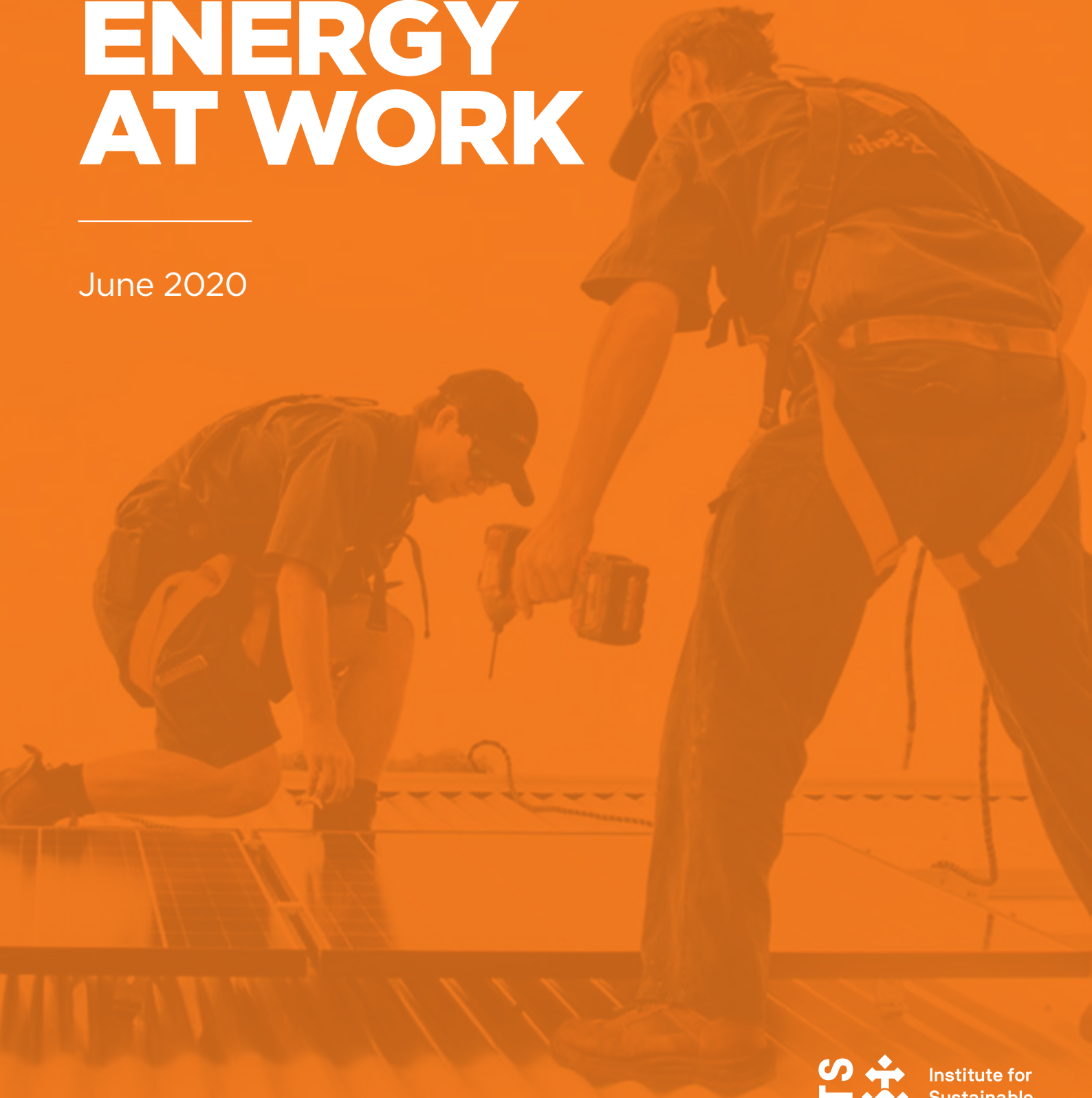


CLEAN ENERGY AT WORK

June 2020



This report highlights the results of the largest study of current and projected employment in the renewable energy industry in Australia.

Acknowledgments

This report is based on research by Chris Briggs, Jay Rutovitz, Elsa Dominish, and Kriti Nagrath of the Institute for Sustainable Futures, University of Technology Sydney.

Thank you to the survey participants who took part in the research underpinning this report, your input is invaluable.

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INTRODUCTION

In mid-2019, the Clean Energy Council commissioned the Institute for Sustainable Futures to undertake research to understand the size and characteristics of the Australian renewable energy workforce.

The renewable energy sector has seen rapid growth, with 2019 setting several new records. What often gets overlooked in times of expansion are the employment and career opportunities that are created by such activities. The Australian Bureau of Statistics (ABS) periodically publishes employment figures for renewable energy activities, but these are estimates based on secondary information rather than ABS surveys.

Through this industry-wide survey, employment factors were derived for the Australian development, installation, operation and supply chains of wind and solar energy,

hydro and pumped hydro power, and batteries. These employment factors are applied to scenarios developed by the Australian Energy Market Operator (AEMO) in its 2020 draft Integrated Systems Plan (ISP) to estimate job creation into the future.

This report does not include the construction of electricity networks, professional services outside of renewable energy businesses, bioenergy or renewable hydrogen, end-of-life decommissioning, recycling or reuse (or mining of resources for renewable energy technologies such as lithium). The report only includes direct jobs in renewable energy generation and the associated supply chains, and does not include induced jobs in other parts of the economy.

KEY FINDINGS



KEY FINDINGS

The *Clean Energy at Work* report highlights the results of the largest study of current and projected employment in the renewable energy industry in Australia, which has boomed in recent years. With this expansion, the industry has reported skills shortages but found a lack of data an impediment to future workforce planning.

In filling this gap, research from the Institute for Sustainable Futures suggests that in 2019, **at least 25,000 people were employed across the renewable energy industry** and almost 10,000 of those jobs were in small-scale rooftop solar. **By 2025 the renewable energy sector could employ as many as 44,000 people** under AEMO's Step Change Scenario. More ambitious scenarios, dependent on policy settings, could result in an even larger workforce. Small-scale rooftop solar, currently representing more than a third of the renewable energy workforce, is set to continue as the largest generator of employment. Wind, large-scale solar, hydro and then battery storage and solar hot water will make up the remainder of the workforce, with the importance of employment within each technology-type heavily dependent on the international and Australian policy landscape.

A robust regional economy has long been linked to a vibrant and prosperous Australia, and renewable energy can be a crucial contributor to that. **Around 70 per cent of renewable energy job opportunities to 2035 could be distributed across regional and rural Australia.**

The renewable energy sector employs a diverse range of essential workers requiring both generalist and specialist skills. Although construction and installation jobs now dominate the renewable energy labour market (72 per cent), by 2035 as many as half of renewable energy jobs could be ongoing jobs in operation and maintenance, especially in the wind sector.

The *Clean Energy at Work* report identifies and highlights that skills shortages exist within the renewable energy labour market leading to a range of issues such as reduced efficiencies and project delays that drive up costs. The survey was undertaken during a boom and therefore provides insight into skill shortages that are likely to recur when the industry grows rapidly again in the future. This is why a review of the structure and suitability of relevant training systems across the renewable energy industry is necessary to respond to the growing needs of the industry and deliver credible career pathways for Australians. Both state and federal government policy have vital roles to play in establishing a robust and secure renewable energy workforce.

Hornsedale Power Reserve, Neoen

CURRENT RENEWABLE ENERGY JOBS

★ KEY FINDINGS

Renewable energy already creates at least 25,000 Australian jobs that provide the foundation upon which to build a strong and stable clean energy workforce across Australia.

Warwick Solar Farm, University of Queensland

» SOLAR

More than half of all clean energy jobs in 2019 were in developing, building and maintaining Australia's solar capacity. Small-scale rooftop solar employs 37 per cent of the clean energy workforce, which equates to as many as 10,000 people. A large proportion of the businesses installing small-scale solar are small to medium-sized that employ fewer than 20 people. Large-scale solar employs 13 per cent of the clean energy workforce.

» WIND

Around 7200 people, or about 28 per cent of the renewable energy workforce, is employed in the construction and operation of Australia's 100 or so wind farms.

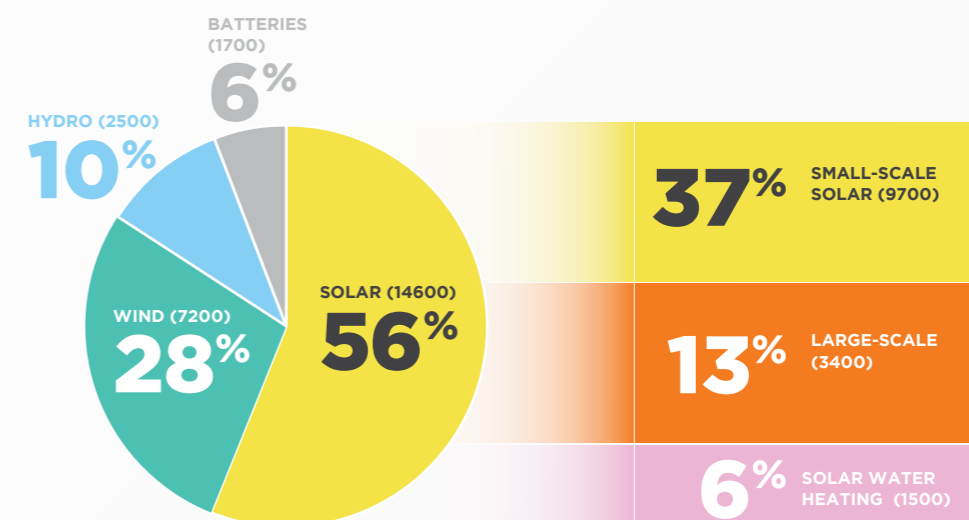
» HYDRO AND PUMPED HYDRO

Hydro and pumped hydro together employ around 2500 people or 10 per cent of the workforce.

