW, Project value $1672m

- There is a big range in project costs from $1m – $3.5m/MW.
- The value distribution varies considerably between pumped hydro projects depending on a) the extent of civil and construction works required and b) the capacity – the cost of the equipment (pumps, turbines and balance of power) becomes more significant in smaller projects.
- Indirect costs (e.g. general, design and approval) are more consistent across the three projects representing almost a third of the costs.
- The operation and maintenance costs are estimated to be 1-2% of the total cost per annum (maintenance of the plant plus staffing).

Battery supply chain

Local capacity in planning, civil & electrical construction
Opportunity downstream in cell manufacturing & assembly, balance of plant, and system management services

Local mining

Opportunity in mineral processing for cobalt & nickel

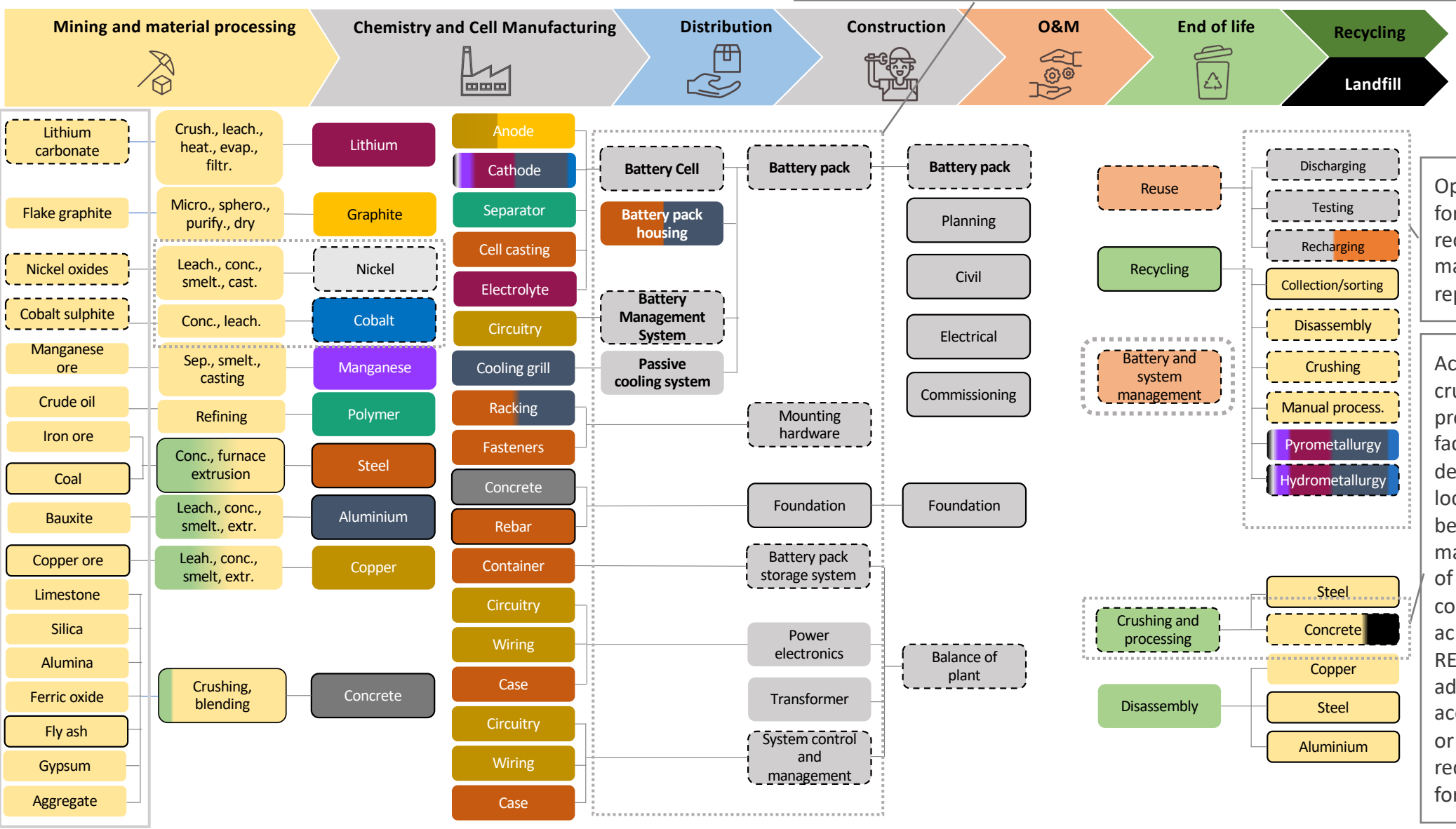


Diagram Key

Local capacity

Opportunity identified. i.e., no current capacity

Flow Key

Potential End-of-life - materials flow back into manufacturing and/or O&M.

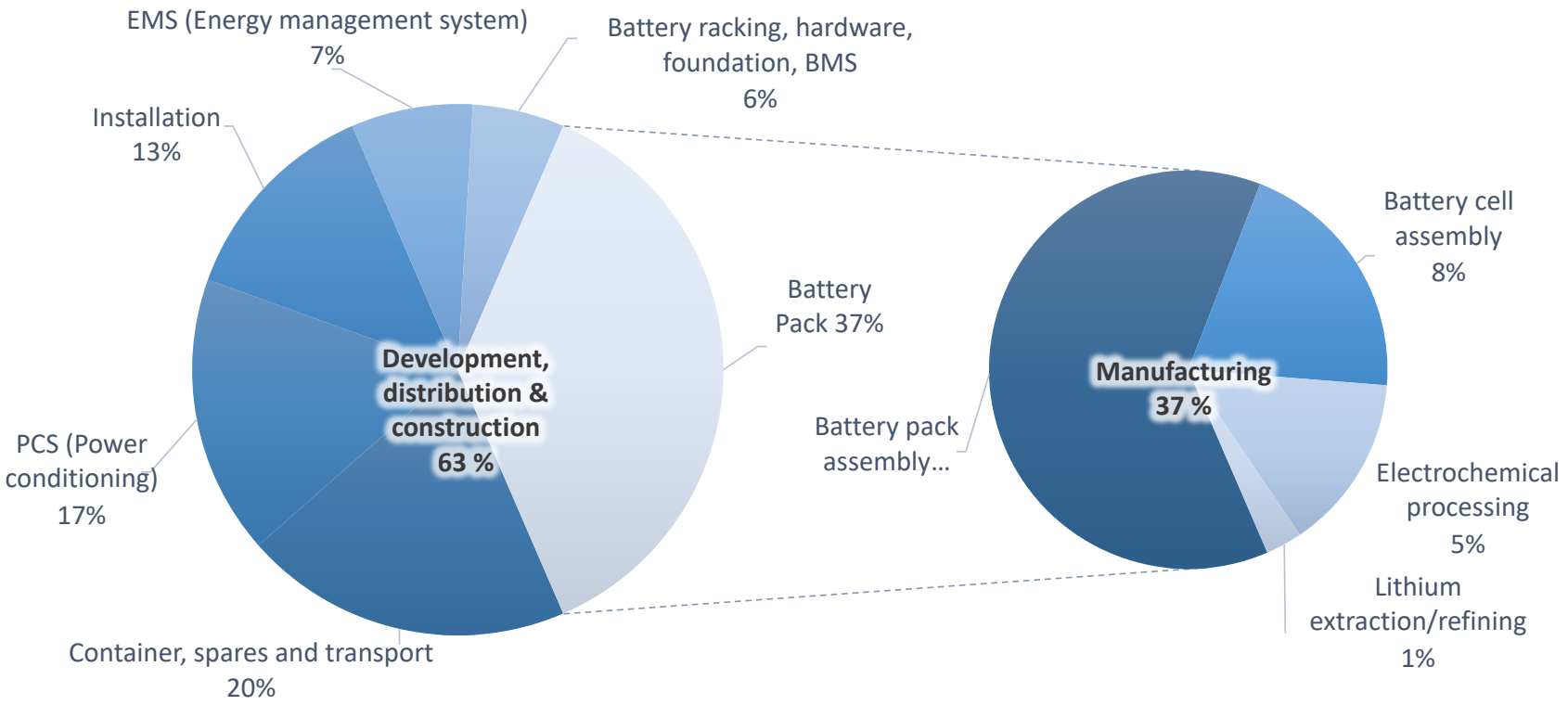
Potential recycled content flowing back into production

Opportunity for reuse, recycling & materials reprocessing

Access to crushing & processing facilities varies depending on location, better EOL management of concrete could be achieved in REZs by addressing access issues or mandating a requirement for recycling

SGSEP.COM

Battery manufacturing & construction cost distribution



- Battery manufacturing accounts for ~37% of cost
- The largest share of battery manufacturing is battery pack assembly (23% of total cost)
- Development, distribution and construction is almost 2/3 of the cost – with major elements being container, spares and transport, power conditioning and installation
- On end of life, literature reports that the refurbishment costs represent 35% of potential resale value but further research is needed to validate

Transmission supply chain

Capacity in planning, civil & electrical construction, operations & maintenance

Opportunity in tower manufacturing

Current capacity in aluminum processing & smelting

Iron ore
coal
Bauxite
Copper ore
Limestone
Silica
Alumina
Ferric oxide
Fly ash
Gypsum
Aggregate

Concentration, furnace, extrusion
Leach., conc., smelting, extrusion
Leach., conc., smelting, extrusion
Crushing, blending

Steel
Aluminium
Copper
Concrete

Tower frame sections
Fasteners/Hardware
Concrete
Reinforcement
Cable
Hardware
Cable
Hardware
Reactive compensation
Relay protection
Communications
Main transformer
Framing and hardware
Main
Control
Amenities
Concrete
Rebar

Towers
Foundation
Conductor
Earthing cable
System
Electrical distribution
Substation buildings
Foundation

Transmission lines
Planning
Civil
Electrical
Commissioning
Substations

Line and non-line maintenance

Disassembly
Crushing and processing
Parts and equipment
Labour
Materials

Disassembly
Crushing and processing

Tower sections
Fasteners and hardware
Cabling
Metal recycling
Steel
Concrete

Mineral oil
Copper
Steel
Aluminium
Steel
Concrete

Opportunity for tower section reuse if onshore manufacturing occurs

Access to crushing & processing facilities varies depending on location, better EOL management of concrete could be achieved in REZs by addressing access issues or mandating a requirement for recycling

Diagram Key

Local capacity

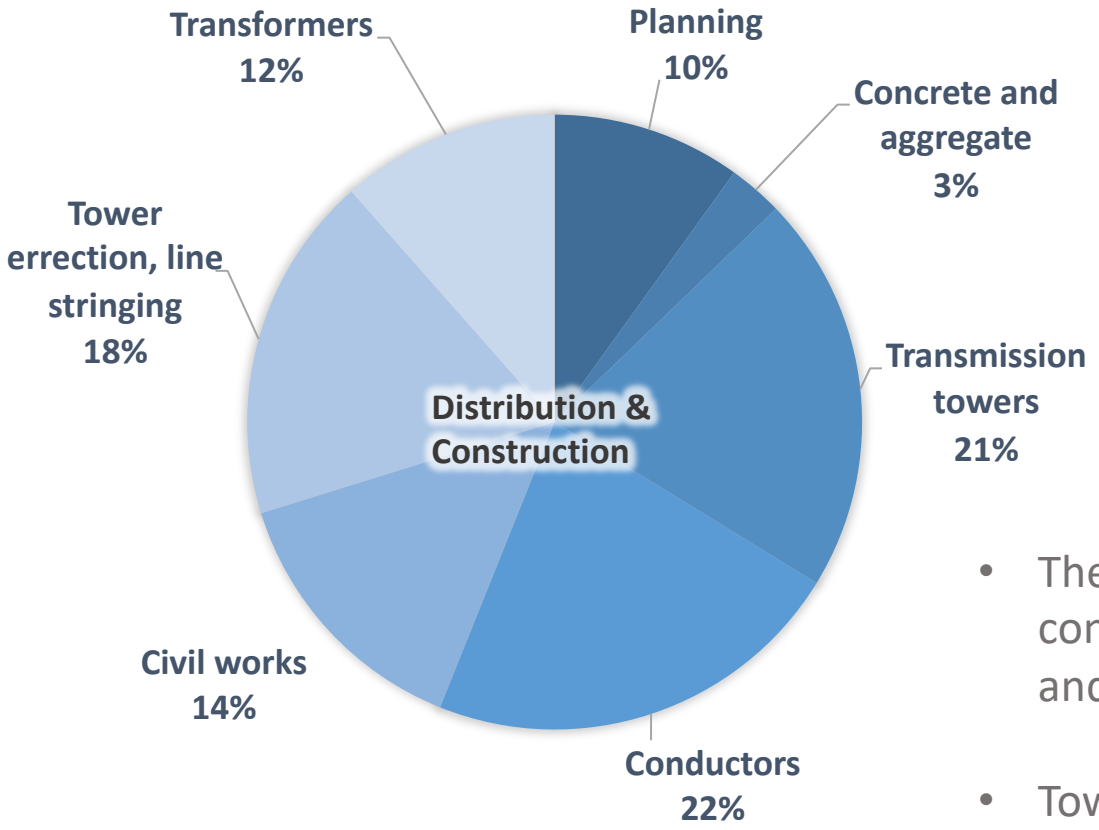
Opportunity identified. i.e., no local capacity

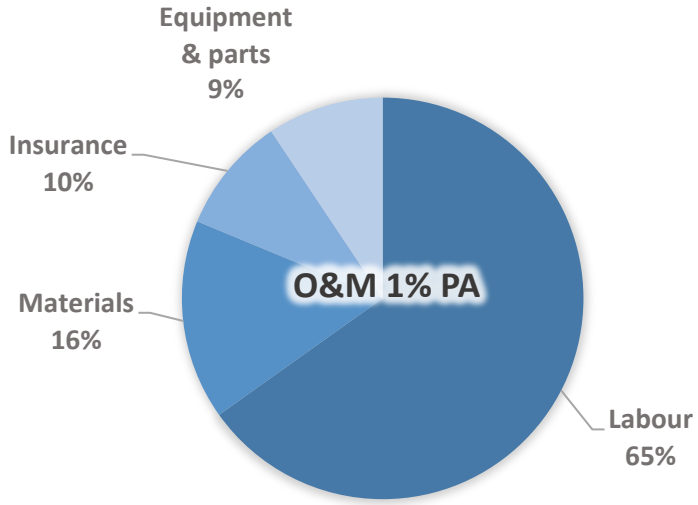
Flow Key

Potential End-of-life - materials flow back into manufacturing and/or O&M.