» BATTERIES

The remaining 6 per cent of the clean energy workforce are employed in the installation of batteries, mainly small-scale distributed batteries, with just 1 to 2 per cent employed in large-scale battery construction.

RENEWABLE ENERGY JOBS BY TECHNOLOGY, 2020





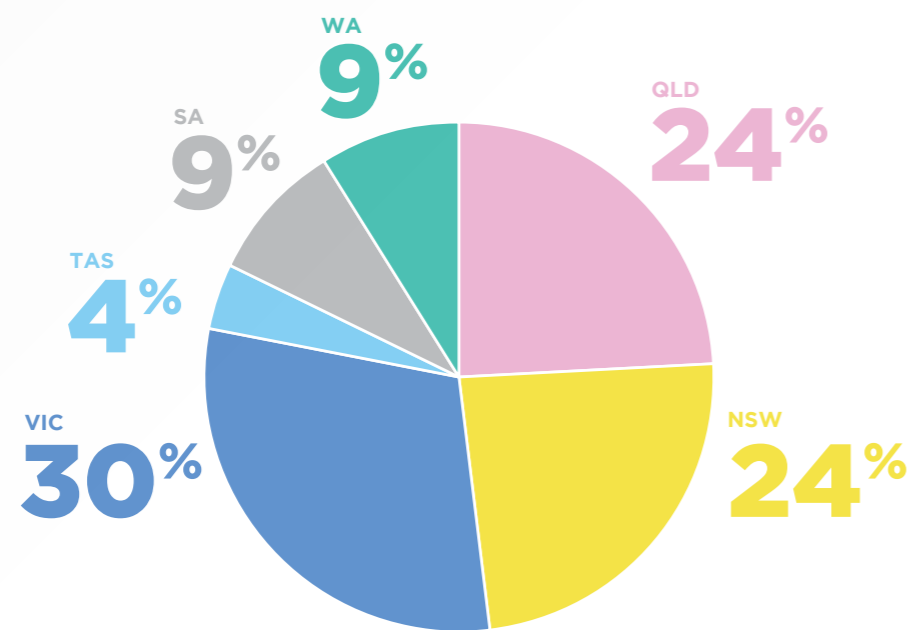
Poatina Hydroelectric, Hydro Tasmania

RENEWABLE ENERGY JOBS ACROSS STATES

Almost a third of all renewable energy jobs are currently in Victoria. Together with New South Wales and Queensland, the east-coast states employ more than three quarters of the renewable energy workforce.

The majority of renewable energy activities are located in regional and remote parts of Australia, driving up local employment in those areas.

INDICATIVE BREAKDOWN BY STATE, RENEWABLE ENERGY JOBS



CLEAN ENERGY JOBS IN THE SPOTLIGHT

CADETSHIP PROVIDES TRAIL-BLAZING OPPORTUNITY

As Tasmania's only female hydrographer in the hydropower industry, Alyssa Edmunds is playing a pivotal role in our renewable future.

"When I viewed the job description, it was just everything I wanted. It was working in and amongst the environment, working in different clusters of people, it was just exactly what I wanted my job to look like."

- ALYSSA EDMUNDS

[READ MORE](#)

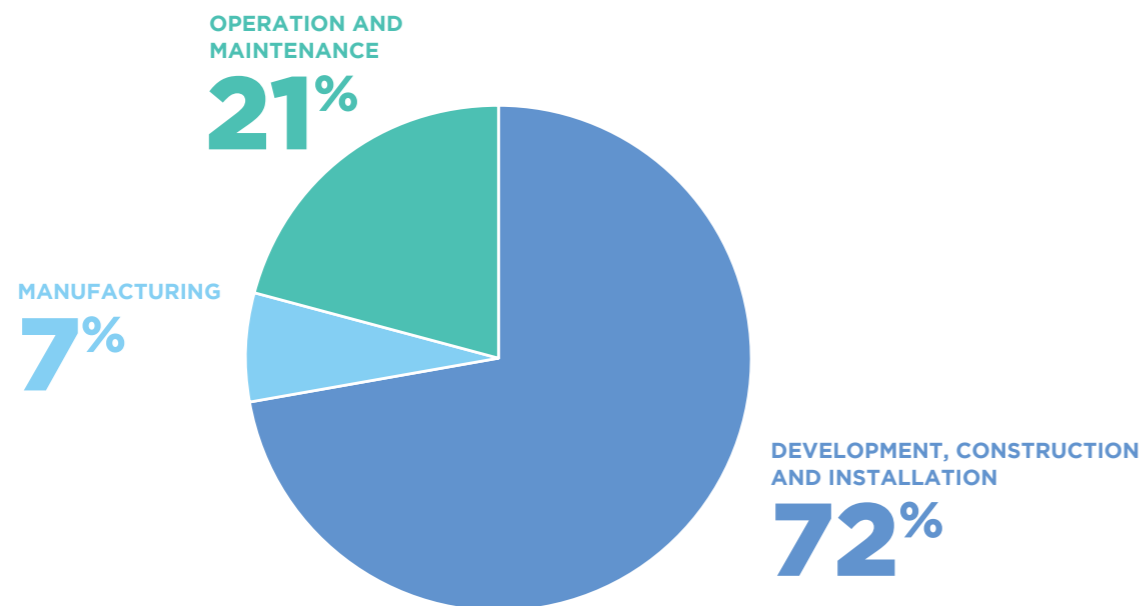


SHORT-TERM AND LONG-TERM RENEWABLE ENERGY JOBS

As Australia emerges from a boom in renewable energy development, the majority of jobs in the sector are in manufacturing, construction and installation, which accounts for as much as 72 per cent of employment. An important focus of this study was to understand the characteristics of the workforce as the industry matures.

This is to ensure that both the industry and the workforce can be supported through a transition from high levels of construction activity to a range of activities across both project development and then operation and maintenance of installations.

DEVELOPMENT, CONSTRUCTION AND MANUFACTURING VS OPERATION AND MAINTENANCE JOBS 2020



RENEWABLE ENERGY OCCUPATIONS

The renewable energy industry is supported by a diverse workforce. Around half of this workforce consists of trades and technicians, machine operators and drivers, and labourers.

Reflecting the importance of the small-scale rooftop solar sector as an employer, electricians and electrical trade assistants are the most in-demand, accounting for

one in five renewable energy jobs. Roofers involved in rooftop solar installations account for another 5 per cent.

The other half of the workforce provides management, professional, and administrative services, such as engineering, design and planning, finance, health and safety, legal, marketing and sales, or form management and senior executive occupations.



White Rock Wind Farm, CECEP Wind Power Corporation and Goldwind Australia

RENEWABLE ENERGY JOBS TO 2035

★ KEY FINDINGS

The renewable energy sector could employ as many as 44,000 people by 2025 if Australia begins a decisive clean energy transition.

AEMO develops scenarios to aid in planning for Australia's future potential electricity needs. Applying renewable energy employment factors to three of AEMO's draft 2020 scenarios shows that the scale and type of employment in the renewable energy sector to 2035 is linked to a range of factors that include federal and state government energy policies, the pace of innovation and adoption of

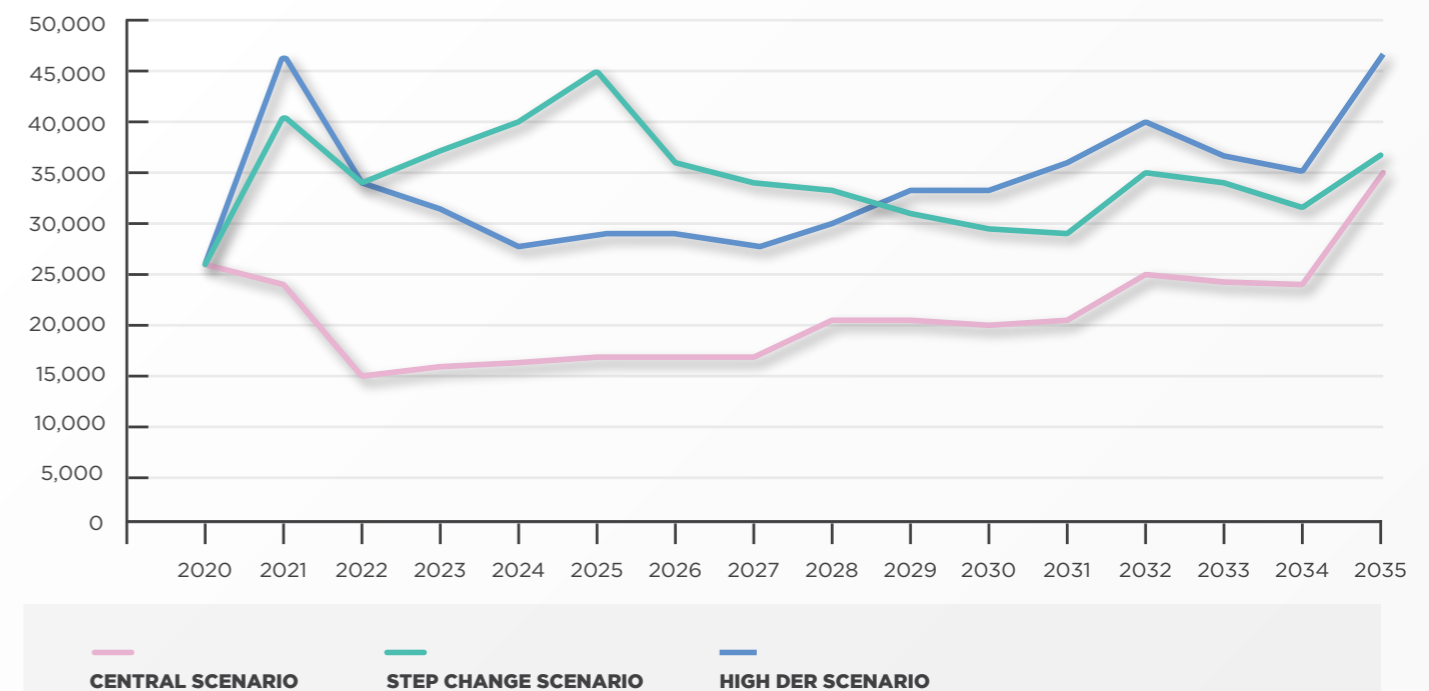
digital technologies, and Australian and international action on climate change. However, these draft AEMO scenarios pre-date the COVID-19 pandemic and therefore reflect the best understanding and projections of the electricity market before any impacts of the crisis have been incorporated.

The three AEMO draft scenarios that were adopted for this study were:

- The Central Scenario, which reflects a business-as-usual approach that includes all current government policies and best estimates of key drivers without any additional policy.
- The Step Change Scenario, which assumes policy commitments towards decarbonisation in Australia in line with Paris Agreement objectives and in concert with similar efforts internationally.
- The High Distributed Energy Resources (DER) Scenario, which assumes a consumer-led transition of the energy sector to more decentralised systems including rooftop solar, household batteries and electric vehicles.

Across the three scenarios, levels and trends in employment vary until the late 2020s, from which point they tend to trend upwards. Under the Step Change Scenario, employment peaks at around 45,000 jobs in 2025. As well as domestic action, this scenario assumes a certain level of global action that accelerates technology improvements. Under the High DER Scenario, employment peaks at around 46,000 jobs in 2021 and then again in 2035 as consumers continue to install rooftop solar systems supplemented by small-scale batteries. Under a scenario with no additional state or federal policies, 11000 jobs will be lost to 2022.

TOTAL AUSTRALIAN RENEWABLE ENERGY JOBS BY SCENARIO 2020-2035





CLEAN ENERGY JOBS IN THE SPOTLIGHT

COMMUNITY CONNECTEDNESS THROUGH ROOFTOP SOLAR

When Mark McClurg paddles out for a surf and looks back at solar panels dotted on roofs, he sees more than the work of his small business.

“ I’m still somebody who has a natural affinity with the environment, especially the ocean. Just knowing that I’m in this clean industry, and I’ve got employees who are in this clean industry - gives me a lot of satisfaction, especially driving around town and seeing all the solar systems that we’ve installed.”

- MARK MCCLURG

[READ MORE](#)



SMALL-SCALE SOLAR

Across all scenarios, small-scale solar is the biggest contributor to jobs in the renewable energy sector. This provides a positive and predictable signal to the labour market. Small to medium-sized businesses are likely to continue to be important providers of rooftop solar and employers for the sector.

LARGE-SCALE SOLAR AND WIND

Together, wind farms and large-scale solar are the second biggest-renewable energy employer. However, the jobs outlook for these technologies are more closely linked to specific projects and government policy settings. For example, in a scenario with a strong policy focus on the Paris Agreement, employment in the wind sector could be double current levels, reaching 14,000 by 2035. However, without policy and reform to address the grid issues and provide investment confidence to support a pipeline of large-scale renewable energy projects, employment in large-scale wind and solar could drop below 30 per cent of current levels in 2022 and 2023 before picking up again. Such inconsistencies in employment levels can affect project costs and timelines as key workers are forced to exit the industry.

BATTERIES

Projections for job growth in large-scale and small-scale batteries are highly uncertain. If AEMO’s High DER Scenario proves closest to reality, these jobs could exceed 14,000 by 2035. However, if the Central Scenario prevails these jobs remain at current levels of around 1500 jobs.

HYDRO AND PUMPED HYDRO

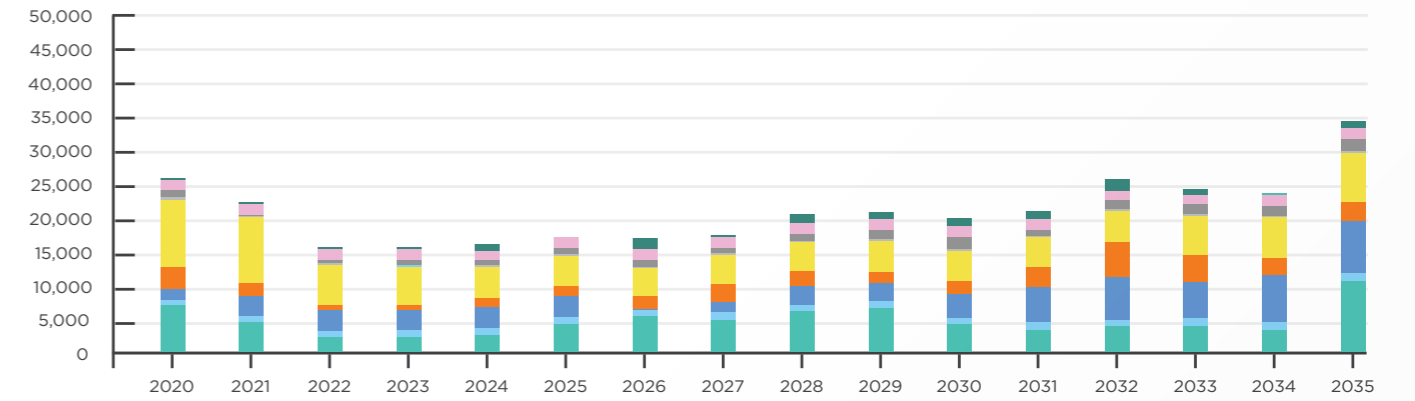
Hydro construction creates major demand for labourers and trades in regional areas and opportunities for local suppliers of cement and steel. Under the Step Change scenario these average 3300 over the period, double the number of jobs today.