Potential recycled content flowing back into production

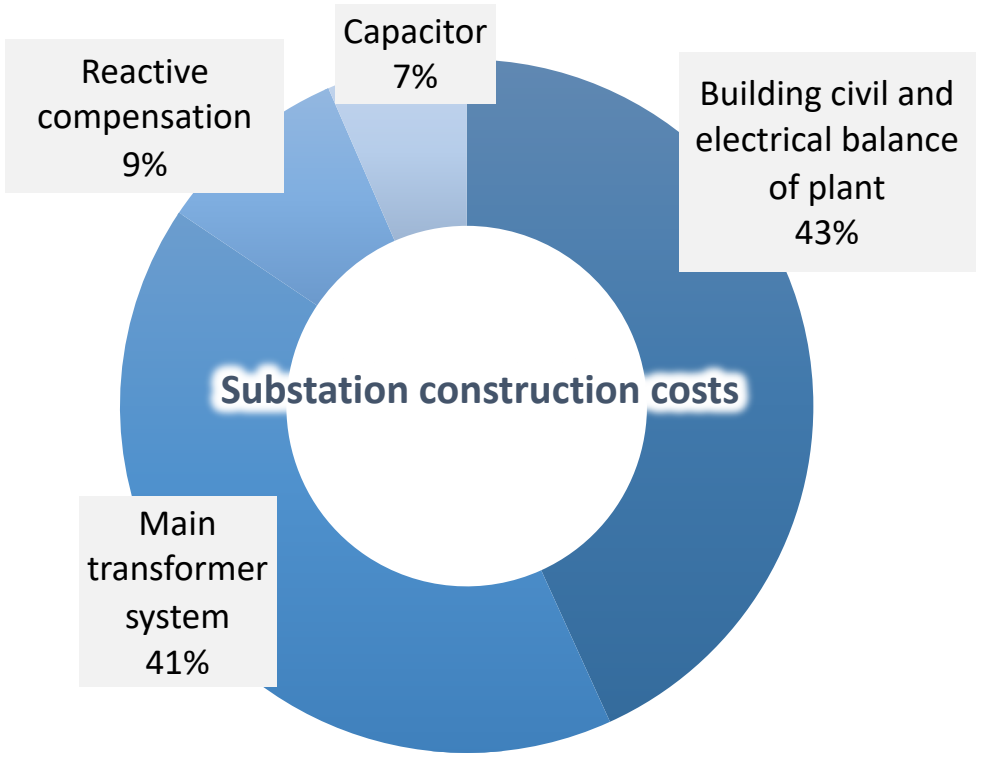
Transmission Line Construction & O&M cost distribution





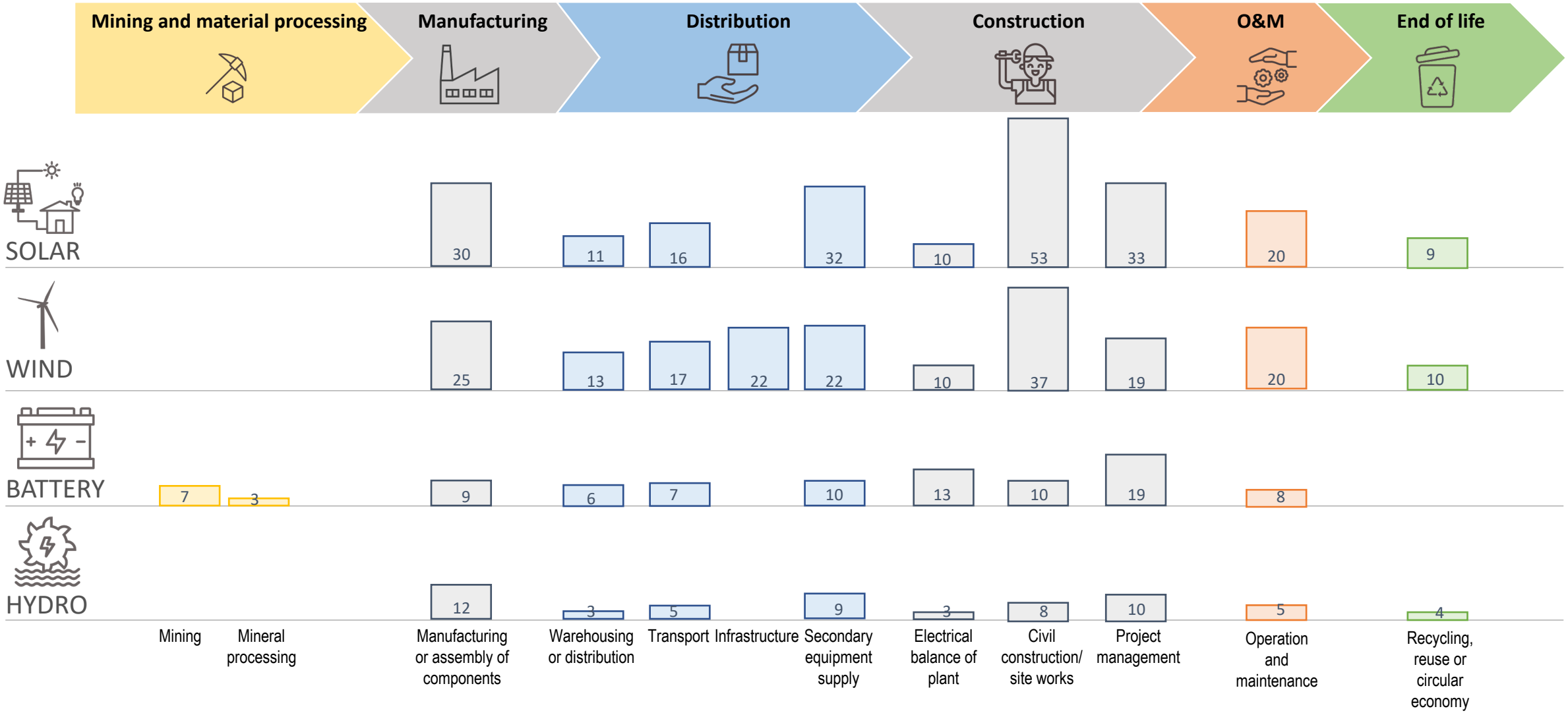
- The major components in the cost structure of transmission construction are tower manufacturing (1/5), conductors (1/5) and transformers (~1/10)
- Tower erection and stringing (electrical works) are ~1/5 and the civil works are ~1/6 of the cost
- O&M costs are estimated at around 1% p.a. of total project cost with labour the major component (65%)

Transmission non-line construction cost distribution



- For sub-stations, the two major elements of cost are:
  - the main transformer system
  - civil and electrical balance of plant construction
- Other minor elements are reactive compensation and the capacitor.

Business Survey Respondents



Note: each figure reflects the number of businesses which responded that they have experience and/or capability at different phases of the supply chain. Around 257 businesses filled out part of the survey and 200 businesses fully completed the survey

Survey insights on local capacity in supply chains

Survey responses indicate **local capacity** across many parts of supply-chains – especially civil construction, steel/metal manufacturing, secondary equipment supply, professional services and operations and management

SOLAR

- Metal work, steel posts, racking & mounting, balance of plant
- Electrical balance of plant – at HV, LV & MV levels
- Civil construction capabilities

WIND

- Civil construction,
- Electrical balance of plant
- Project management

BATTERIES

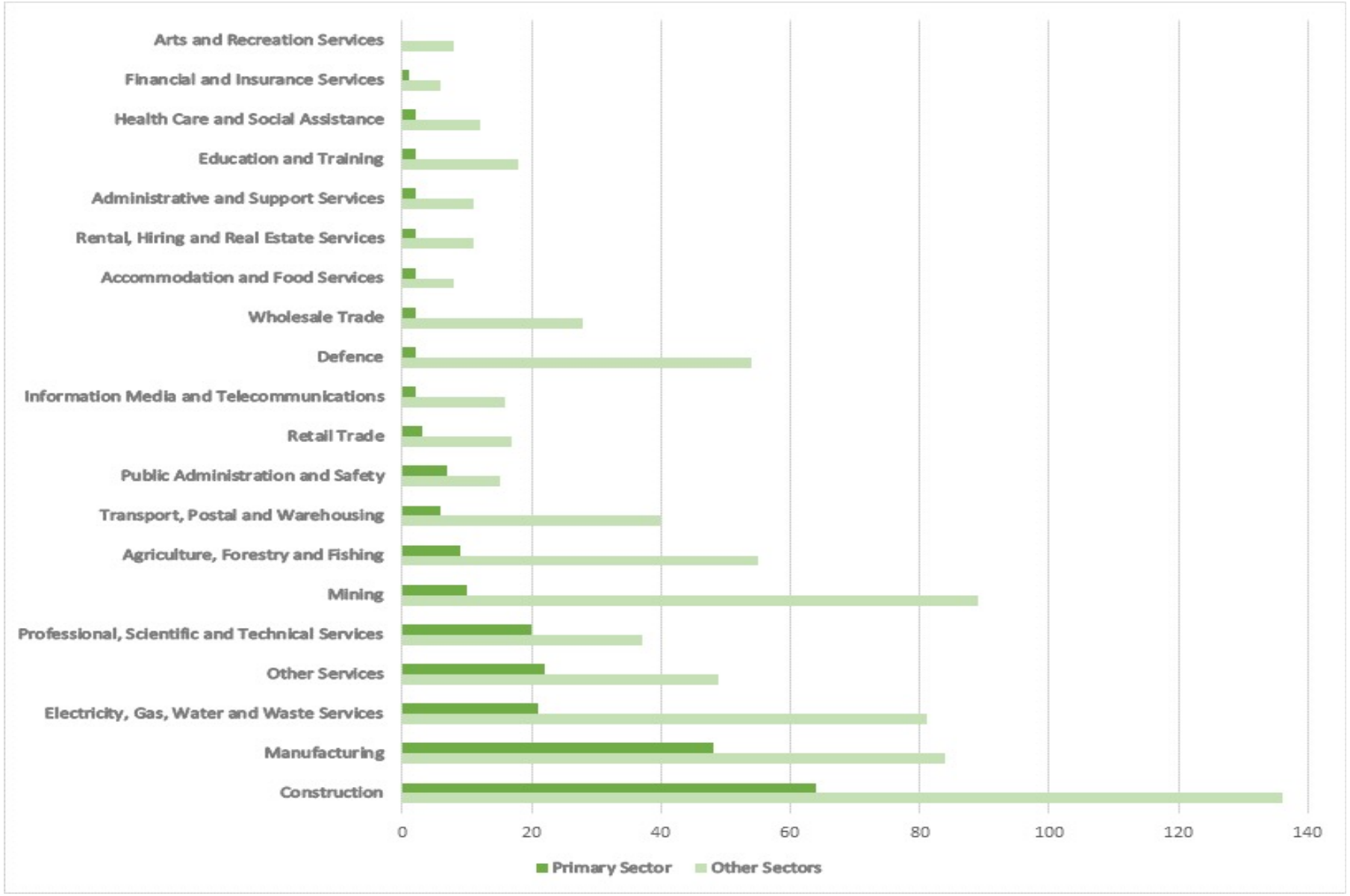
- Mining
- Mineral processing
- Manufacturing or assembly of components
- Electrical balance of plant

HYDRO

- Project management
- Civil construction/site works experience,
- Manufacturing or assembly of components
- Electrical balance of plant

Survey responses include detailed breakdowns of capacity for each of the major categories (civil construction, manufacturing, balance of plant etc) and will be provided with full report

High inter-connection between construction, mining and manufacturing within RE supply chains



- Construction is the 'primary' or 'other' sector for > 200 businesses
- Mining is the 'primary' sector for only 10 businesses – but ~ 90 other businesses also operate in the sector
- Manufacturing is the 'primary' sector for ~50 businesses – but 80+ businesses nominate it as an 'other sector'
- Electricity, gas, water and waste is the 'primary sector for only 20 businesses – but 80+ businesses also operate in the sector
- There is a 'long tail' with small numbers of primary sector businesses but greater numbers operating e.g. warehousing, agriculture, defence

Note: multiple responses were allowed for 'other sectors'

High inter-connection between construction, mining and manufacturing within RE supply chains

Inner circle = primary sector

Outer circle = 'other' sectors

- For mining businesses, 60-70% operate across others sectors (note small sample though)
- For manufacturing, the range is 40% (EGWW) – 60% (mining and construction)
- For construction businesses, the range is 25% (manufacturing) to 40% (mining)
- For Electricity, Gas, Water and Waste (EGWWS), the range is 30% (mining, manufacturing) to 70% (construction)
- For mining, therefore, 30 – 60 % of businesses in these other sectors also operate in mining

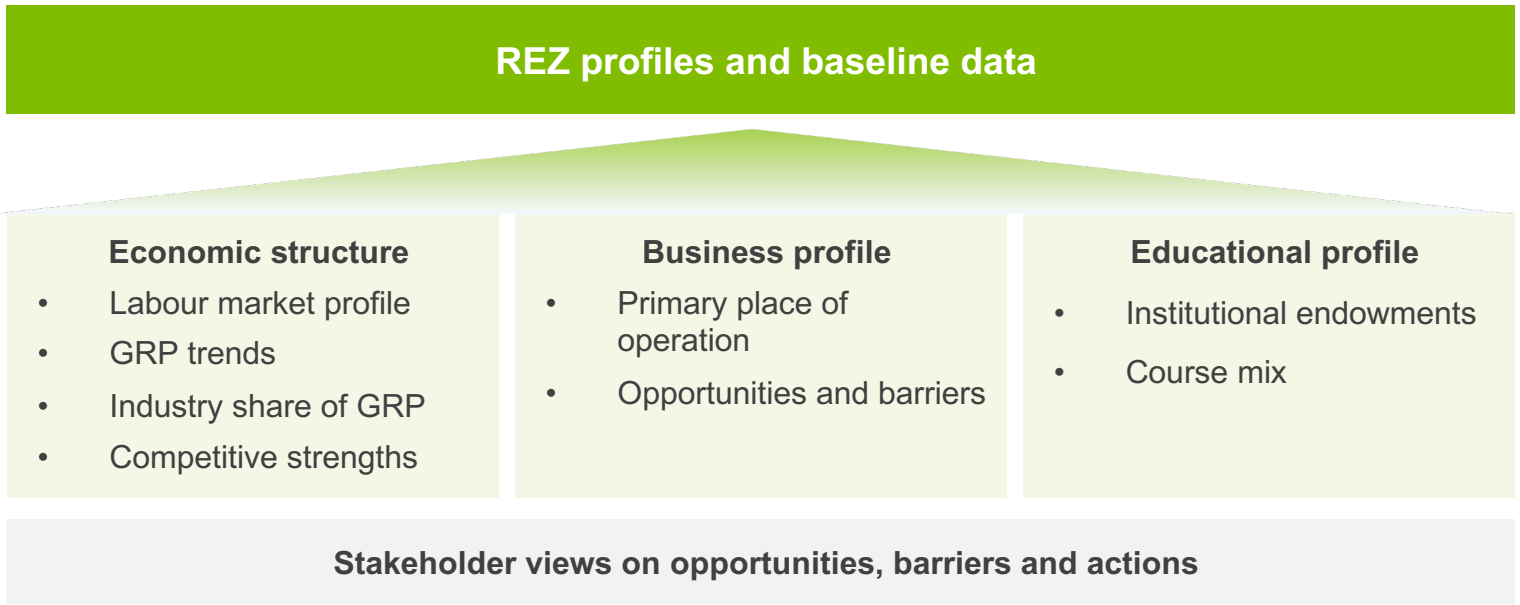
04

REZ profiles

Introduction

The objective of developing REZ profiles is to establish region-specific baselines that can help to benchmark the region's progress on economic and social development as it undertakes a transition to a low carbon economy.

The REZ profiles are based on a combination of economic, business and educational factors. These indicate 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.

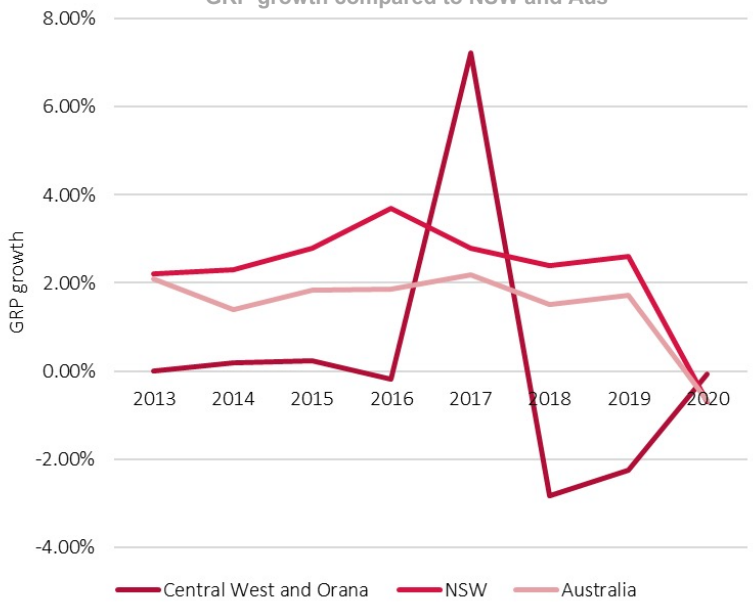


Central-West Orana | Economic structure

Over the years

This region has generally underperformed against the national and state economy over the past decade, however with significant fluctuations, as is typical of agrarian economies. GRP peaked in 2017 before falling sharply, and partially recovering by 2020.