RENEWABLE ENERGY JOBS BY TECHNOLOGY TYPE

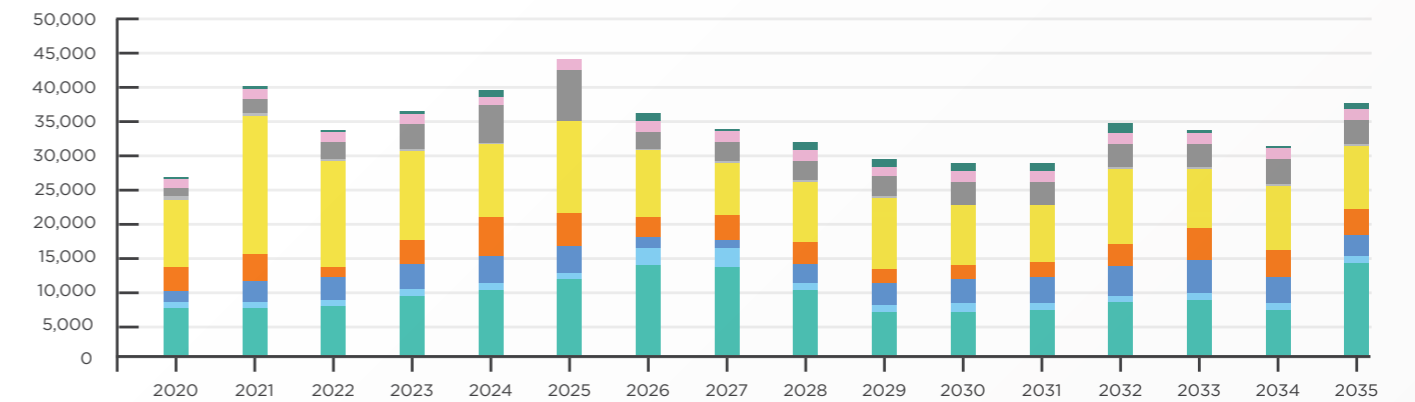


Hallett Wind Farm, AGL

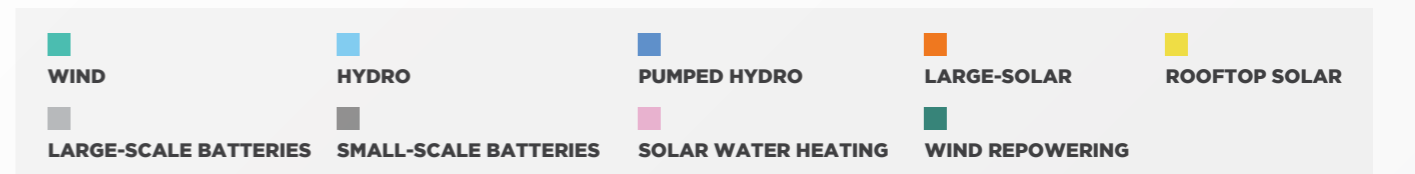
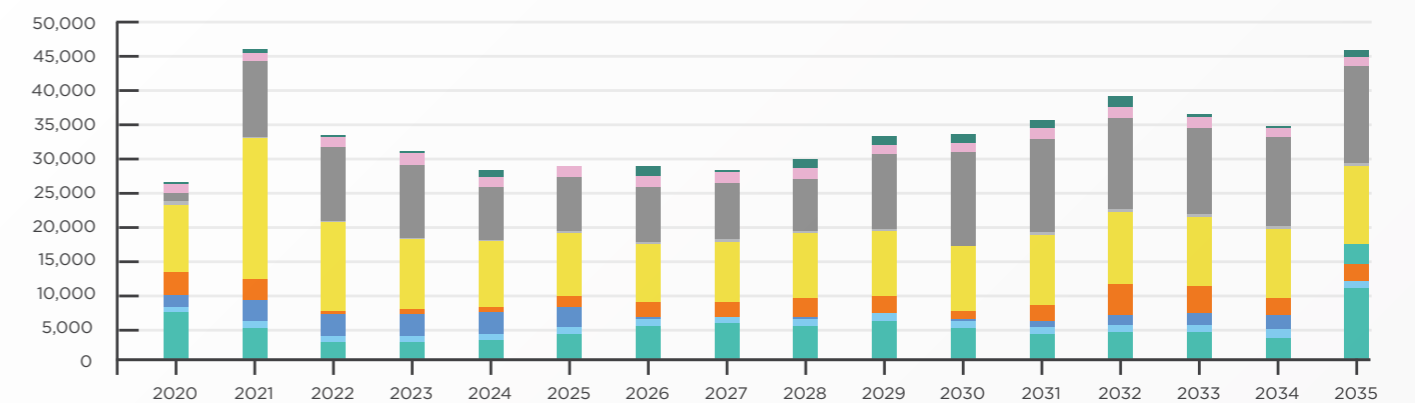
TOTAL RENEWABLE ENERGY JOBS BY TECHNOLOGY-TYPE, CENTRAL SCENARIO



TOTAL RENEWABLE ENERGY JOBS BY TECHNOLOGY-TYPE, STEP CHANGE SCENARIO



TOTAL RENEWABLE ENERGY JOBS BY TECHNOLOGY-TYPE, HIGH DER SCENARIO



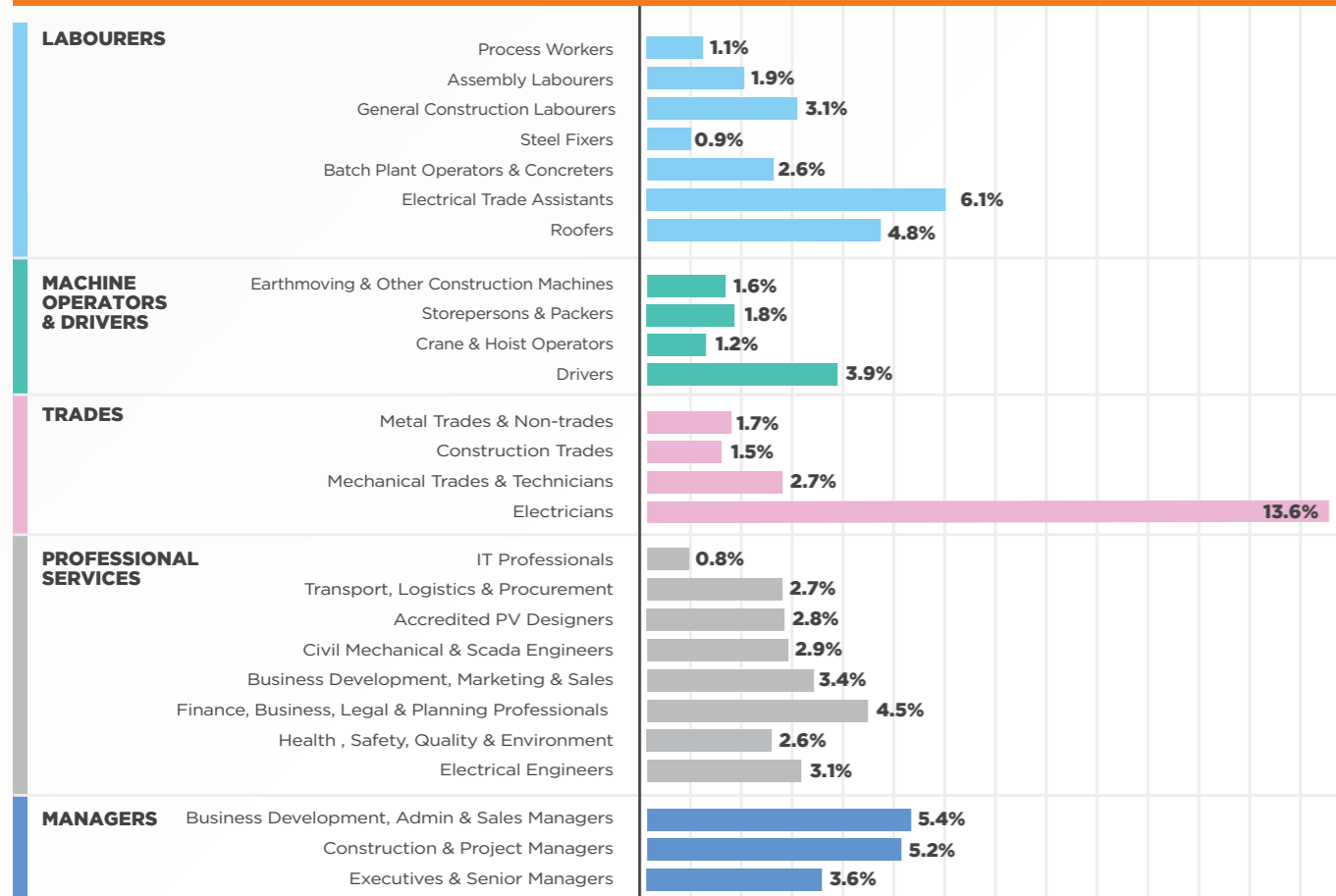
JOBS FROM 2020 TO 2035 BY OCCUPATION

With growth across the sector, there will be increased demand for trades and technicians. In the rooftop solar industry, this will likely result in a continued need for qualified electricians and rooftop solar installers, but also electrical trade assistants and roofers. In large-scale solar and wind, construction will also require electricians, but assembly labourers and mechanical trades as well. As the workforce in the operation and maintenance of renewable energy projects grows, there will be increased demand for specialised technicians. Much of the jobs outlook from hydro power and pumped hydro relates to

the construction of new capacity and is therefore likely to involve concreters, drivers, and general or civil labourers.

Professional services will also be needed in support of new renewable energy projects. These include engineering, finance, legal, planning, marketing, sales, health and safety and IT – especially IT specialists with knowledge of Australian energy systems. Managers and executives that provide business development, sales and construction and project management are high growth areas for employment.

RENEWABLE ENERGY TECHNOLOGIES: OCCUPATIONAL COMPOSITION - COMPOSITE (%)



CLEAN ENERGY JOBS IN THE SPOTLIGHT

ROAD LESS TRAVELLED A SOURCE OF PRIDE

Transporting over-sized wind turbine components to site has proven to be a job like no other for veteran truck driver, Robert Liston.

“Every job you do and every truck you drive is different. But what I do now, on a scale of 1-10, it’s probably about an 11 because of the size and the weight of everything.”

- ROBERT LISTON

[READ MORE](#)

ONGOING JOBS FROM 2020 TO 2035

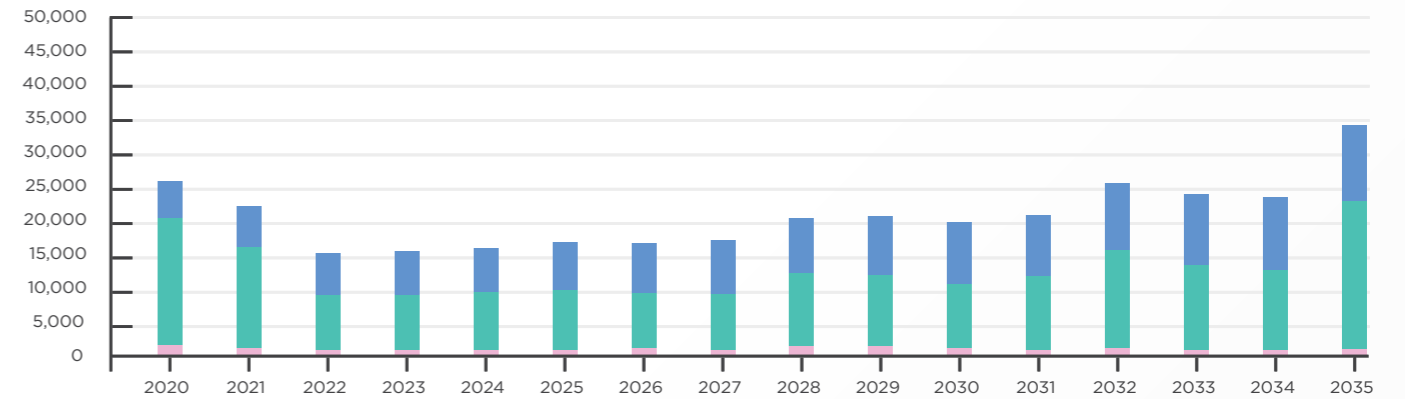
★ KEY FINDINGS

By 2030, jobs in the operation and maintenance of renewable energy installations could account for 50 per cent of jobs in the sector.

Currently, nearly 80 per cent of the renewable energy jobs are project based, in connection with manufacture, development, construction and installation of new sites. Under the Central Scenario, which reflects business-as-usual, almost a third of all utility-scale wind

and solar jobs could be in operation and maintenance. Under scenarios with additional renewable energy policies, these jobs could represent 45 per cent or even 50 per cent of the renewable energy workforce. Most of these permanent jobs are in the wind sector.

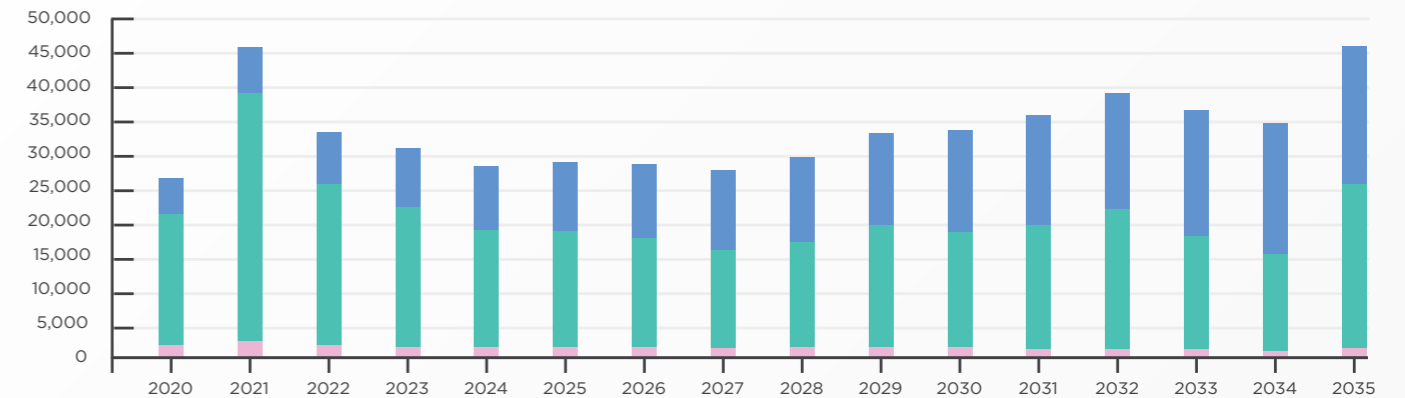
MANUFACTURING, CONSTRUCTION AND OPERATION AND MAINTENANCE JOBS, CENTRAL SCENARIO



MANUFACTURING, CONSTRUCTION AND OPERATION AND MAINTENANCE JOBS, STEP CHANGE SCENARIO



MANUFACTURING, CONSTRUCTION AND OPERATION AND MAINTENANCE JOBS, HIGH DER SCENARIO



■ MANUFACTURING (DOMESTIC)
 ■ DEVELOPMENT AND CONSTRUCTION
 ■ OPERATIONS AND MAINTENANCE



 CLEAN ENERGY JOBS IN THE SPOTLIGHT

IT ALL STARTS WITH THE RIGHT PIECE OF LAND

Senior Power Generation Engineer Karina White specialises in large-scale solar projects from the ground up.

“I’ve just got back from spending six months out in rural NSW on a construction site, so it was really exciting for me. I was involved in the client procuring that project, and then I managed the design and construction.”

- KARINA WHITE

[READ MORE](#)

 CLEAN ENERGY JOBS IN THE SPOTLIGHT

TAKING FAMILY LIFE TO GREAT NEW HEIGHTS

Former FIFO mine worker Jarred Alsop says being able to pick up his kids from kinder has been one of the benefits of working above ground as a wind turbine technician.

“The future for me – I’m planning on staying in this job forever. I’ve moved from the diesel mechanic trade to this. I mean looking at the two, I know which one is going to fall over first. I think this is definitely the place for me to be, and I love the work.”

- JARRED ALSOP

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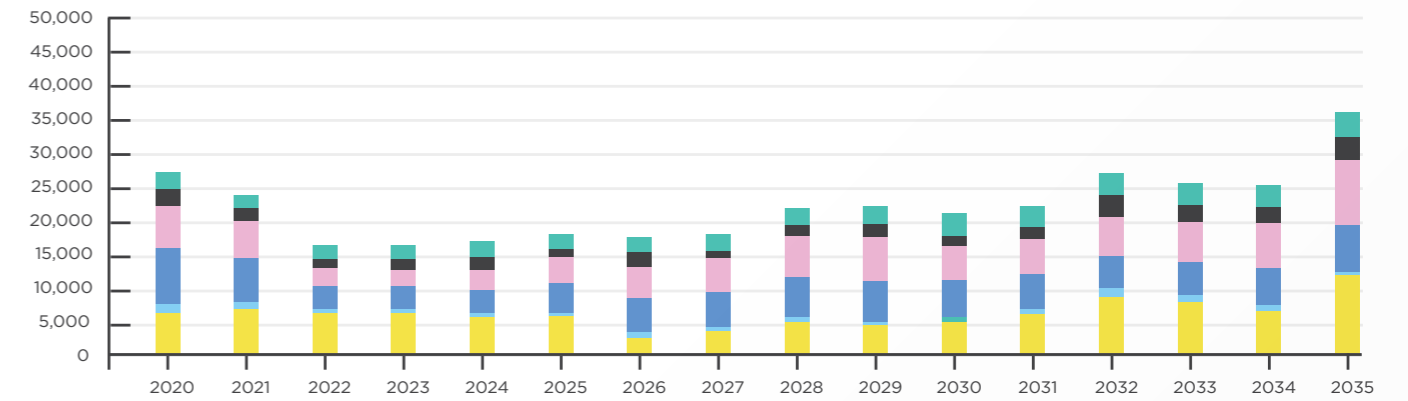
JOBS FROM 2020 TO 2035 ACROSS STATES

NSW is the state with the highest total number of jobs in the renewable energy sector to 2035, but both Queensland and Victoria are close behind. In a scenario with high levels of rooftop solar, such as the High DER Scenario, Queensland becomes the second-biggest employer in renewable energy in Australia. State energy policies have an important effect on the growth of clean energy jobs.