GRP growth compared to NSW and Aus

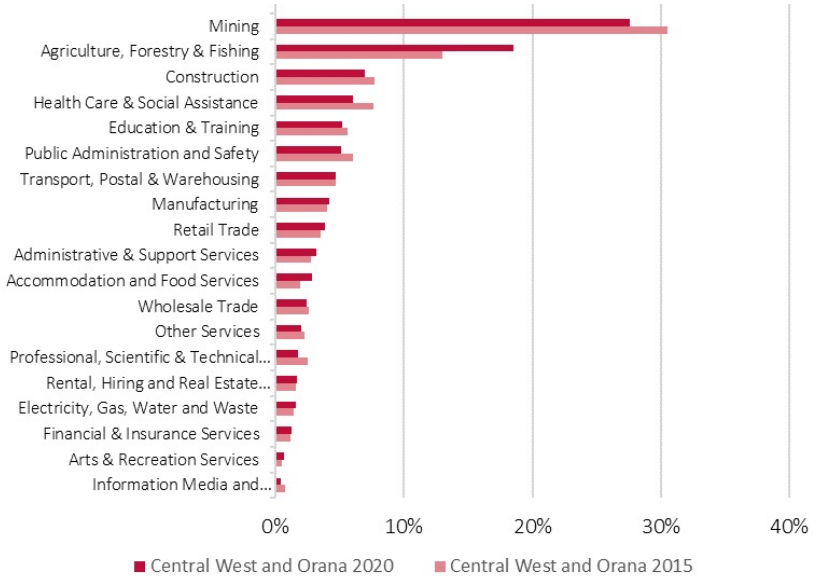


From 2015-20

No major industry structural shifts:

- strong growth (almost 6%) in agriculture, forestry and fishing
- mining, population serving jobs fell as share of total production, despite growing in absolute terms

Industry structure (percentage of GRP) , 2015-20



In 2020

Competitive strengths (LQ analysis):

Mining

Agriculture, forestry & fishing

Unemployment rate 2015-21

Central-West Orana | Social and economic profile

Labour market profile

- Slightly higher share of full-time workers than the regional NSW average
- Unemployment levels comparable with state-wide average, suggesting there is not a lot of unused labour capacity that can be easily redirected into other uses
- Higher shares of First Nations unemployment and not in labour force, compared to state average

Business profile

- 212 businesses surveyed operate in the CWO region
- Stakeholders reported there are opportunities for greater collaboration between local businesses on projects
- Large contracts are an identified barrier to procurement participation for some businesses
- Strong inter-connectivity between mining, manufacturing and construction (from survey)

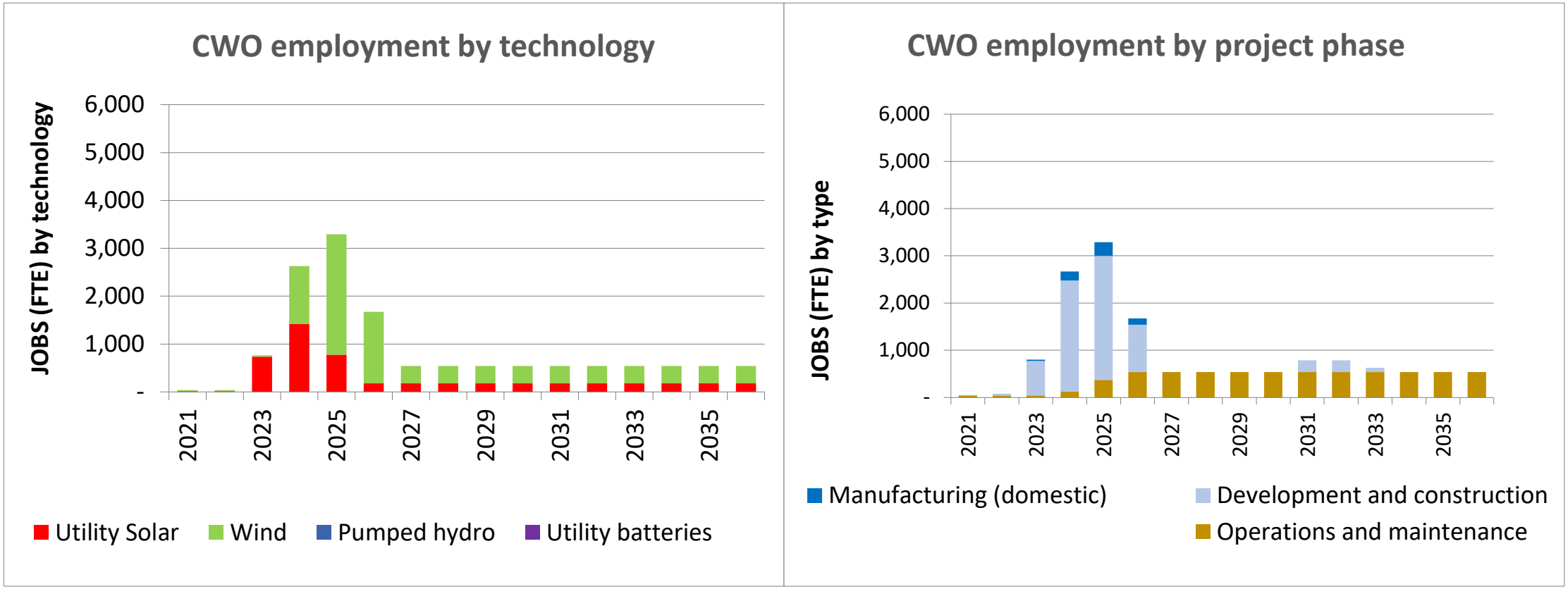
Educational profile

- Engineering and related technologies account for the largest share of qualifications in the region
- Major institutions: CSU, TAFE campuses and Connected Learning Centres for remote learning
- Course mix: lack of courses on trade skills and apprentices must travel to other campuses

Key barriers and constraints

- Skills and labour shortages (e.g. of electricians, plumbers and mechanics), alongside workforce attraction and retention challenges
- Transport bottlenecks and disruptions
- Lack of housing availability, increased cost of housing and challenging access to construction materials
- Low community engagement and uncertainty regarding social benefits of REZ to the community

Central-West Orana | Renewable Employment

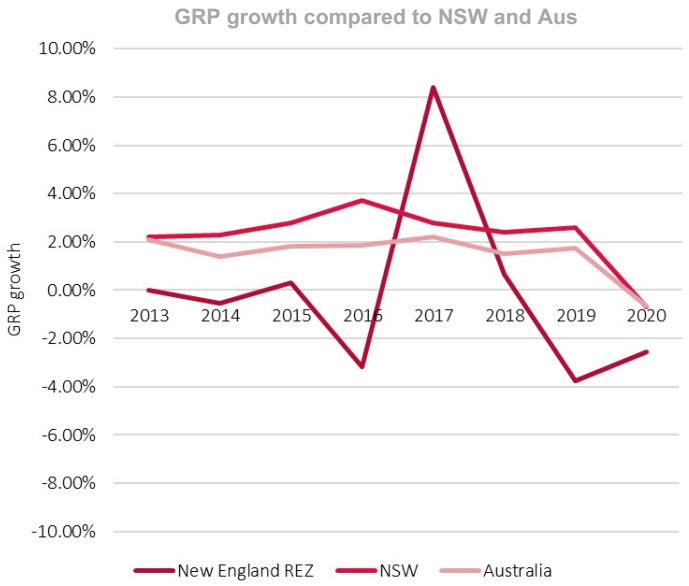


Note: manufacturing employment is based on BAU/2019 survey data – it does not include potential employment from new policies to increase local share. The projection for development and construction and operations and maintenance is the total employment that would be created based on projects forecast to be built in the area – not all jobs would be sourced from the local workforce

New England | Economic structure

Over the years

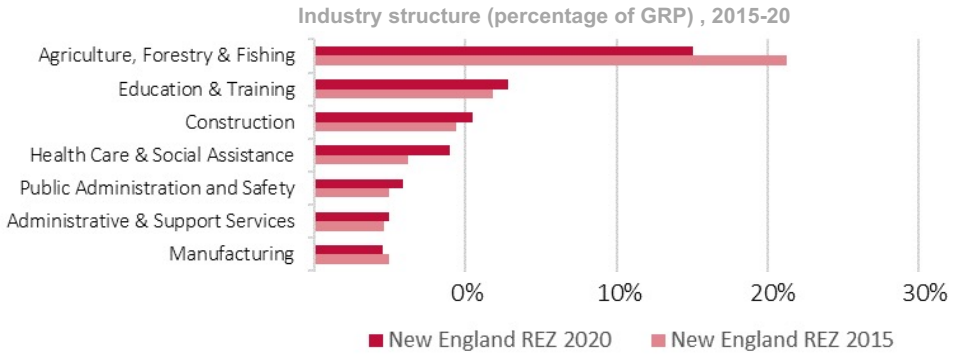
This region has generally underperformed against the national and state economy over the past decade, however with significant fluctuations, as is typical for regional farming communities.



From 2015-20

Industry shifts:

- Overall, a relatively undiversified regional economy, agriculture, forestry and fisheries is the largest industry in terms of economic activity, explaining the volatility in GRP growth over the past 8 years
- However, this sector has decreased both proportionally and in outright production
- Education, construction, healthcare and public administration has grown in share of production

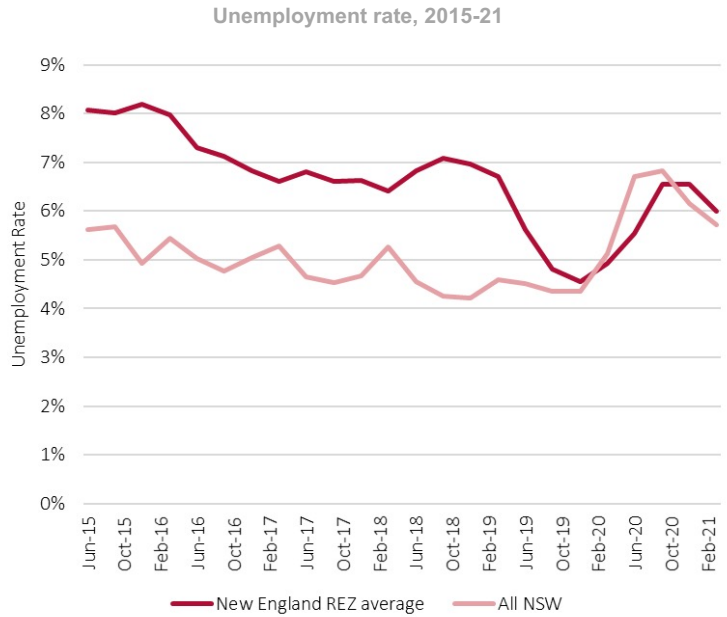


In 2020

Competitive strength (LQ analysis):

Agriculture, forestry & fishing

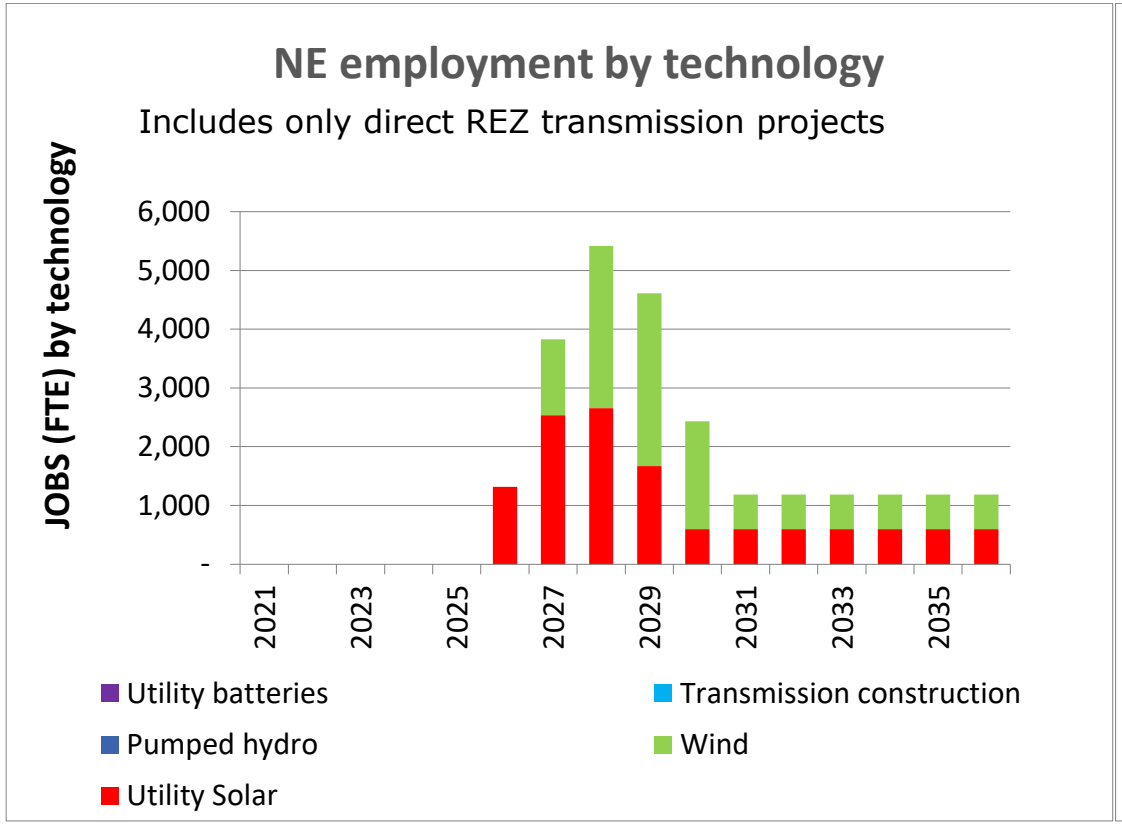
25% of GRP

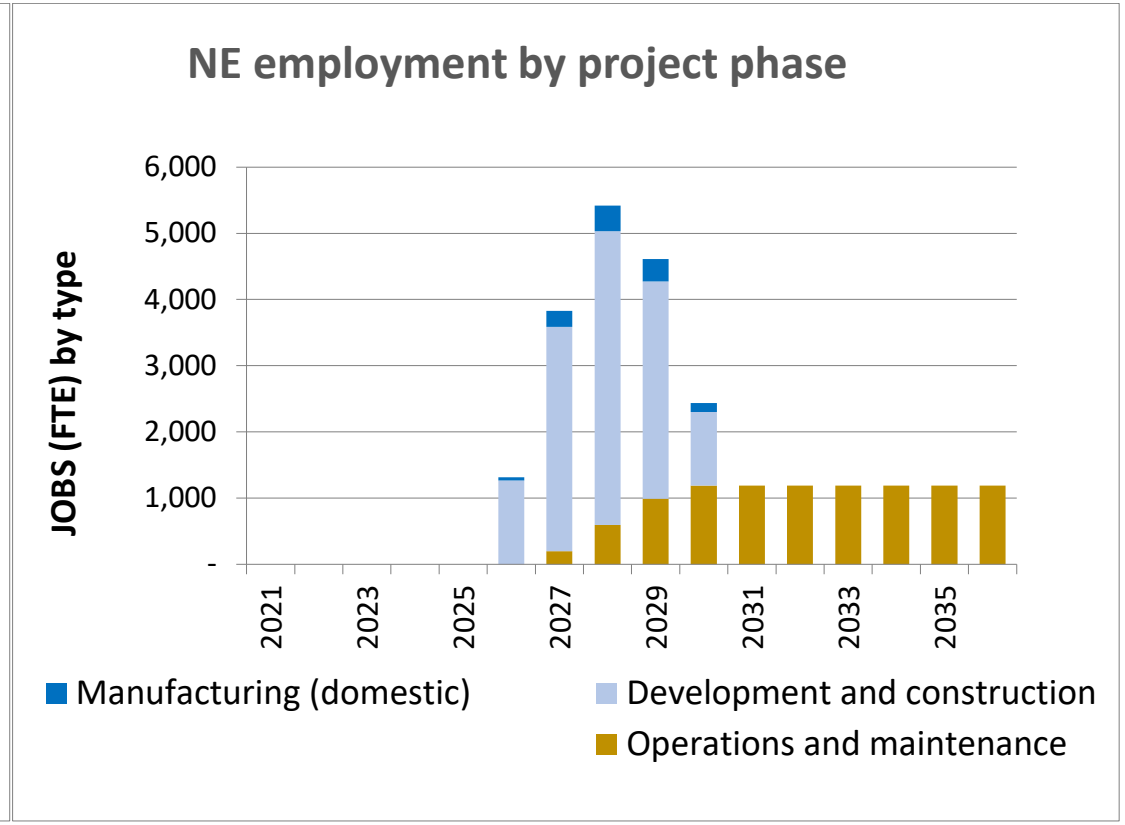


New England | Social and economic profile

Labour market profile	• Diverse employment and qualifications in the region. There is a large share of agricultural employment, as well as education to support ancillary industries due to UNE anchor institution • Lower share of full-time workers than the state average; similar shares of part-time and unemployed. • Share of First Nation population not in the labour force is extremely high (55%), almost 10% higher than the state average. First Nation unemployment is 1% higher than the state average.
Business profile	• 96 businesses surveyed operate in the Northern Inland region • Identified need for local suppliers to be upskilled in commercial risks when executing large contracts • Opportunity to develop skills transfer initiatives to support businesses through industry transitions
Educational profile	• Management & commerce, society & culture, health & engineering represent the largest share of qualifications. Share of agriculture and environmental related studies is significantly higher than NSW average. • Major institutions: UNE Armidale, TAFE campuses and a Connected Learning Centre at Glen Innes • Course mix: wide range of courses at advanced diploma, diploma and certificate level
Key barriers and constraints	• Skills and labour shortages were noted as a barrier within the region, this is compounded by a lack of relevant training availability. • Shortages in housing stock, although there is current land availability • Community services will require additional support as will infrastructure in terms of upgrades to road and rail • LGAs are currently resource-constrained in both procurement and community engagement areas • Ecological impacts of major infrastructure build

New England | Renewable Employment



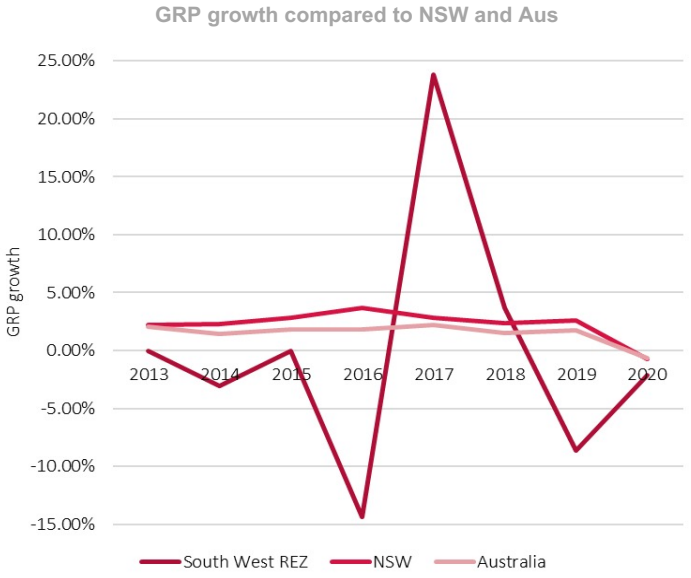


Note: manufacturing employment is based on BAU/2019 survey data – it does not include potential employment from new policies to increase local share. The projection for development and construction and operations and maintenance is the total employment that would be created based on projects forecast to be built in the area – not all jobs would be sourced from the local workforce.