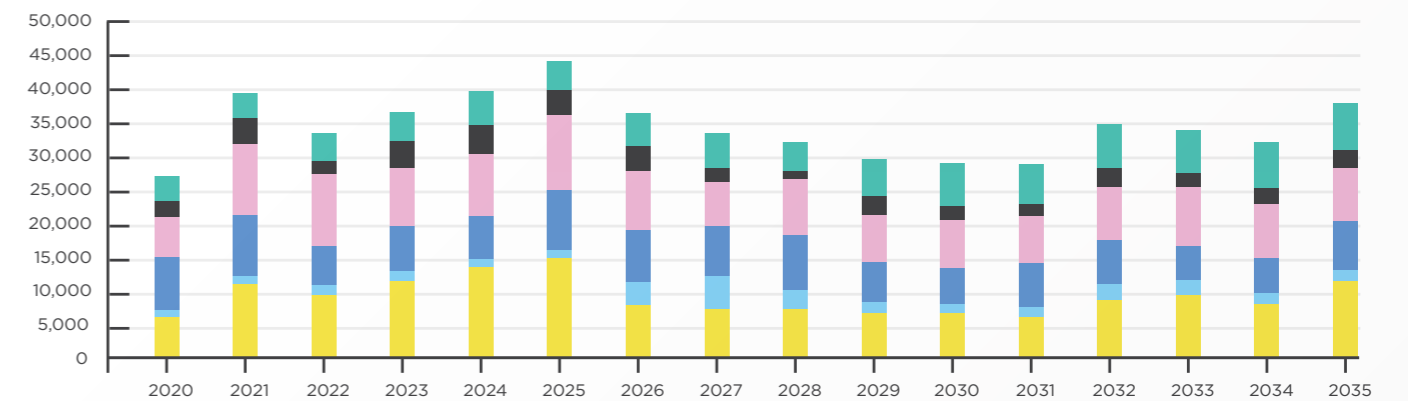


Warwick Solar Farm, University of Queensland

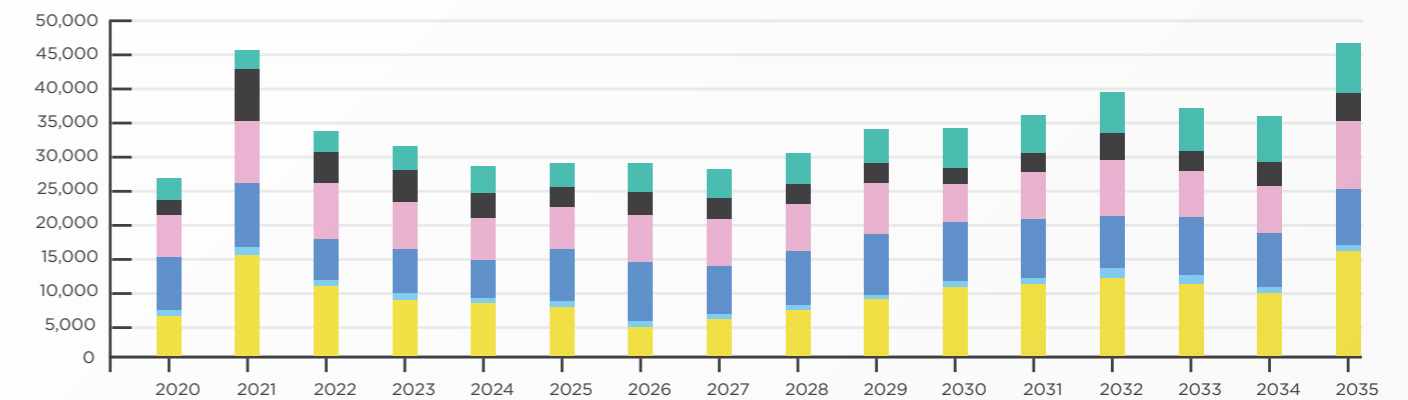
TOTAL RENEWABLE ENERGY JOBS BY STATE, CENTRAL SCENARIO



TOTAL RENEWABLE ENERGY JOBS BY STATE, STEP CHANGE SCENARIO



TOTAL RENEWABLE ENERGY JOBS BY STATE, HIGH DER SCENARIO



SKILLS SHORTAGES

★ KEY FINDINGS

Renewable energy developers and installers are facing challenges in recruiting skilled and experienced staff.

Across the sector, but especially in large-scale renewable energy, policy uncertainty, the project-based nature of construction and installation jobs, remote site locations, and salary competition with other industries are proving obstacles to attracting and retaining quality workers. Renewable energy developers face difficulties recruiting workers with relevant experience in certain activities, and existing training systems are not meeting industry needs. This results in the need to invest in the training of new workers, many of whom might leave the sector in search of more enduring employment prospects.

There is a high demand for electrical and grid engineers, and construction managers across wind and large solar projects, with developers finding recruitment for these roles challenging. In the last 12 months, two thirds of renewable energy companies that tried to recruit a construction manager had medium to high difficulty (it took more than five weeks to find a suitable candidate).

In the wind sector, there are certain unique occupations that are only occasionally needed but are nevertheless critical to the construction phase. Examples are crane drivers and specialised truck drivers for wind turbines. It can take two years to train in wind farm transportation

and the driver may then seek ongoing work in another industry. As operation and maintenance of wind farms becomes an increasingly important role there will also be heightened demand for blade technicians, yet these are already hard to source. Blade technicians and other wind operation and maintenance technicians are occupations to which traditional apprenticeships are ill-suited. There are no targeted upskilling courses for workers to transfer from other industries, and the pre-requisite qualifications are costly. This is creating bottlenecks and driving employers to recruit internationally; an issue that will only grow in significance over time.



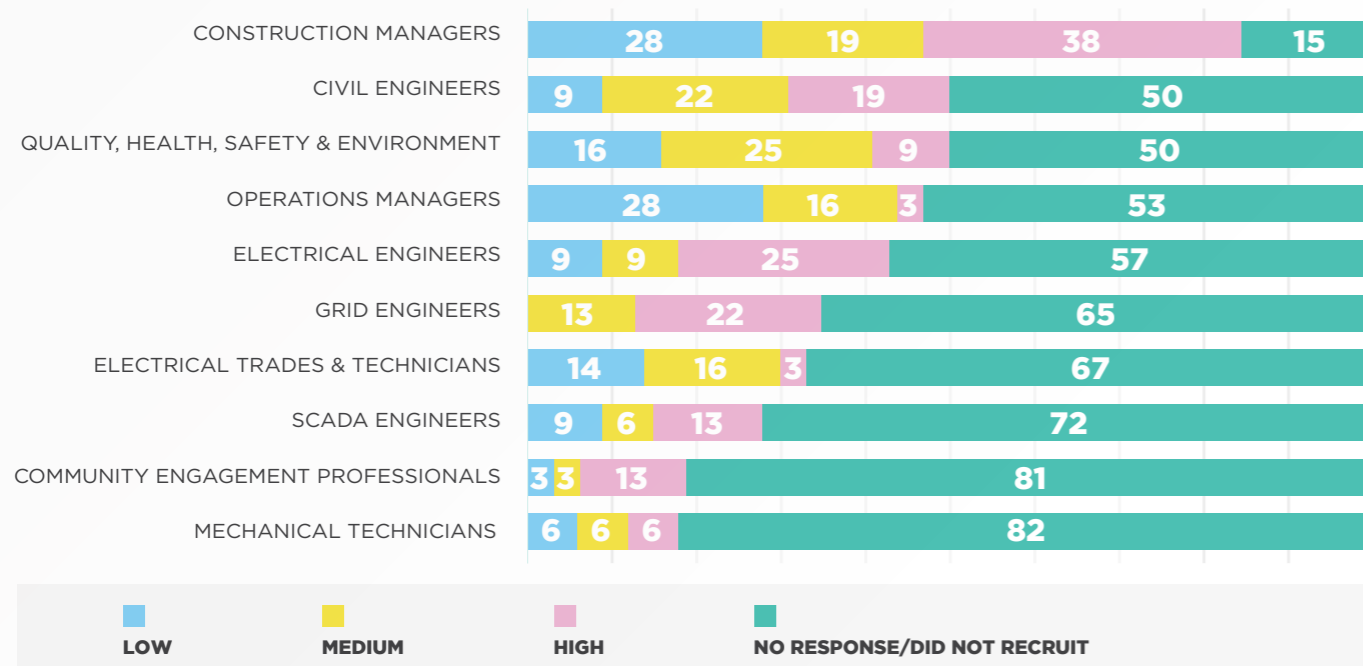
Tarraleah Hydroelectric, Hydro Tasmania

The hydro sector is a special case. As there have been no large hydro construction projects in Australia in several decades there is likely to be a shortage of suitably experienced trades, technicians and labourers. There are already indications that skilled drillers will be difficult to source suggesting that importing skills is likely to be necessary.

The study also confirmed anecdotal evidence that most small-scale solar businesses face difficulties in recruiting accredited solar designers, electricians, electrical trade assistants and roofers, especially in regional areas, yet these are in high demand. Under some scenarios this demand will see a steady increase.

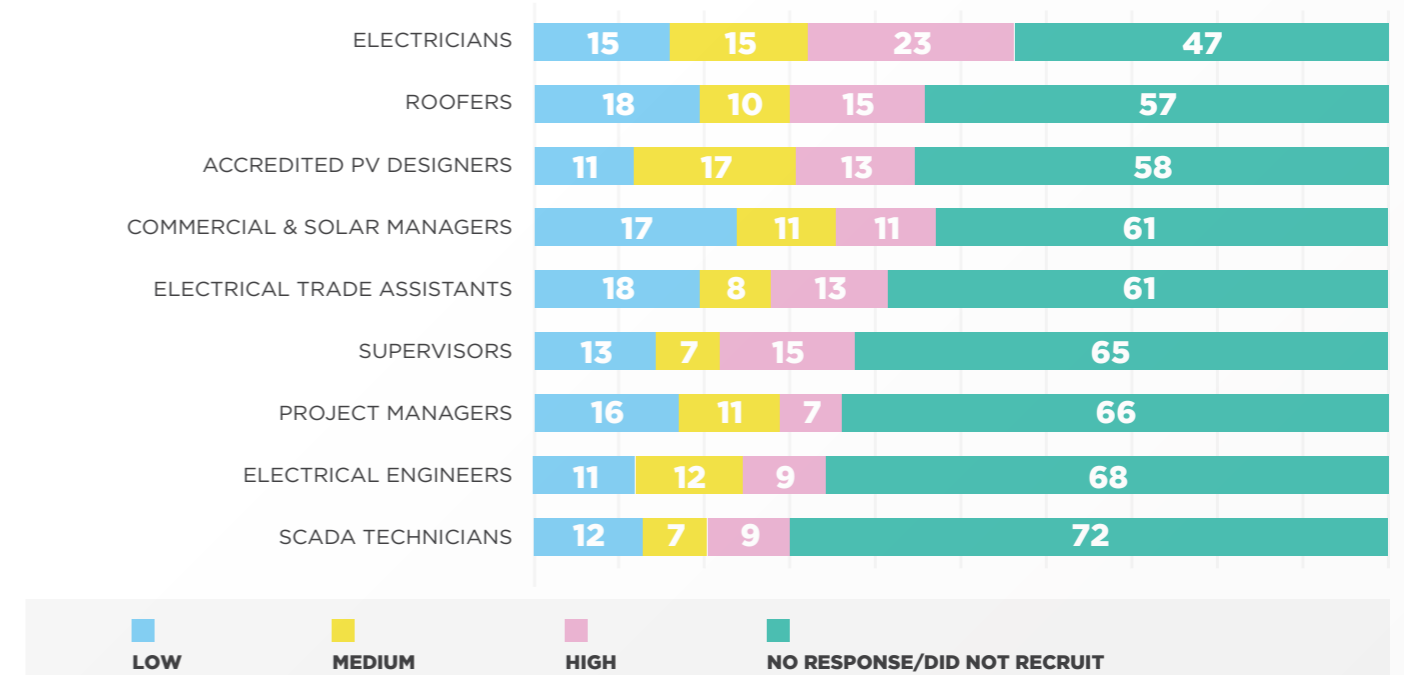
LARGE-SCALE RENEWABLE ENERGY SKILLS SHORTAGES

RECRUITMENT DIFFICULTIES FOR WIND AND LARGE-SCALE SOLAR (% OF ALL RESPONSES)

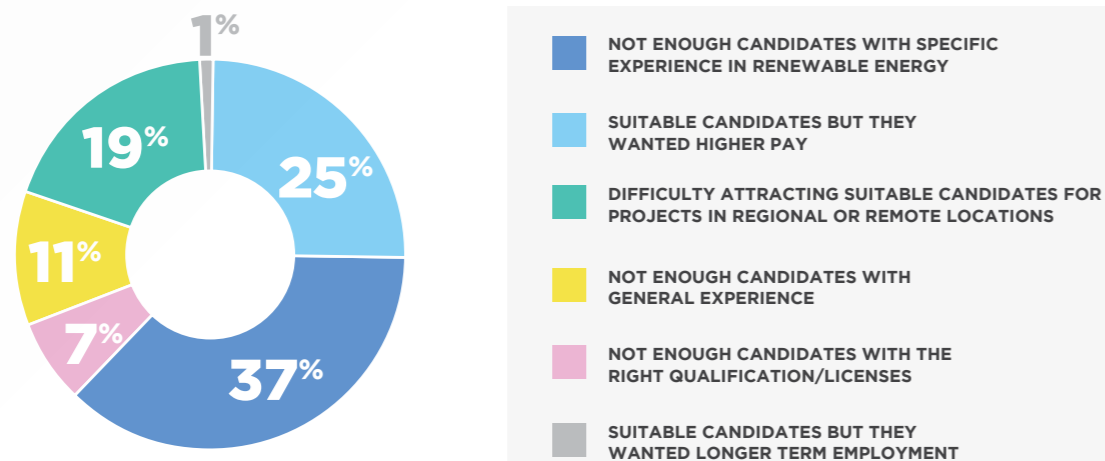


SMALL-SCALE RENEWABLE ENERGY SKILLS SHORTAGES

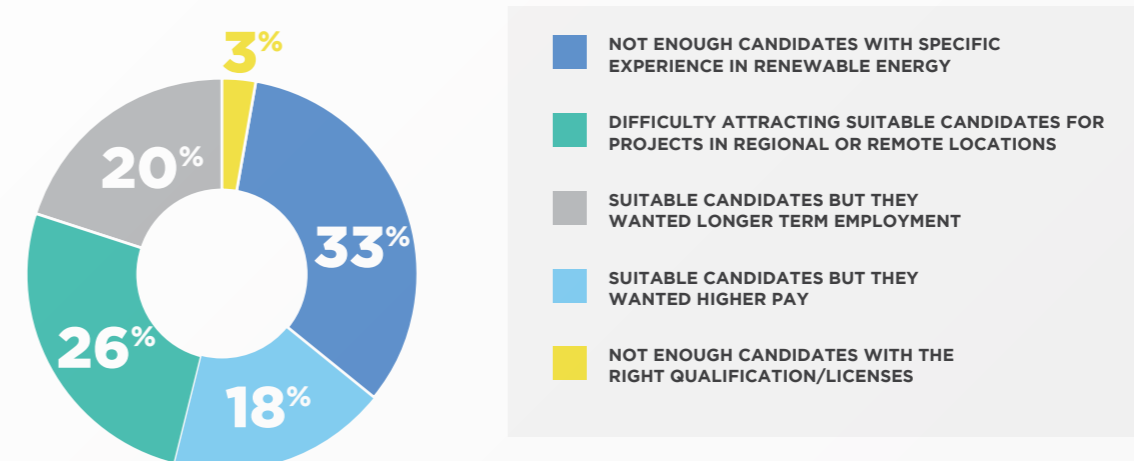
RECRUITMENT DIFFICULTIES FOR SMALL-SCALE SOLAR (% OF ALL RESPONSES)



CAUSES OF RECRUITMENT DIFFICULTIES FOR WIND AND LARGE-SCALE SOLAR (%)



CAUSES OF RECRUITMENT DIFFICULTIES FOR SMALL-SCALE SOLAR (%)



REGIONAL DEVELOPMENT

★ KEY FINDINGS

Renewable energy jobs can play a meaningful role in a regional industry development strategy.

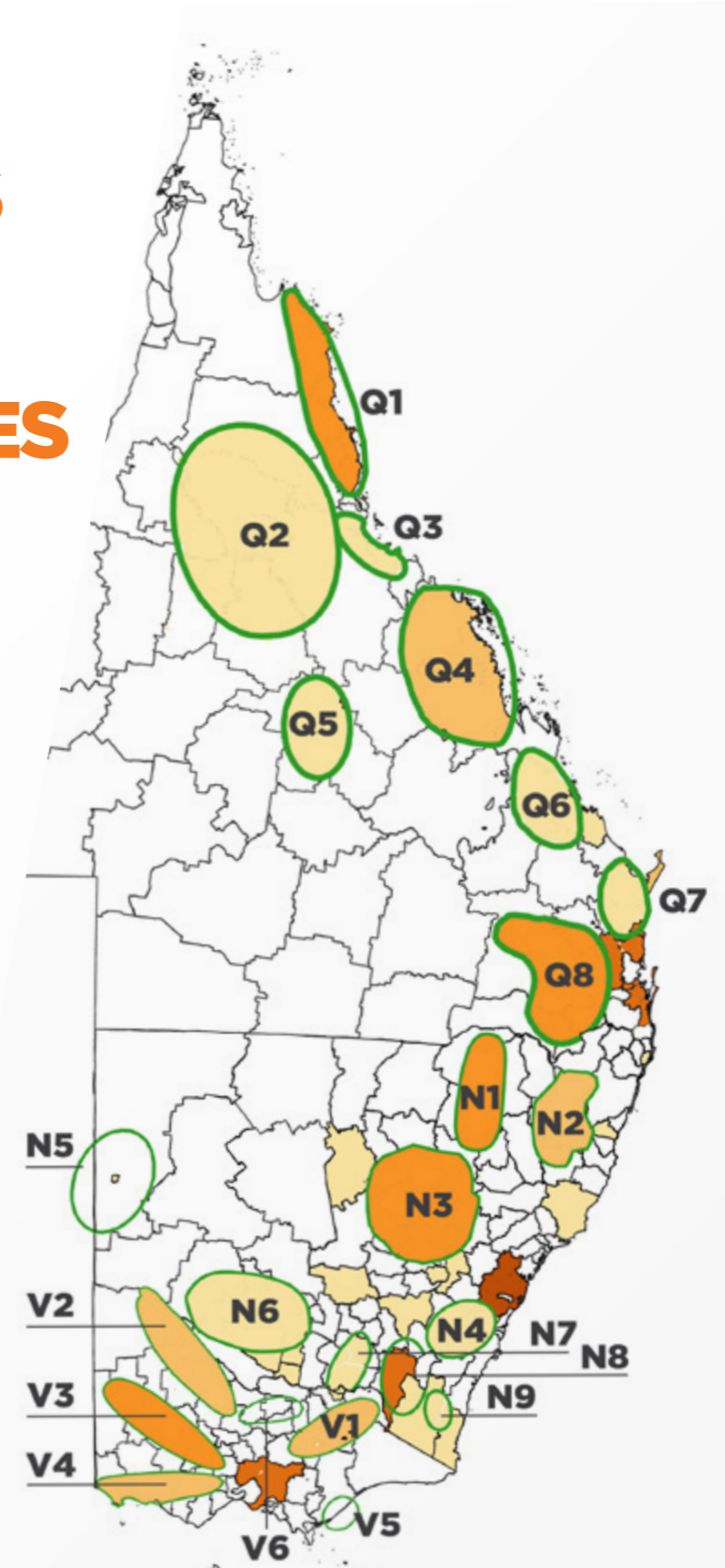
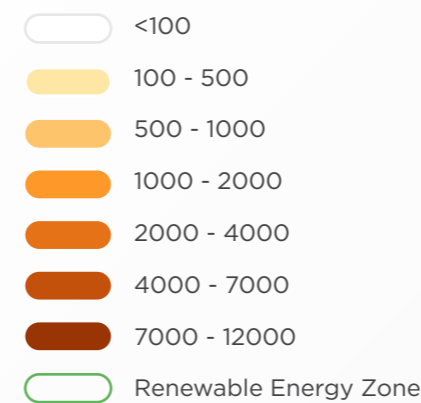
In most states, around two thirds of renewable energy jobs to 2035 could be in regional or remote areas. The location of these jobs obviously depends on planning decisions around the positioning of new renewable energy sites.