South-West | Economic structure

Over the years

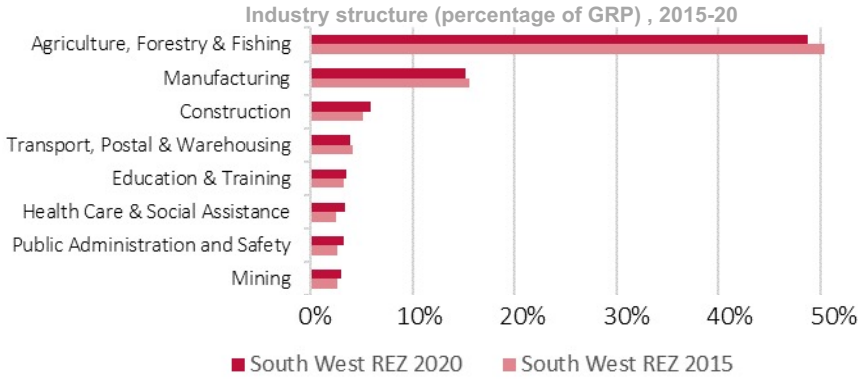
This region has generally underperformed against the national and state economy, particularly during 2013-16. Significant fluctuations are typical in agriculture dominant communities. 49% of all GRP is attributable to agriculture, reflecting the region's identity as SE Australia's food bowl.



From 2015-20

Industry shifts:

- Regional economy highly reliant on Agriculture, explaining the economic volatility in recent years
- Both Agriculture and manufacturing make the largest contributions to GRP, however they have declined slightly both in outright terms and also as a share of total GRP
- There may be an opportunity to leverage the manufacturing sector's presence for future renewable infrastructure
- Health care and social services, public administration and construction have grown slightly in the last five years.

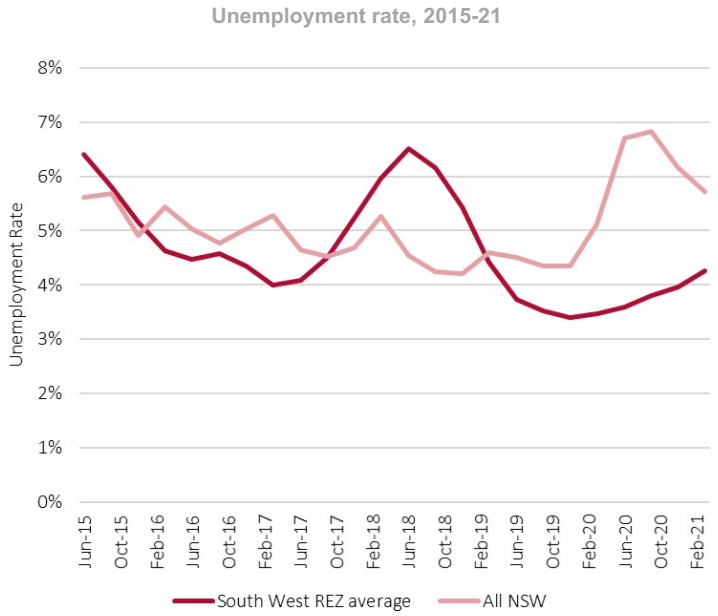


In 2020

Competitive strength (LQ analysis):

Agriculture, forestry & fishing

49% GRP



South-West | Social and economic profile

Labour market profile

- Higher share of full-time employees, lower share of part-time employees compared to regional NSW average
- Unemployment rate is below the state average, suggesting low levels of spare labour capacity in the region
- Lower shares of First Nation unemployment (8%) compared to state average (8.9%), as well as higher shares of First Nation employment in both full- and part-time work.

Business profile

- 100 businesses surveyed operate in the Riverina region
- Identified need for local suppliers to be upskilled in commercial risks when executing large contracts
- Opportunity to develop skills transfer initiatives to support businesses through industry transitions

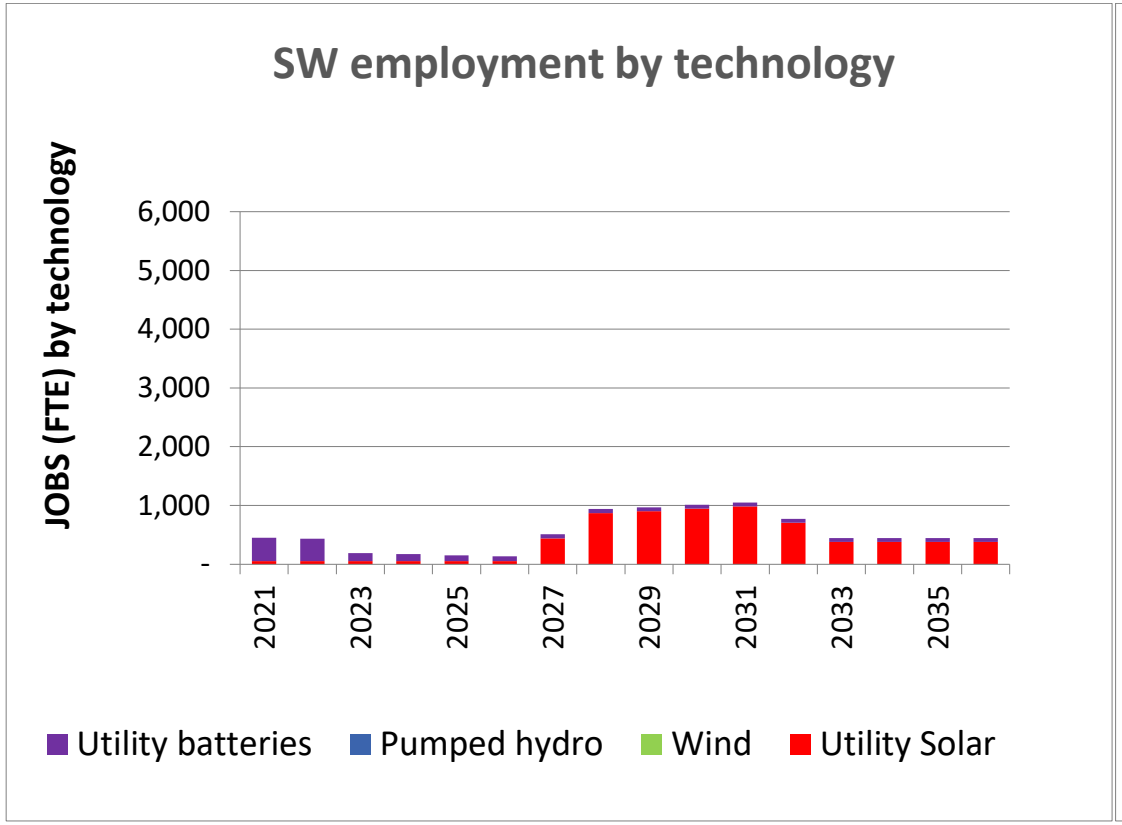
Educational profile

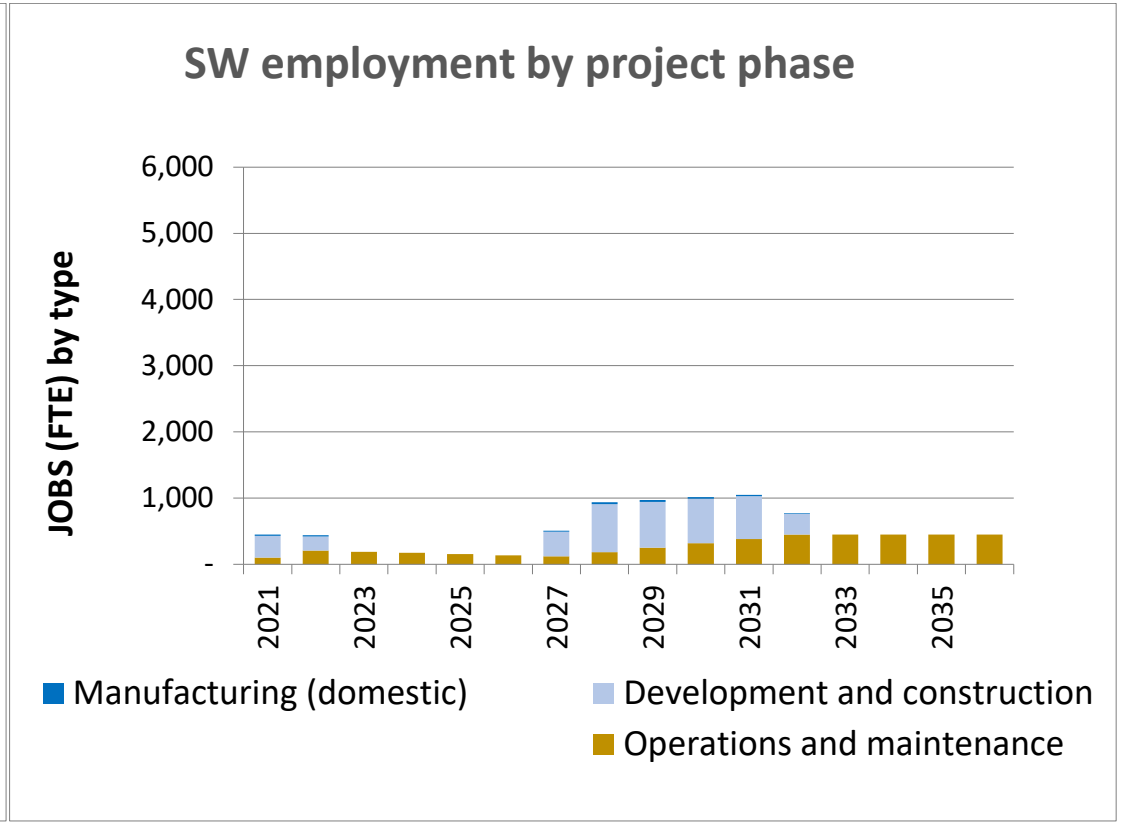
- On average, lower qualifications compared to NSW, reflecting predominance of agricultural employment
- In the SW REZ region, engineering and agriculture related qualifications are the most dominant
- Major institutions: La Trobe University, TAFEs in Hay, Deniliquin, Griffith and other townships
- Course mix: wide range of courses in health, education, business, science and engineering at La Trobe Uni

Key barriers and constraints

- Labour shortages are a key barrier, given the challenges in retaining and skilling personnel in renewables industries, compounded by regional factors such as housing shortages
- Supply chain constraints and geopolitical disruption, e.g. from Asia
- Timeframes in relation to waste storage is a barrier and has been further impacted by landfill levy
- Industry feedback indicates there is a lack of certainty around government's renewables objectives, particularly among SMEs who find it challenging to navigate updates to the regulatory environment

South West NSW | Renewable Employment



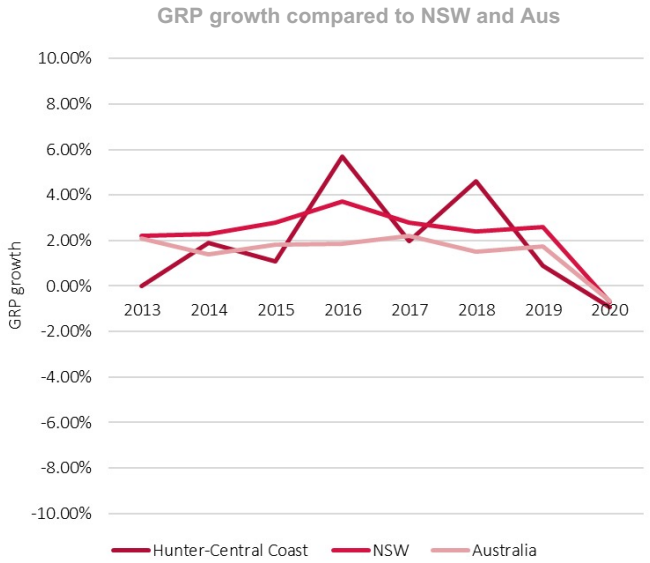


Note: manufacturing employment is based on BAU/2019 survey data – it does not include potential employment from new policies to increase local share. The projection for development and construction and operations and maintenance is the total employment that would be created based on projects forecast to be built in the area – not all jobs would be sourced from the local workforce

Hunter-Central Coast | Economic structure

Over the years

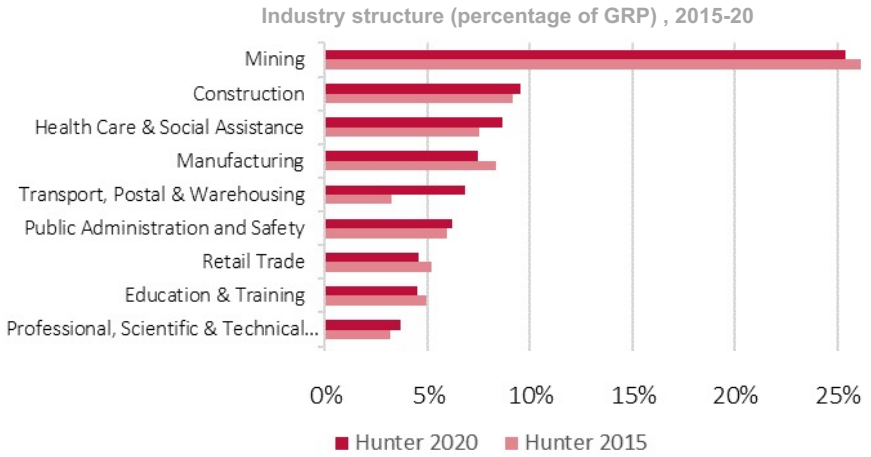
The Hunter and Central Coast region has broadly outperformed the NSW and national economy since 2013, with particularly strong growth between 2016-18. Mining is a key driver of regional growth, making up more than 25% GRP.



From 2015-20

Industry shifts:

- Transport, postal & warehousing and health care recorded the largest increases as a proportion of overall GRP
- Mining has grown in outright terms but contributed a smaller share of GRP over this period
- Business surveys indicated a strong relationship between manufacturing, construction and mining, of which the Hunter has relatively high shares



In 2020

Competitive strengths (LQ analysis):

- **Mining**
- **Healthcare & social assistance**
- **Retail trade**
- **Accommodation & food services**

Hunter-Central Coast | Social and economic profile

Labour market profile

- Lower share of full-time employees compared to the state average. Part time workers and the share of unemployed occur in relatively similar rates compared with the rest of NSW, likely due to a lower overall labour force participation rate in the area.
- The region has similar levels of First Nations unemployment to the NSW average.

Business profile

- 232 businesses surveyed operate in the Hunter-Central Coast region.
- There is feedback suggesting a stronger focus on long-term job sustainability is needed, as well as engagement programs to improve the workforce pipeline.

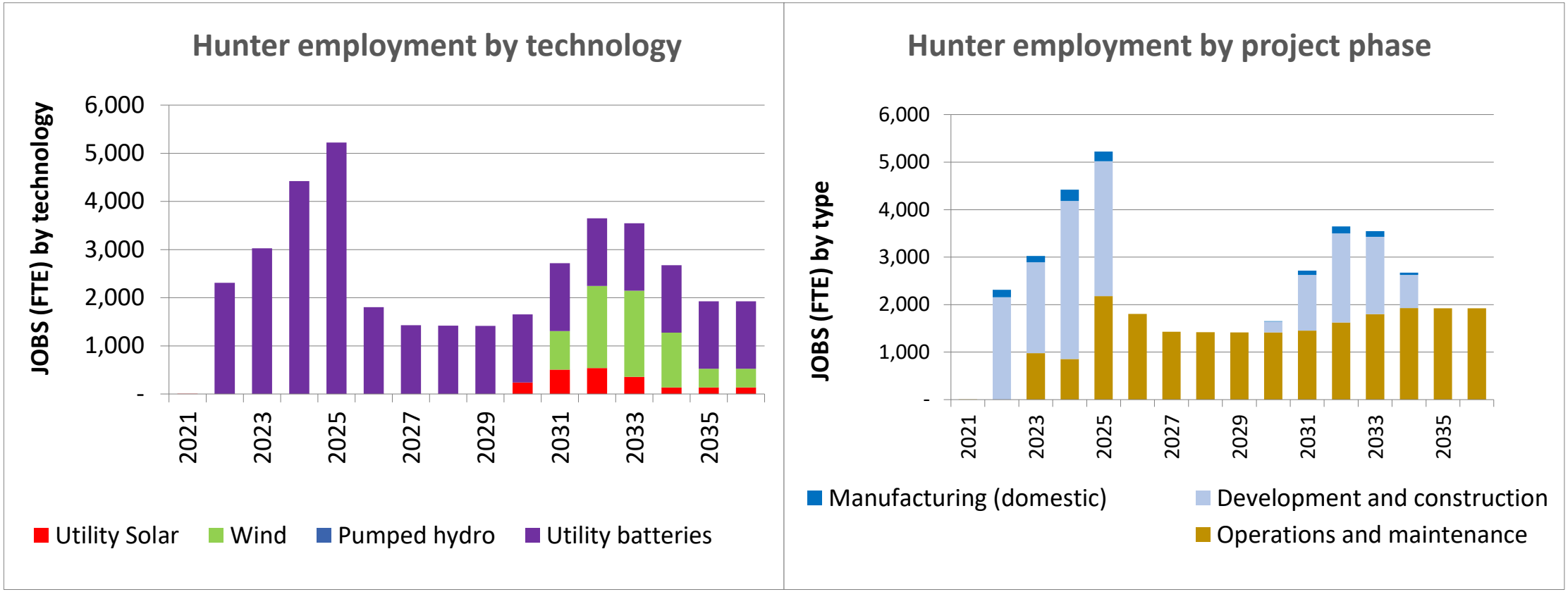
Educational profile

- Higher share of residents with engineering related qualifications, potentially due to the region's mining focus. Opportunity to leverage these skills for future renewable energy construction, operations and maintenance.
- Major institutions: University of Newcastle (UoN) and research hubs, e.g. Williamtown Aerospace Centre
- Course mix: TAFEs provide wide range of courses: manufacturing, engineering, business, info technology

Key barriers and constraints

- Skills and supply chain shortages in the region. Lead times for training in key skills to match projects is relatively long compared to the timespan of construction
- Limited manufacturing capacity, potentially due to limited availability of land. This may change in the future as mining land is repurposed, however the ecological impacts and utility of those lands is uncertain.
- 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
- Lack of communication and collaboration across different policy areas poses challenges to coordinated planning

Hunter | Renewable Employment

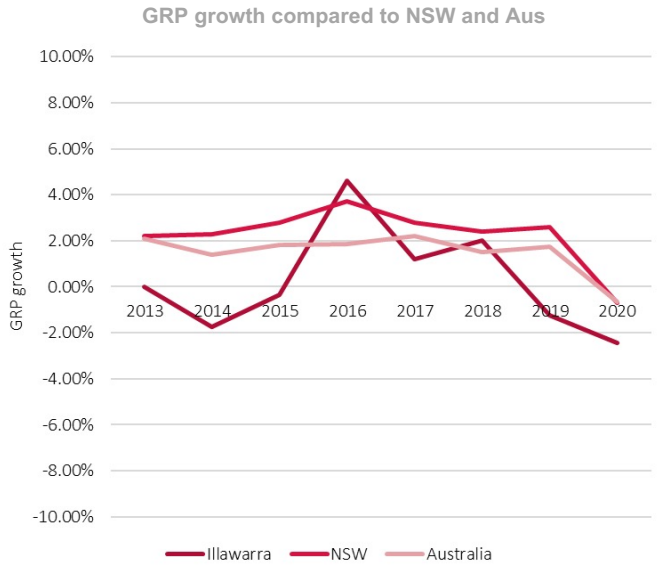


Note: manufacturing employment is based on BAU/2019 survey data – it does not include potential employment from new policies to increase local share. The projection for development and construction and operations and maintenance is the total employment that would be created based on projects forecast to be built in the area – not all jobs would be sourced from the local workforce.

Illawarra | Economic structure

Over the years

The Illawarra has slightly underperformed compared to the national economy since 2013. There has been significant fluctuation, with strong growth between 2015 and 2016, before falling to 2017. Since 2018, growth has continued to trend downward.



From 2015-20

Industry shifts:

- The region has a diverse economy, with GRP distributed across many industries. Construction, manufacturing and Logistics are significant contributors to GRP.
- Health care, public administration & safety, and professional services have recorded the significant growth

In 2020

Competitive strengths (LQ analysis):

- **Public administration**
- **Mining**
- **Construction**
- **Agriculture, forestry & fishing**

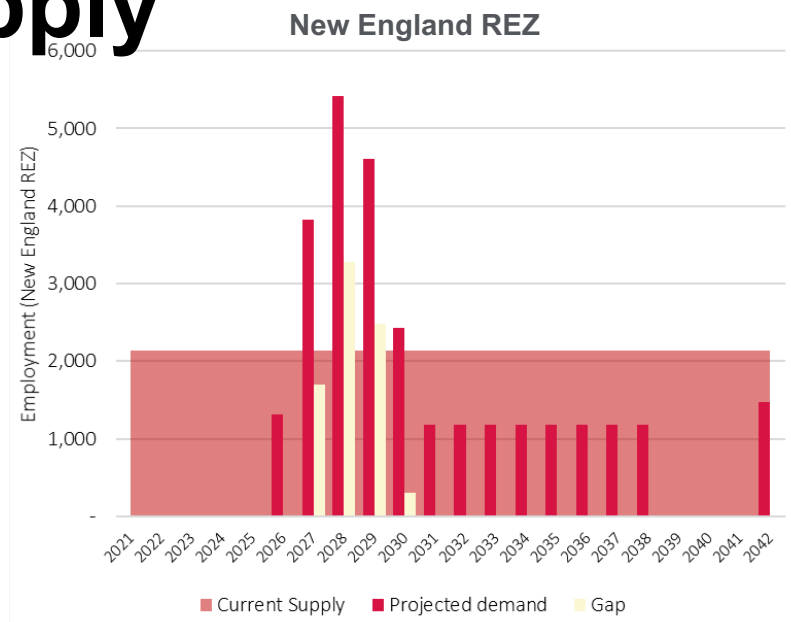
Illawarra | Social and economic profile

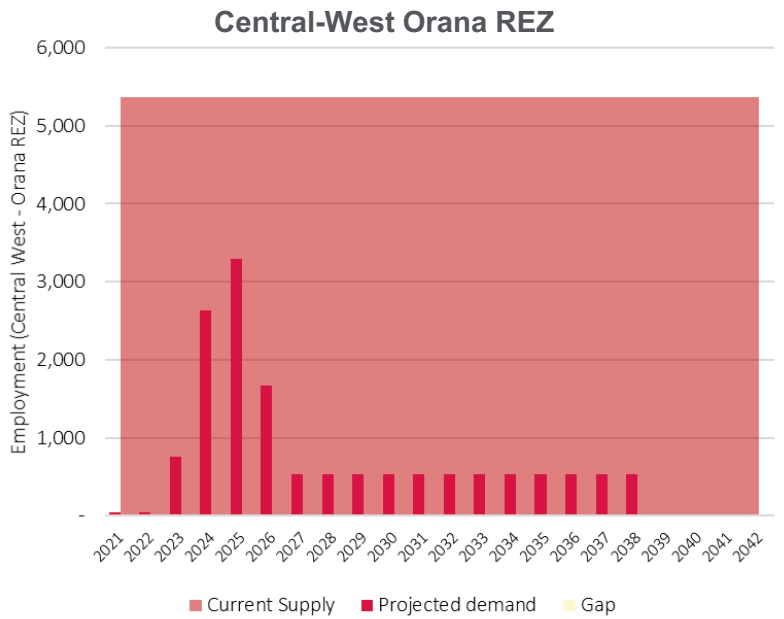
Labour market profile	• Compared to the regional NSW averages, Illawarra has slightly higher rates of full-time employment, and relatively similar levels of unemployment • The share of First Nation unemployment is slightly lower than the state average
Business profile	• 118 of businesses surveyed consider their primary operations to be in the Illawarra region • There is feedback for TAFE funding to adapt training courses to future clean energy needs, as well as buy-in from training providers to co-develop training packages
Educational profile	• Engineering is the most common qualification held among the region's population, and is well above the state average, due to the share of engineering related employment in local manufacturing and construction activity • Management and commerce qualifications also constitute a larger share compared to the NSW average, as do society and culture, health and education
Key barriers and constraints	• Skills shortages and supply chain issues. The most significant barrier to skills development is the lack of funding and resources to TAFE to develop and delivery tailored courses for the clean energy future. • Potential land use conflict due to residential encroachment and densification, which may impact future infrastructural upgrades • A barrier to economic development is the conflict between energy retailers, network providers and renewables in the current grid

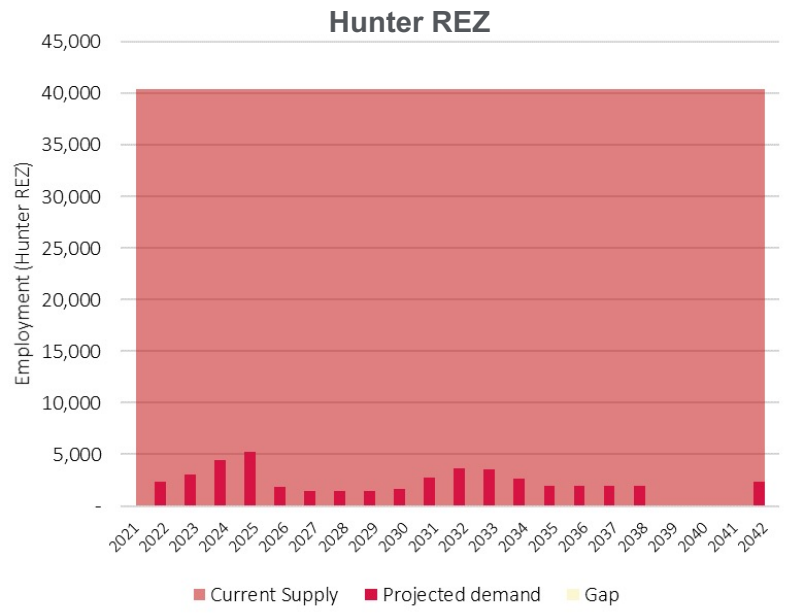
Note: there is no employment projection as no new large-scale generation is currently projected to be built in this REZ. The employment opportunity is for manufacturing to supply projects built in other REZs (and potentially offshore wind in the future).

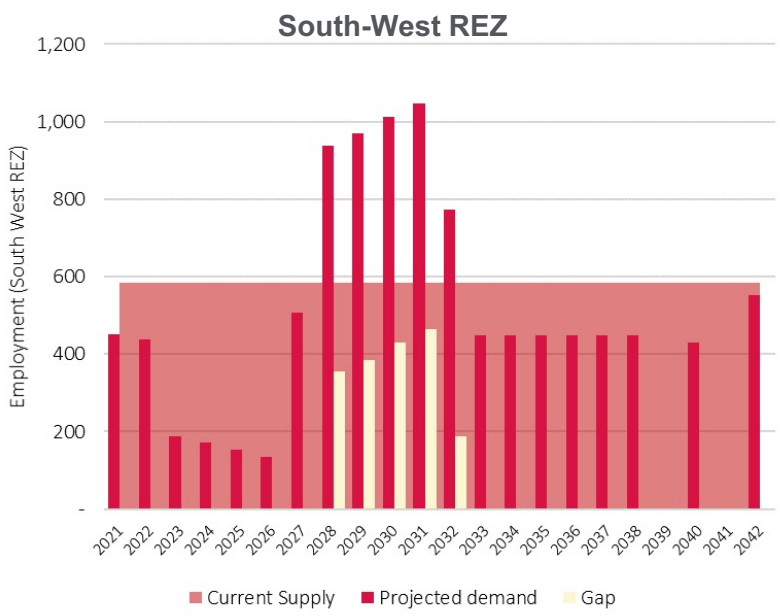
Labour market supply

- The delivery of the infrastructure will draw on local and regional labour in key occupations.
- The size of the REZ labour markets varies significantly, and there could be labour supply constraints in some REZs, particularly during the Construction phase
- In New England and the South West REZs, it is expected that the demand for key occupations will outstrip supply in the regional labour market during Construction phases. Even during the O&M phase, the demands on the labour market will likely place strain on the supply of occupations as they will also have non-RE demands
- In Central West-Orana, the construction phase may create constraints in labour supply, however through O&M this risk is lower.
- In the Hunter, the size of the labour market suggests that labour supply to meet demand may not be a major issue
- This analysis looks at high level supply-demand only and doesn't factor in the skills profile.