AEMO proposes Australian Renewable Energy Zones (REZs), which are areas of high wind or solar resource potential that could provide low cost connection options if part of a coordinated transmission plan. Given the design of the Australian

electricity network and the likely locations of these REZs, job growth in the renewable energy sector could be well distributed across the states, providing genuine opportunities in many regional areas.

PROJECTED RENEWABLE ENERGY JOBS UNDER AEMO RENEWABLE ENERGY ZONES

NUMBER OF JOBS





 CLEAN ENERGY JOBS IN THE SPOTLIGHT

WINDS OF CHANGE BLOW INTO COLAC

Traditionally host to agriculture, forestry and tourism, the Mt Gellibrand wind farm has brought economic diversity to Victoria's Western District.

“ With the bigger projects like a wind farm, you've got double benefits. First, they rent the land for the towers themselves - that gives an income to the people who own the property. Second, there are the jobs that are created during the build, and we have quite a few people working out there from the local area now that it's finished.”

**- ALEX MCKENZIE,
VICE PRESIDENT OF COLAC & DISTRICT CHAMBER OF COMMERCE**

[READ MORE](#)

 CLEAN ENERGY JOBS IN THE SPOTLIGHT

STICKING WITH SOLAR

Becoming a Clean Energy Council Accredited Installer was a smart career choice for Naomi Burke.

“ It's always really rewarding when you finish a job to see how happy and excited the customers are with their systems, and you hear about them proudly telling all of their friends 'oh I got solar' and comparing their usage and everything.”

- NAOMI BURKE

[READ MORE](#)

★ KEY FINDINGS

Renewable energy already creates more jobs than the domestic coal sector and could match the number of all coal jobs by 2035, but it cannot be a complete replacement for the loss of jobs in coal regions.

In all scenarios, renewable energy projects employ more people than domestic coal mining and coal power generation from now through to 2035. Under the Step Change and High DER scenarios, renewable energy employment is higher than thermal coal mining and comparable to export and domestic coal mining and electricity generation. Growth in local renewable energy is likely to match job losses in the domestic coal sector. Across all three scenarios, renewable energy jobs increase with each scheduled retirement of coal-fired power stations. Most of the coal workforce is in the export sector – the future of these jobs depends on the pace of the global clean energy transition and international demand for coal exports.

Detailed analysis of the occupational profile and location of renewable energy

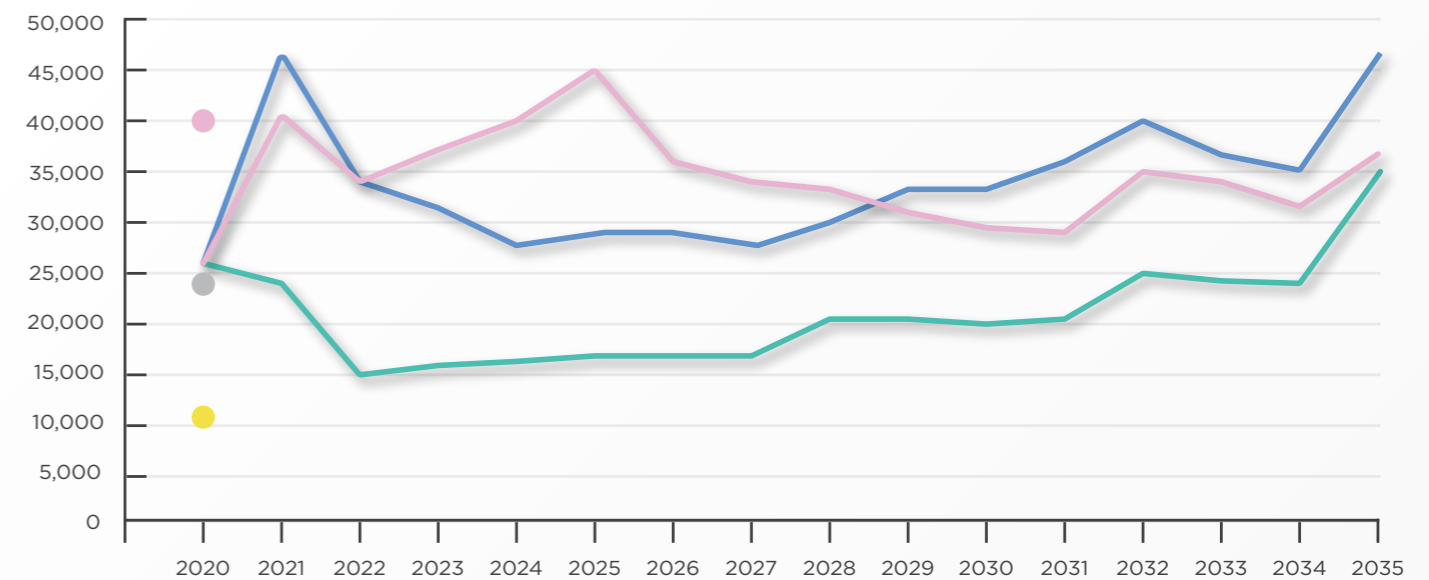
employment by the Institute for Sustainable Futures illustrates that the sector can play a role in replacing some of the coal jobs that will be lost. Examples include construction managers, electricians, mechanical trades and drivers. However, renewable energy employment is likely to be more dispersed throughout regional areas, and there is no direct match for the core coal mining workforce of semi-skilled machine operators. This indicates therefore that renewable energy will not directly replace the loss of coal jobs. However, supported by renewable energy, Australia could develop a strong presence in new energy-intensive heavy industries.

In short, a transition plan is needed for coal regions to diversify their economies and prepare workers and communities. Renewable energy projects can play a role as part of a broader strategy to help in this transition.



Gunning Wind Farm, ACCIONA Energy

TOTAL AUSTRALIAN RENEWABLE JOBS VS. CURRENT COAL JOBS



— **CENTRAL SCENARIO**
— **STEP CHANGE SCENARIO**
— **HIGH DER SCENARIO**

● **ALL COAL MINING (EXPORT & DOMESTIC)**
● **THERMAL COAL (EXPORT & DOMESTIC)**
● **DOMESTIC COAL (GENERATION & MINING)**

AUSTRALIAN BUREAU OF STATISTICS DATA WAS USED TO DERIVE COAL JOBS

BUILDING THE CLEAN ENERGY WORKFORCE OF THE FUTURE

This first ever national study of the Australia's renewable energy workforce highlights the size and projected growth of the sector. It is the first step in informing a discussion about the necessary workforce planning that will enable Australia to maximise the job and skill opportunities from a clean energy future. However, certain policy implications are already clear from this analysis.

POLICY IMPLICATIONS

- A review of the structure and suitability of relevant training systems across the renewable energy industry is needed to better align with industry needs and deliver certainty of career pathways. Traditional apprenticeships, short courses, group training schemes and inputs from higher education institutions should be considered as areas for review.
- Federal and state government policies play important roles in establishing a robust and secure renewable energy workforce by supporting - or creating an environment that supports - an investment pipeline.
- The renewable energy industry can make a positive contribution to regional development planning, including by working with regional development bodies, regulators and networks to develop innovative blueprints for training regional workers.
- To overcome the challenges that renewable energy businesses have faced in attracting and retaining talented and skilled employees, the sector must become an employer of choice. This can only occur through collaboration with training bodies, unions, regional development organisations and policymakers.





The full methodology that accompanies this report is available to download separately.

DOWNLOAD

References

Australian Bureau of Statistics data was used to derive coal jobs | [Australian Energy Market Operator draft ISPs Clean Energy Australia Report](#) | Institute for Sustainable Futures, UTS: Renewable Energy Jobs in Australia - Methodology. | [Institute for Sustainable Futures, UTS: Renewable Energy Jobs in Australia - Methodology: Appendices 1 - 5](#) | Institute for Sustainable Futures, UTS: Renewable Energy Jobs in Australia