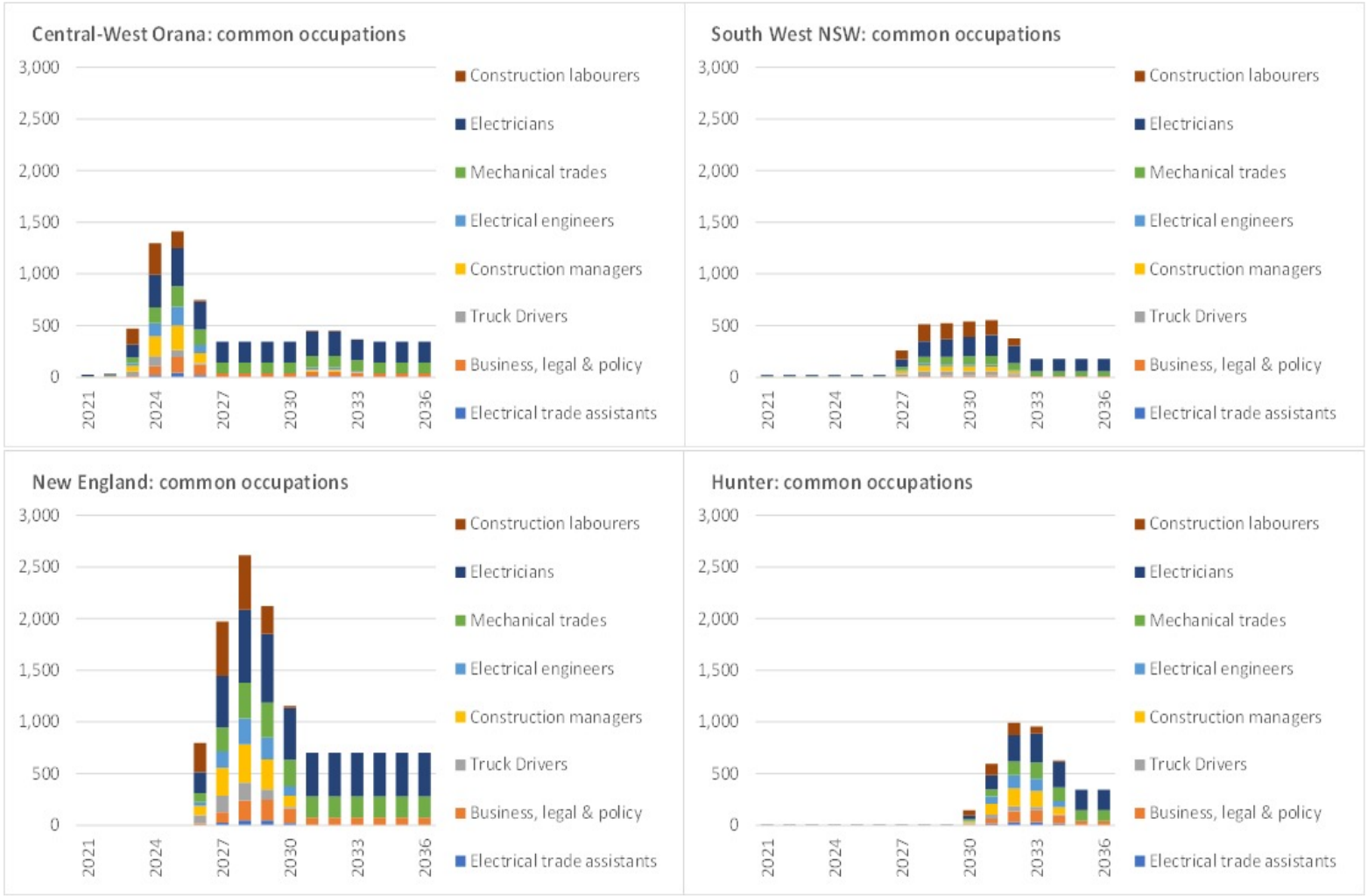






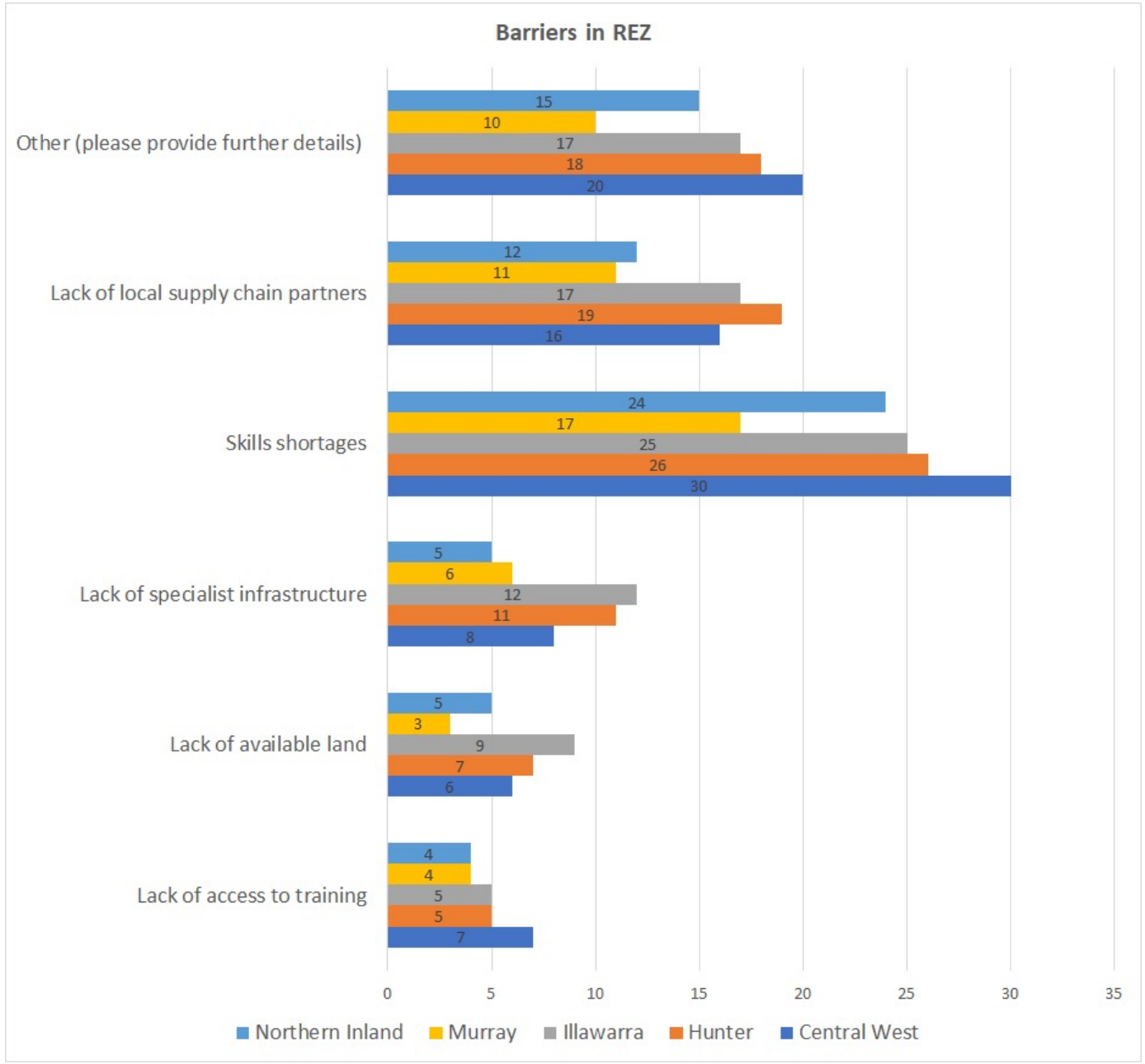
Labour market supply

- The employment demand by key occupation based on installed capacity for each REZ is illustrated to the right.
- It is important to note this is employment demand generated by the generation and transmission construction and not a projection of employment within each REZ (a proportion of the workforce will be sourced from elsewhere).
- Based on the surveys conducted by ISF during 2019-20, skill shortages – or more accurately 'recruitment difficulties' have been experienced for construction managers, engineers, electricians, mechanical technicians, transmission lineworkers and riggers, drillers and crane operators.
- Each of these occupations should be considered as priorities for skill and training to increase employment within NSW and the REZs.



Labour market supply

- Analysis of business survey responses indicate that businesses in most regions consider skills shortages to be the most significant barrier to growth (see slide 71)
- This suggests that even if labour markets are deep or sufficient to absorb some of the increased demands renewable infrastructure construction will create, there appears to be a lack of skills required to meet the needs of many businesses.
- In the Central West-Orana, where supply-demand analysis suggested the gap in labour wasn't the most acute, skills shortages are considered the biggest barrier for businesses
- This highlights the need to look beyond labour supply and ensure that those in the labour market have the right skills to support businesses in the renewable energy and adjacent sectors.



05

Opportunity evaluations

Introduction

Types of Opportunities

There are two broad type of opportunities for increased local employment and industry development evaluated:

- **Increasing local employment in project phases that are by their nature undertaken within Australia i.e. t**he project development, transport and distribution, construction and operations and on-site maintenance.
- **Increasing local industry involvement across the supply chain** i.e. increasing local content up and down the supply chain in mineral processing, manufacturing, off-site maintenance is much lower.

Data Sources

Scoping of opportunities has been undertaken through two major channels:

- Desktop research and pre-existing knowledge of research team
- Interviews with stakeholders.

The evaluation also draws on research from three other recent projects undertaken by ISF:

- *Employment and Material Requirements for Energy Generation and Transmission Construction* (Infrastructure Australia, in partnership with AEMO, June 2021): surveys and interviews were conducted with Transgrid and five of the six major transmission EPCs in Australia, and a workshop was held with industry, TAFE and training providers. The report can be found here.
- *The Potential for Offshore Wind Energy in Australia* (Blue Economy CRC, with CSIRO, MUA, ETU, ACTU, AMWU): a study into the feasibility of offshore wind which was released in July 2021. The report can be found here.
- *Renewable Energy Employment in Australia* (Clean Energy Council): a survey of employment in wind and solar farms, battery storage, distributed solar and pumped hydro storage conducted in 2019-20. The report can be found here.

Evaluation criteria

Three categories have been used to evaluate opportunities, the ***Viability for NSW,*** the ***Value of the Opportunity,*** and the ***Cost of Opportunity***

	VIABILITY FOR NSW				
Criteria	How significant are the advantages of local supply and proximity?	Are there local sources of comparative advantage or resources?	Can the industry and workforce be scaled to realise the opportunity?	Is the scale of local market volume sufficient to support new investment? ?	Are there market entry barriers?
Description	Are there advantages inherent to local proximity that provide a competitive advantage, such as existing industry specialisation, infrastructure that reduces time to market, supply chain resilience and risks, expertise, quality etc.?	Are there other local sources of comparative advantage in NSW such as resource endowments, labour market depth, infrastructure, etc? How does the cost of local supply compare to imports?	Does local capacity to scale production and/or the workforce exist or will there be capacity barriers or constraints? e.g. material supply such as steel, skilled labour supply etc.	Does market volume exist for a viable and/or efficient local supply? e.g. is market demand sufficient to support new investment in a production facility, investment in new training capacity etc	e.g. established global supply chains where other nations have existing specialisation and capacity.

	VALUE OF OPPORTUNITY				
Criteria	What is the scale of the opportunity (employment, revenue)?	Is it likely to be a sustainable, longer-term source of employment?	How many jobs will be net to existing jobs in the region?	What are the multiplier effects for other industries in the region?	What is the potential to reduce unemployment over the longer-term?
Description	Employment and market size estimates	Longer-term employment and industry opportunities have a higher value and should be prioritised.	Job creation opportunities that create net additional jobs rather than simply reallocate labour are higher value. Short-term reallocation of labour can have negative impacts on the longer-term health of regional labour markets, industries and communities.	Some industry development opportunities have higher multipliers or flow-ons for associated industries and supply chains.	Opportunities that create jobs suitable for the unemployed and disadvantaged or under-represented labour market groups.

Evaluation criteria (cont.)

	COST OF OPPORTUNITY		
Criteria	What is the scale of impact on RE project delivery costs?	What level of investment in supporting regional social infrastructure, housing or skills is required to support population growth?	What is the cost to government?
Description	Assessing potential impacts of initiatives to increase local industry participation on electricity prices is important in order to avoid impacts on the opportunity to use clean energy as a source of competitive advantage in energy-intensive industries and wider impacts on other sectors. It is also important that requirements for projects within the REZs do not outweigh the benefits and increase costs relative to projects outside the REZs. Assessment of the implications of increases in project cost for electricity prices is complex. Indicative estimates of potential impacts on project costs will be assessed.	Will realising the opportunity also require investment in other forms of infrastructure? If so, what types of infrastructure? Will other investment be needed to support population growth if that is required?	Will the opportunity require funding or support from government with costs?

Evaluation summary

KEY	High likelihood or value, or low opportunity cost	Medium likelihood, value, or opportunity cost	Major barriers, low value, or high opportunity cost

Opportunity	Viability for NSW	Value of Opportunity	Cost of Opportunity
Wind Tower Manufacturing			
Transmission Tower Manufacturing			
Wind Farm Manufacturing (non-tower)			
Battery Energy Storage (BESS) Supply-Chain			
Solar Farm Infrastructure			
Electrical Balance of Plant			
Transmission Construction Workforce			
Solar Construction Workforce			
Wind Maintenance Technicians			
End of Life			
Mining and Minerals			
Offshore Wind			

Note: no evaluation is made for cost of opportunity for offshore wind as it considered too early to assess.

Local Content, Project Costs and Electricity Prices

One of the objectives of the project and the plan under development by the RESB is to increase local employment without significant impacts on electricity prices which could impact on wider economic opportunities.

Where data is available or reported, we provide information on the potential impact on **project costs**. Whilst in theory, renewable energy project cost increases should flow through into **electricity prices**, the relationship in practice is less direct and more complex.

There are four pathways through which an increase in the project costs for renewable energy projects can lead to an increase in electricity prices (or, more likely, a lower rate of price decrease).

- Wholesale market electricity prices: increased project costs for renewable energy projects could flow through into spot market prices. In practice, non-hydro renewable energy projects are almost always price-takers and coal, gas and hydro are the price-setters. This may change over time but at present the link is weak and it is reasonable to state modest project cost increases are unlikely to flow through into wholesale electricity prices.
- PPAs between a project and electricity user: Increased project costs could flow through into higher strike prices between a project and a specific off-taker. For large creditworthy off-takers, there is likely to be significant competition between projects with varying capacity to pass-through costs to off-takers.
- PPAs between a project and an electricity retailer: Increased project costs could flow through into higher strike prices between a project and a retailer which are then passed onto electricity customers. Electricity purchase costs typically range between 20-25% of retail electricity charges and electricity retailers purchase from a range of sources.
- Long-term Electricity Supply Agreements for the REZs: Proponents can bid for Long Term Energy Service Agreements (LTESAs), which contain an option to a fixed strike price for their output. An LTESA strike price could either be 'over' or 'under' the wholesale electricity price and therefore incur savings or costs which would flow through into distribution charges for included customers (energy-intensive industries have typically been excluded).

Consequently, there is not a simple 1:1 flow-through from project cost to electricity prices, especially where project costs are modest. As project cost impacts escalate, it is more likely there will be pass-through.

Wind Tower Manufacturing

SUMMARY

- There is significant interest amongst stakeholders in the opportunity to develop wind tower manufacturing.
- NSW has steel manufacturing capacity but investment would be required in a new wind tower factory. There are some advantages (e.g. industry reports 7.5-10% lower cost than Victoria due to co-location with steel supply) & could be opportunity to supply towers to neighbouring states, offshore wind and to produce hydro pipes.
- It was reported the minimum viable scale for investment in a new factory is approx. 250MW p.a. and the optimal scale around 350MW p.a. for 6 years – 1500MW (minimum) or 2100 (optimal). If half of the 12GW target is assumed to be wind (6GW) that represents one-quarter (minimum) to just over one-third (optimal) of new capacity built.
- Based on an adjusted range for the cost differential of approximately 10% - 35% to account for increased shipping costs and lower NSW production costs, the cost impact would be ~0.25% - ~0.9% (minimum scale) to ~0.35% – ~1.2% (optimal scale)
- A wind tower factory would employ ~175-200 workers directly and based on BlueScope modelling 3000MW of wind towers would lead to just under 2000 direct jobs in steel manufacturing and associated industries.

Note: the manufacturer reports RE industry claiming a 40% cost differential which they consider 'unrealistic'. In our consultation, industry quoted 50% which is used for upper range to be conservative.

Viability for NSW		• OEMs prefer global supply chain and there is a cost premium. Under VRET, the cost-differential for local production was estimated to be 20/25% (manufacturer) to 50% (RE industry). • Local supply quicker to market and would reduce supply chain risks which have increased significantly with rising shipping costs and times • Co-location with steel in NSW can significantly reduce cost of transport and product damage • No major barriers to scaling workforce or local manufacturing • Minimum scale for new facility is 250 MW p.a. and optimum scale is 500 MW p.a. over at least 6 years
Value of Opportunity		• 175-200 jobs (tower factory) and major boost to local steel supply chain (just under 2000 direct jobs based on Bluescope modelling) • High probability jobs will be sourced for local population which can be trained through a mix of TAFE and accredited on-the-job training • Semi-skilled jobs that could reduce local unemployment • Longer-term and associated opportunities in pumped hydro tubes, offshore wind and potentially onshore to other states
Cost of Opportunity		• Towers account for ~10% of total wind farm cost and ~15% of capex • Adjusting the VRET cost range for savings in shipping and co-location, cost differential is ~10% - 35%. • Bluescope has space available for co-location • No infrastructure requirements for government but to facilitate investment, local content requirements (or an equivalent mechanism) would be required for certainty on project pipeline

Transmission Tower Manufacturing

SUMMARY

- Transmission towers have been imported to date, in particular from China which has purpose-built fabrication plants.
- The large-scale transmission build-out 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.
- 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.
- The key factor to improving cost competitiveness is a modern, automated facility which integrates fabrication/processing and galvanisation to remove additional handling and transport cost. Ferretti International, (FI) which is establishing a facility in South Australia, states that a feasibility study found that an automated factory reduced the cost from $2800/t to $2200/t which was comparable to the imported price (2019 prices).
- The lack of testing facility has been raised as an issue. FI notes towers are made against established standards so only minor testing should be needed and would cost ~$1m if international testing was required unless there were major issues.

Viability for NSW		• ASI has >85 steel fabrication members in NSW, of which 12 have indicated via member profile they have capability to manufacture transmission towers. • No workforce capacity issues were identified in stakeholder interviews. The skillsets used in the factory being established by FI include logistics, handling, chemical controls, electronic and mechanical maintenance. • Established supply chains can represent a barrier to local suppliers.
Value of Opportunity		• ISF projects 211,000 tonnes of steel throughput will be required across Australia and 79.000 tonnes under the ISP over 2020-35 under current scenarios. • Direct employment in an automated tower manufacturing facility is ~80 according to FI plus 20 jobs in transport and logistics. • Based on modelling commissioned by Bluescope, the volume of steel processed could create ~ 300 direct jobs in steel manufacturing.
Cost of Opportunity		• FI says with the operation of a purpose-built facility transmission towers will be cost-competitive with imported towers. • FI 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 to cover almost 50% of funding. The balance of the funding will be from commercial financing tools. Bluescope has space available

Wind Farm Manufacturing (non-tower)

SUMMARY

- There were some other manufacturing opportunities raised in the course of stakeholder engagement:
    - Wind blade manufacturing
    - Nacelle/hub assembly
- There are also some other types of manufacturing which have been, or could be, undertaken locally:
    - reinforced steel and concrete foundations, anchor cages are a prospective opportunity where local industry is competitive
    - low-voltage cables were considered a potential opportunity
    - Transport equipment manufacturing (there is some equipment manufacturing associated with transportation of wind turbines)
    - Maintenance (e.g. there is currently some local wind gearbox maintenance)
- In general, there are significant barriers to the expansion of wind farm manufacturing but there could be opportunities with concerted industry engagement, procurement incentives and other forms of government support.

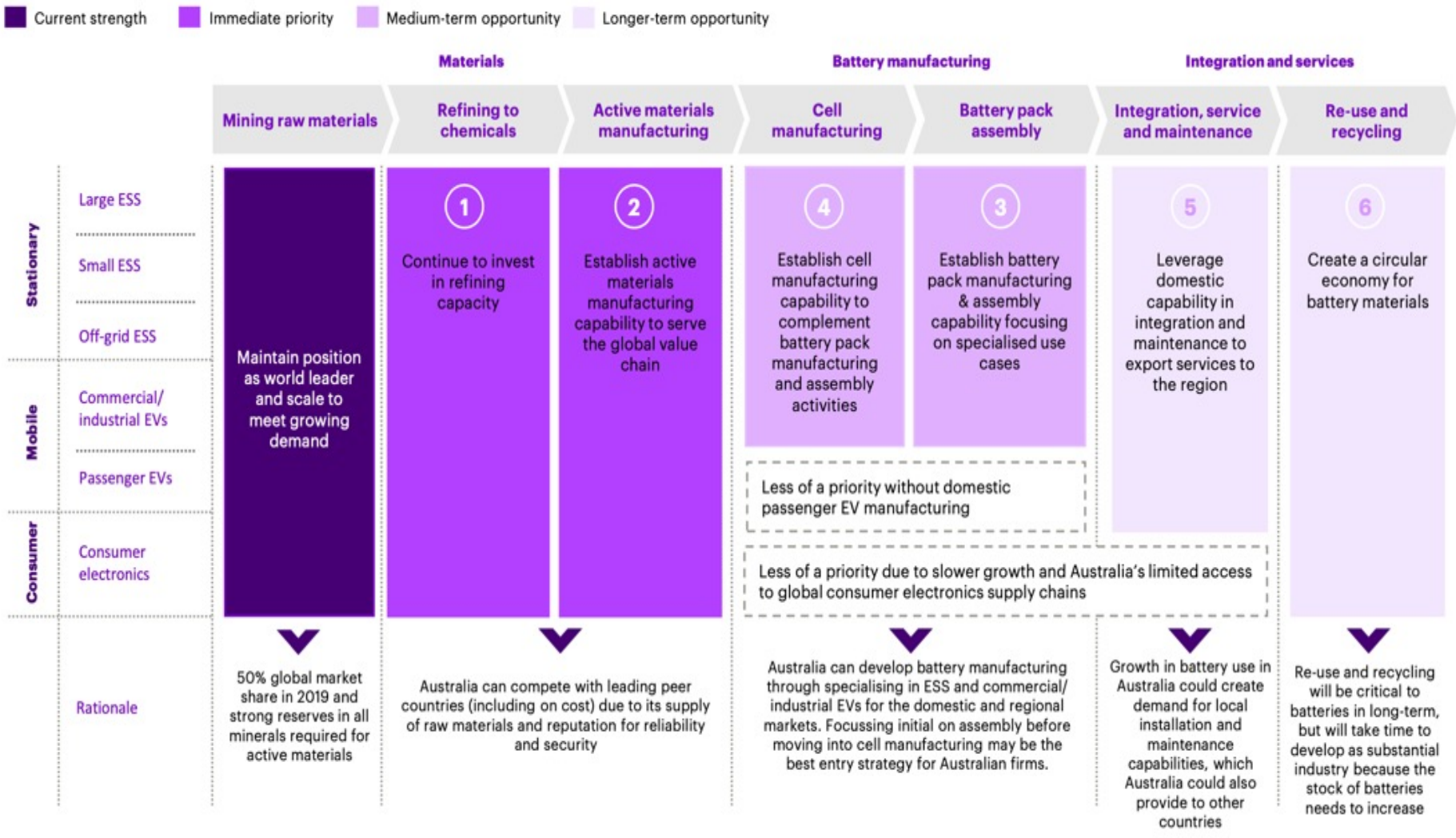
Viability for NSW		• For **wind blades**, there are variations in design between different types of blades which is a barrier to the scale required for local manufacturing (there is 1 known international firm that manufactures multiple blades). Sstakeholder engagement raised potential for market engagement by the NSW and Victorian Governments to stimulate interest by pooling demand with a facility on the border.
		• For **nacelle manufacturing**, firms are often co-located with fine divisions of labour. Nacelle manufacturing is unlikely to be realistic for Australia but hub and drivetrain assembly occurred for VRET. It was suggested collaboration between projects could be encouraged to support local assembly, most likely in a port with nearby manufacturing capacity.
		• For **maintenance**, there is growing onshore manufacturing but major components are generally serviced in a central global repair centre offshore with specialised expertise and equipment
Value of Opportunity		• There is significant value in these other manufacturing opportunities. Around one-quarter is in the nacelle (including assembly), around 15% is in blade manufacturing and almost one-third in O&M (with around 20% in replacement parts)
Cost of Opportunity		• Procurement criteria could assist in creating incentives for local manufacturing but as there are established supply chains most of these opportunities are likely to require significant engagement and additional facilitation and support. • The most prospective opportunities is clearly nacelle/foundation assembly.

Battery Energy Storage (BESS) Supply-Chain

SUMMARY

- $7.4bn market opportunity and 34,000 jobs for Australia.
- Australia is one of few nations with all minerals. NSW nickel and cobalt deposits attracting interest in processing operations.
- Australia has fifth-largest market with potential for specialisations relating to energy storage and EVs
- Series of OECD nations (e.g. US, UK and EU) establishing sovereign supply chains for economic and national security and regulating social and environmental standards
- Opportunity for manufacturing. Labour costs are only 10% and comparable to OECD competitors. Upstream development will support manufacturing as minerals are 55% of cost structure. Energy Renaissance establishing battery pack assembly and cell manufacturing facilities.
- Barriers include access to capital and higher electricity costs

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



Source: A summary of opportunities produced by Accenture (2021) for The Future Battery CRC is reproduced here as it was a comprehensive assessment. In terms of rating, viability = orange; value = green; opportunity cost = orange.

Solar Farm Infrastructure

SUMMARY

- 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.
- The level of local supply of solar farm infrastructure (i.e. excluding panels) is currently generally low – concrete (low volumes), fencing (steel) and miscellaneous products (e.g. hold-down bolts).
- 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 a significant increase in infrastructure such as piles, trackers and cabling being sourced locally.
- Business respondents to the survey reported significant local capacity though there is limited experience.

Viability for NSW		• Local supply is quicker to market and more responsive to changes in project schedules • 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). • It was observed that local conditions were leading to some innovations on piles (e.g. hollow steel tubes for sandy soils) and frames (e.g. 5b). • Local industry is evaluating opportunities for expansion. There are variations in design which need to be reflected in production capacity.
Value of Opportunity		• No data available on volume of employment or revenue • ISF projects 1.55m tonnes of steel would be produced for solar farms in NSW ('Step plus REZ' scenario) from 2020 – 35. • Regional SME's and local steel supply chain likely to be beneficiaries
Cost of Opportunity		• Local supply was reported to be 20 – 30% more expensive. Steel industry stakeholders questioned this figure and if supply was compliant with trade and production standards. • The International Renewable Energy Agency estimated mounting and racking accounted for 13% of total cost. • There may be role for government in facilitating and supporting local SMEs but no infrastructure required.

Electrical Balance of Plant

SUMMARY

- Solar and wind farms use two types of transformers: a distribution transformer (installed with inverters) and substation transformer used to set up voltage for transmission. Transformers are currently manufactured in NSW and Australia.
- Electrical equipment, combiner boxes and cables and conduits are imported, but the cables and conduits could be supplied from Australia. Other components such as monitoring systems, security systems and weather stations are all manufactured in Australia.
- For solar, wind and battery storage, there were 10-15 businesses that indicated they had capability in the space.

Viability for NSW		• Based on VRET, an increase in transformer manufacturing is one of the likely outcomes for local content tender provisions • Other balance of plant manufacturing opportunities are more challenging. Low-voltage cabling could be expanded in Australia but there are established supply chains for most other types of balance of plant. • There could be opportunities in assembly of balance of plant componentry
Value of Opportunity		• Balance of plant is a generally in the order of 5-10% of the value for renewable energy technologies. • There also significant supply chain opportunities for smaller businesses
Cost of Opportunity		• There is a cost premium but no data was provided by stakeholders for this project • No major infrastructure requirements were identified for the NSW Government. The major policy action relates to local content criteria for transformer manufacturing. If the NSW Government wanted to pursue other balance of plant manufacturing, that would be likely to require significant engagement and support.

Transmission Construction Workforce

SUMMARY

- 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.
- Skill shortages were identified for various categories of engineers (electrical, structural, mechanical, civil, telecommunications), construction managers, site supervisors, electrical commissioning specialists, line workers and riggers. Infrastructure Australia has identified wider shortages across the infrastructure sector.
- The low level of transmission construction in recent debates has led to a significant reliance on international recruitment which is a significant risk factor (especially in times of COVID). Maintenance on specialised equipment has typically been done by international workers due to low volumes.
- Consequently, there is an opportunity for local job creation in transmission construction and maintenance which could reduce the risk associated with transmission construction.
- There are also opportunities to create employment for First Nations communities. Project EnergyConnect has a minimum requirement of 2.5% of total project spend on Aboriginal & Torres Strait Islander participation in the workforce, with at least 30% of this minimum target being spent on the Contractor's Aboriginal and Torres Strait Islander employees, apprentices and trainees.

Viability for NSW		• Local supply would increase the resilience of the supply chain and reduce risks associated with transmission construction. • The major uncertainty is the extent to which a local workforce can be developed in time e.g. It usually takes four years to train a Certificate 3 lineworker. Depending on the qualifications already held, electricians, distribution line workers and riggers can transition in 1-3 years. • Transgrid has training facilities in Wagga Wagga and could expand to train for the wider market across NSW and the National Electricity Market.
Value of Opportunity		• ISF's projection is for a peak workforce of 2500 across the NEM and over 1000 in NSW by 2024. NSW has the largest share (40%+) of the NEM transmission construction jobs. • Cross-sector opportunities could be developed for line workers (rail, distribution) and electrical commissioning specialists (transmission, generation). • There are opportunities to create pathways for school leavers into professional roles and disadvantaged labour market groups into construction trades.
Cost of Opportunity		• Local workforce development and recruitment should have a modest positive impact on project costs. • Additional social infrastructure may be required (e.g. a transmission EPC reported difficulties in finding housing for staff in the South-West REZ) • Funding is also likely to be required to expand training facilities and provision.

Solar Construction Workforce

SUMMARY

- 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% of the Bomen Solar Farm construction workforce in Wagga Wagga were from First Nation communities. Of the 300 construction workers engaged for Karadoc solar farm (Victoria), there were 90 long-term unemployed 38 First Nation workers and 70% 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 for the unemployed, either through redeployment to other projects or as a bridge to other construction projects. Consequently, there is an opportunity to increase local employment and address social disadvantage through better employment practices.

Viability for NSW		• A FIFO workforce will generally have more experience working on solar farms, but there are sufficient case studies to demonstrate viability of local employment. 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 • Regional unemployment levels are low in some areas. Remote solar farms may also not have sufficient population catchment. • 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.
Value of Opportunity		• Peak construction labourer workforce of 500-600 across REZs • Use of local workforce will improve the social licence of RE projects. There are persistent complaints about the use of FIFO workforces in regional communities by solar farms. • Programs to target disadvantaged labour market groups can reduce long-term unemployment
Cost of Opportunity		• Modest improvement to project costs • No major infrastructure requirements • 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.

Wind Maintenance Technicians

SUMMARY

- Over time, the number of wind farm maintenance technicians will grow significantly across the fleet of wind farms. Wind farm maintenance requires a mix of electrical and mechanical technicians to maintain the turbines, electricals and blades. 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. 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 … 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).

Viability for NSW		• Industry preference is for local workers due to lower cost, connection with community and logistics of workforce management. • Mechanical technicians can be recruited from a variety of industries in regional areas (e.g. fitters and turners, agricultural workers with a mechanical background). • There are wider skill shortages for electricians in regional areas and there is sufficient time for these to be addressed for maintenance.
Value of Opportunity		• On-going jobs over lifetime of wind farms which require regular maintenance. Contractors often service a group of wind farms • If wind farms are refurbished with new turbines, the jobs would continue beyond the life of the existing turbines (~20 years). • Opportunity for good quality, long-term jblue-collar jobs.
Cost of Opportunity		• Local workforce would modestly reduce O&M costs. • 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 • No major infrastructure requirement • New training infrastructure may need to be established, although there is the possibility of leveraging investment in blade apprenticeship and training facilities in Victoria.

End of Life

SUMMARY

- There are circular economy opportunities to extend RE technology life, reduce costs and minimise waste through repairing, servicing and replacement. Recycling rates will also become important for exports (e.g. EU has passed a law mandating labelling on recycled content for batteries).
- Local supply chain capability in reuse/repowering also results in long-term employment opportunities in the operations and maintenance stages of the life cycle. There is an opportunity to transfer skills from the manufacturing sector, assembly and disassembly, ensuring the highest value recycling as well.
- Until 2025, it is anticipated that PV waste will be from distributed systems and geographically located in Sydney, the central coast, and northern costal regions but by 2035 both utility and distributed will be generating a large share of waste.
- Opportunities within REZs exist for co-location of local recycling, materials processing and manufacturing facilities with efficient logistics of distribution, collection and transfer of components/materials. Integration with Special Activation Precincts (SAPs) and established recycling collection and processes (e-waste in particular).
- However, there is a need for specialised equipment to fully process solar panels and scale up. Market certainty on volumes is required to justify capital investment. The National PV Product Stewardship Scheme under development will provide certainty in investment and infrastructure, R&D and increase participation in PV recycling

Viability for NSW		• Projected RE waste generation will provide the volumes to develop recycling at scale for PV and battery storage, with an opportunity to combine existing e-waste collection schemes, infrastructure and processing • Establishment of local steel manufacturing capability for transmission towers would also facilitate better end-of-life handling of transmission line infrastructure and production to Australian standards • Skills can be transferred from assembly during construction of RE technology to decommissioning, disassembly and refurbishment.
Value of Opportunity		• Anticipated 10,000 tonnes(t)/y by 2025 and 63,000 t/y by 2035 PV waste generation in NSW with low value recovery (only Al - $1,000/t and Cu – $5,000/t, glass stockpiling) and high value recovery (Si – $12,963/t and Ag - $533,000/t) – process still in its infancy • 6,500-8,200 t/y by 2035 energy storage batteries • 9.2 jobs are created per 10,000 t of waste recycled (400 new jobs) compared to 2.8 jobs per 10,000 t of waste disposed (120 new jobs).
Cost of Opportunity		• Need to establish the collection, transfer and recycling processes for RE technologies. • Estimated costs for PV recycling – low value pathway: capex: $1.5 mil for 1,500t/a, opex: $650/t, gate fee; $15/unit; and high value pathway: capex: $7 mil for 4,500t/a, opex: $1120/t, gate fee :$15/t. • There are a number of grants for development of end of life management that can be leveraged e.g. NSW Circular Solar ($10mil), ARENA R&D rounds, CEFC Australian Recycling Investment Fund ($100m)

Mining and Minerals

SUMMARY

- NSW and Australia have opportunities in mining and to extend into mineral processing for battery storage.
- A report on the battery supply chain by the 'Future Battery CRC' report by Accenture found Australia can compete with leading peer countries (including on cost) due to its supply of raw materials and reputation for reliability and security. Downstream purchasers are increasingly looking to source battery materials from mines with sustainability certification. Producers expect net zero emissions to become a supply chain requirement.
- NSW contains the largest deposits of nickel and cobalt outside the Democratic Republic of Congo, which are essential materials for lithium battery manufacturing. NSW also has small deposits of lithium.
- There are projects under development for processing facilities, co-located with new nickel and cobalt mining operations in NSW, which significantly reduces the cost and waste associated with transporting bulk unprocessed ore material. Unique cobalt deposits found in NSW have attracted investment in innovative materials processing technologies with better environmental outcomes (Cobalt Blue proposed facility).
- There are circular economy opportunities for minerals processing facilities with co-location (e.g. Parkes SAP), which have the ability to reprocess recycled cathode chemistries.

Viability for NSW		• Australia is a global leader in battery materials supply, export markets are sufficiently mature and growing rapidly in scale. • Emerging investment in NSW battery material mining and processing capacity. However, new mineral processing operations are capex intensive and securing an offtake agreement to underwrite investment is a significant barrier. • In general, projects are seeking offtakes from international producers but there could be scope for a domestic offtake via local manufacturing for government procurement. • No major workforce skills issues identified in engagement but there is competition for labour within region.
Value of Opportunity		• 9500 FTE jobs Australia wide could be created in material processing by 2030 with a diversified supply chain according to the Future Batteries CRC Report • $1.9 billion Australia wide value-added opportunity in refining and active materials processing/manufacturing • Opportunity to provide jobs for workers from declining industries such as coal mining. • Materials processing facilities have the potential to re-process recycled material.
Cost of Opportunity		• Some supporting infrastructure requirements (e.g. oversized route upgrades to facilitate transportation of large processing and manufacturing infrastructure during project construction) • Other areas for Government could include supporting investment attraction, local content requirements in procurement, support for uptake of renewable energy, achievement of net zero emissions and certification.

Offshore Wind

SUMMARY

- Offshore wind was not originally included in the REZs by AEMO but was included 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 totalling over 10 GW under development off the coast of Newcastle and Illawarra REZs.

- 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 and AEMO has stated modelling for offshore wind should be expanded for hydrogen superpower scenarios.

- 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.

- Some of the supply chain opportunities include tower manufacturing, port facility development and operations, vessels (e.g. primarily smaller survey and maintenance vessels), electrical balance of plant, steel manufacturing (towers and other smaller elements e.g. ladders).

Viability for NSW		• A locally-based construction and maintenance workforce has cost and social licence advantages. Co-location with port facilities will be advantageous. There are benefits for local production of towers. • 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. • 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.
Value of Opportunity		• Employment modelling was undertaken by ISF for the Blue Economy CRC report. 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. • Major pathways internationally for the workforce have been from offshore oil and gas, energy industries and cross-sector skills (e.g. finance). Opportunities should exist for transition of the coal workforce within the Illawarra and Hunter
Cost of Opportunity		• 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 to develop local supply chain capacity.

06

Barriers

Barriers: introduction

Barriers have been primarily identified through engagement - interviews, REZ workshops and survey results.

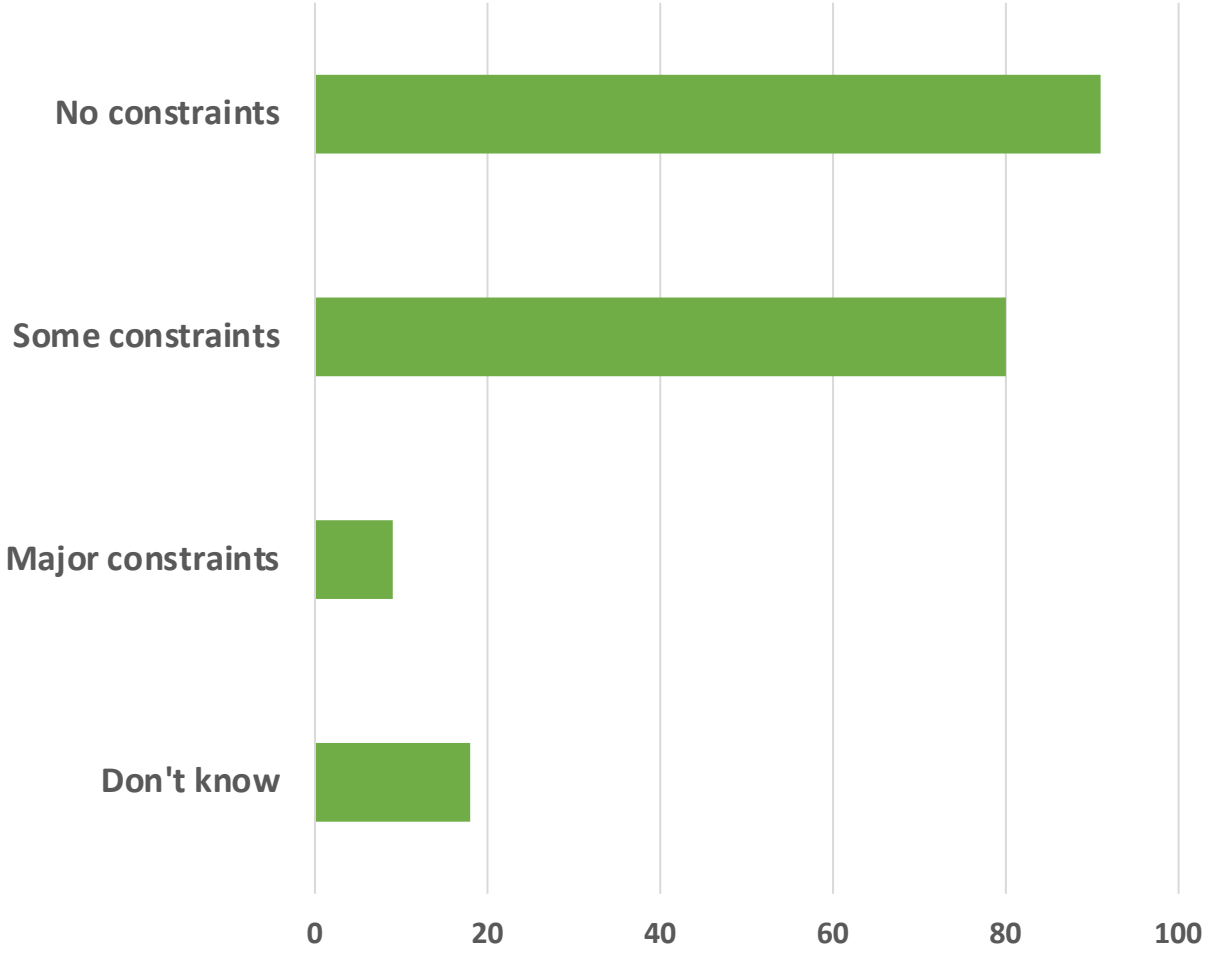
Barriers are analysed under broad themes:

- Skills shortages
- Training market and system capacity
- Supply chain
- Infrastructure
- Regulation, planning and policy

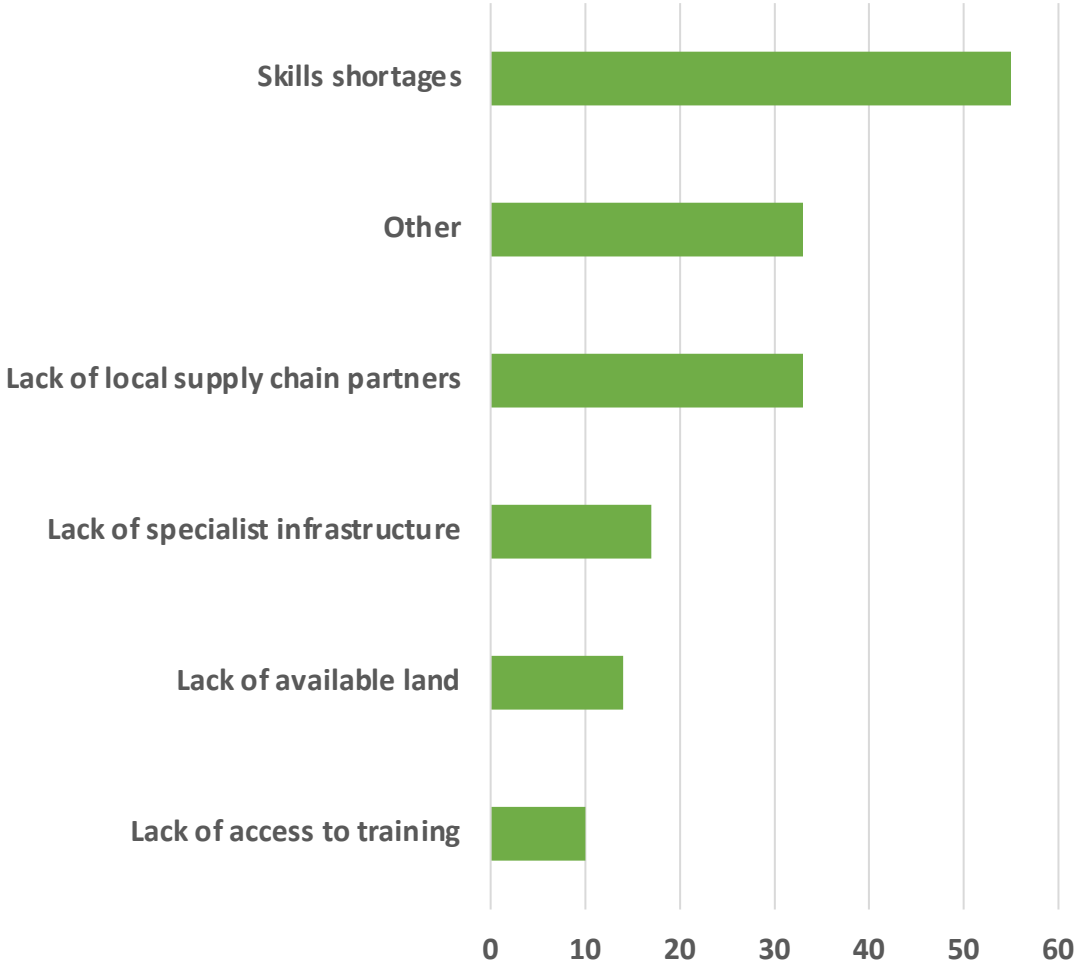
Stakeholders identified barriers that directly impact opportunities to increase local content and jobs (e.g. skills, training and supply chain) and broader contextual barriers that impact opportunities more indirectly (mainly in the categories of infrastructure, regulation, planning and policy)

Key survey results

- Around half of businesses said there were no constraints
- A similar proportion said there were some or major constraints on their ability to take advantage of opportunities
- However, very few see major constraints – noting some were unsure of constraints



Skill shortages were the #1 barrier in Survey



Around 1/3 of respondents nominated skill shortages as the primary barrier (and some of the 'other' responses also related to skill shortages).

General Drivers of skills shortages

- Low unemployment rates/tight labour market in some regions and competition for skills and labour within regions with other industries e.g. mining and manufacturing
- Reports of issue with lack of transferrable skills, upskilling labourers and skills leakage amongst existing workforce
- Difficulties in attracting workers to live and work in regional areas due to wider issues such as employment for spouses, housing availability, health services etc
- Decline in migrant labour due to COVID-19 - though COVID-19 has driven some people from the cities to the regions
- Many regional areas have lower younger residents and an ageing workforce

RE drivers:

- Renewable energy sector not acting as a coordinated industry sector for skills e.g. lack of portability of entitlements
- Short construction phase time-frames, lack of longevity of work, uncertainty around projects going ahead and timing create barriers to investment in apprenticeships, workforce building and training
- Labour and product supply bottlenecks where major infrastructure is delivered concurrently, rather than sequentially

Barriers: Training market and system capacity

A series of reviews at Federal and NSW level have identified structural issues with the VET sector, and our engagement elicited similar views highlighting issues with training market and system capacity

Barrier	Key factors
Low/declining demand for training	• Low demand for specialised courses in each REZ. • Low enrolments in relevant units of competency and qualifications • Trades and VET have become less attractive relative to university education for school-leavers and young people
Low/declining supply of training	• Australian market is small and renewable energy is a 'thin market' (low demand), leading to 'rationalisation' of specialised training packages and further erosion of opportunities for specialised skills to be developed • Specialist training is expensive to set up, capital expenditure on equipment is high e.g. for the hydrogen supply chain • Loss of big companies and 'supply authorities' training apprentices • Under-resourcing of TAFE and shortage of trainers: high skills demand within the industry and a considerable salary differential between industrial and training employment
Training packages	Divided views on training packages: • Industry representatives: training packages unsuitable and would not be used by industry • Unions/training providers: industry knowledge of training packages is low outside major companies. Training packages broadly suitable with some gaps e.g. blade maintenance. Barriers are infrastructure, resources and people to deliver training in context of under-resourced TAFEs and private RTOs in thin markets.

Barriers: supply chain

Supply chain barriers include a range of market constraints, specific constraints for SMEs and regional suppliers, technology and competitive barriers and trade-offs between local supply and least cost.

Theme	Key factors
Market constraints	• Compressed delivery timeframes - undermines ability for local suppliers to scale up • Lack of sufficiently sized off-takers e.g. for minerals • Over-reliance on international supply chains by overseas owners of solar and wind farms e.g. project specifications that favour overseas suppliers.
SMEs/regional suppliers	• Unreasonable liquidated damages, retentions and contract terms • Uncertainty in tender processes • Lack of market knowledge - procurement processes, contacts, connections with tier suppliers and RE project developers, awareness of opportunities • Limited organisational capacity and significant existing workloads
Manufacturing, technology and cost competitiveness	• Mixed views on cost competitiveness. Some see potential for NSW to be cost competitive on production but for some products it remains cheaper to import and there can be significant differences between costs of local and overseas manufacturing. High local costs - stringency of local workforce legislation, transport and energy. • Perception barrier about Australia's ability to manufacture at competitive prices which manufacturers say does not reflect the reality of advanced manufacturing
Local production versus lowest cost	• Local economic development needs to be balanced with renewable energy being competitive in the market. However, overseas supply also creates risk e.g. waiting for supply, currency risk, price increases. Sovereignty of supply (uncertain provenance) is a major security issue for batteries • Tension between competitive tenders to secure a low strike price versus increased opportunities from e.g. greater consolidation through a single or fewer proponents. • Lack of consideration of wider economic benefits compared with financial value when considering investment means that the value in capacity building of regional economies and labour markets is not priced in to the financial appraisal

Barriers: infrastructure

Short-term construction may adversely impact local communities, putting pressure on local infrastructure and services (e.g. childcare, health, roads), particularly accommodation. Local infrastructure constraints may present specific barriers during the construction phase.

Theme	Key factors
Accommodation	• Additional accommodation and facilities needed for the construction phase and some needed for workers for large-scale maintenance. Combined with local shortages of suitable housing stock, this could cause issues with local housing affordability in some regions, especially for apprentices. • Multiple stakeholders highlighted potential opportunities to work with government to find alternative uses for purpose built accommodation e.g. affordable housing
Local infrastructure constraints	• Transport bottlenecks and disruptions, rental vehicle availability, out-of-hours transportation movements, transport to/from job locations • Issues with local roads - may not be adequate for construction and maintenance phase • Limitations in regional rail networks • Lack of warehousing facilities • Lack of suitably zoned and serviced land • Land use conflict and competition - urban sprawl, rezoning of industrial land, current pressures on agricultural land, need to balance carbon and biodiversity offsetting and protections • New demands on infrastructure due to increasing scale of projects/components e.g. blade size Constraints may require upgrades to shared infrastructure

Barriers: regulation, planning and policy

Stakeholders nominated some deficiencies in coordination, regulation, planning and policy as well as local councils' capacity to manage the scale of the infrastructure tasks

Theme	Key factors
Coordination, clarity and transparency	• Lack of joined up thinking and coordination by Government – siloed approach at departmental level, competition rather than coordination between states, lack of integrated economic and investment framework at a Regional NSW level - multiple precincts competing for investment across a range of different regional initiatives (Special Activation Precincts, Clean Manufacturing Precincts, Renewable Energy Zones etc) but not recognising fully the inter-dependencies of each and not fully aligning with local housing and social infrastructure supply planning • Some stakeholders said there was insufficient industry and community engagement • Perceived lack of benefit sharing especially relating to social benefits and social licence
Policy constraints	• Absence of consistency of policy, direction and support from Federal and state governments, short term thinking and past policy positions that have contributed to a cautious approach to investment by business • Absence of a national stewardship scheme for PV panels • Lack of policy aimed at keeping manufacturing jobs in the country
Regulation and local planning constraints	• Issues relating to statutory planning and zoning requirements - land use rules and regulations were not written with new technology in mind • Lack of capacity and resources in some regional Councils to be able to forecast future demand for infrastructure and move quickly to address supply shortages. Capacity constraints for local suppliers and councils to keep up to date with and manage impact of regulatory changes. • Tension between regional job opportunities and housing supply considered a major barrier to attraction of regional communities but is also one that Councils are very challenged in addressing due to financial and other resources as well as their limited abilities to deliver large-scale infrastructure • Slow approvals process for the distribution network • Need for regulation to support whole of life material recycling and rehabilitation of sites • Lack of capacity and resources in some regional Councils to plan for wider economic development opportunities for inward investment, particularly if such investment will come quickly but be temporary (for instance growth due to construction-phase activity)

Institute for Sustainable Futures
University of Technology Sydney
PO Box 123 Broadway, NSW, 2007
www.isf.uts.edu.au