

Australia’s Clean Energy Workforce

Discussion Paper

April 2023

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# About the study

The Australian Government has commissioned Jobs and Skills Australia (JSA) to undertake a capacity study on the workforce needs for Australia’s transition to a clean energy economy. The study will provide critical evidence and insights to support the workforce planning, policy development and program design needed to build a strong and vibrant clean energy sector.

The final Terms of Reference for the study were published on 4 April 2023 and are available at Attachment A**.** These incorporate feedback from state and territory governments, industry, unions, and the education and training sector.

JSA has committed to deliver an interim report to the government in May 2023 and a final report by mid-2023. JSA also intends to publish several accompanying resources over the coming months.

The purpose of this discussion paper is to provide stakeholders, interested parties and the broader community with a sense of the study's scope and approach, and an early opportunity to provide submissions. JSA welcomes feedback on this discussion paper from all interested parties.

## Why are we looking into this?

Australia is reshaping the way we generate, use and export our energy. Significant investments in clean energy technology and the electrification of our houses, vehicles and industries will help reduce emissions and cut power costs.

However, this transition will not be possible without a workforce that is equipped with the right skills. Just like any other element of the energy transition, our investment in skills development will take time and proper planning. This is especially important for workers and communities reliant on existing high-emissions intensity industries that require proactive long-term support. The scale of transformation ahead will also require us to create genuine opportunities to increase the participation of women, First Nations Australians, and other historically under-represented cohorts at all levels in the energy sector and traditional trades. These ambitions won’t be achieved without effective coordination across education, training, migration, and industry, which has proved challenging to this point.

JSA will contribute its labour market and skills expertise and build upon the work that has already been produced by industry, academia, community advocates and governments. We will also be consulting widely with our stakeholders and partners to understand the widest range of perspectives and experiences. Through this independent study, the Australian Government will have the evidence it needs to make informed decisions about the future clean energy workforce.

## What the study will do

The Terms of Reference (Attachment A) outline the full scope of the study:

The figure lists summarises the terms of reference for the study:

Define the clean energy workforce and describe its current state.
Analyse future demand for clean energy workers, and the impact on employment in high-emitting sectors undergoing transition.
Analyse future supply of clean energy workers. What are the skills? Where do these skills exist currently? what are the education, training and migration pathways?
Identify the enablers and barriers to developing and delivering clean energy education and training.
Explore opportunities and barriers for women, First Nations Australians. people with disability and Australians from culturally and linguistically diverse backgrounds.
Explore sector specific enablers and barriers face by small, medium and large employers.
Regional case studies and analysis of place-based success factors. 
International comparative analysis and case studies.

The study will be supported by extensive consultation and genuine partnerships, led by a steering group of industry and technical experts and stakeholders. 

Our mandate is to:

* help clarify what jobs and industries make up our clean energy workforce
* understand how different transition scenarios will affect our future workforce needs and impact employment in high-emitting sectors
* explore how the workforce opportunities created by clean energy can be shared across regions and with First Nations Australians, women, people with disability and Australians from culturally and linguistically diverse backgrounds
* identify the education, training and migration pathways that we should be developing, and the underlying system settings needed to enable those pathways.

The study will not look at the merits of particular technologies, projects or investments, or the non-workforce impacts of the clean energy transition.

# Definitions and terminology

**What is a capacity study?**

Capacity refers to our power and ability to do or achieve something within specific constraints. Jobs and Skills Australia’s capacity studies will assess the current and future demand for, and supply of, labour and skills in a critical area of the economy. They will also make recommendations on how skill shortages (or surpluses) can be averted, within set time, resource and legislative constraints and government objectives.

JSA has established an ongoing capacity study function, which will:

* bring together subject matter experts, data specialists and people with stakeholder engagement expertise
* be informed by Project Steering Groups, with key stakeholders directly represented
* provide a detailed assessment of labour and skills supply and demand, employment arrangements, and education, training and migration pathways
* produce long-term modelling of future workforce demand and supply.

## How to define the clean energy workforce?

Our review of existing studies in Australia and internationally indicates there is no single definition of the clean energy workforce. International research into the ‘green workforce’ tends to use definitions from sources such as the International Labour Organisation, the United Nations Environment Programme, the U.S. Bureau of Labour Statistics and the World Economic Forum, often adapted to each country’s own context.

Table 1 illustrates the breadth and variety of definitions that have been applied. Typically (but not exclusively) definitions seek to capture all activities that contribute to a reduction in carbon emissions, spanning:

* the replacement of fossil fuel based electricity with renewable energy sources including wind, solar and hydroelectricity
* the creation of other alternatives to fossil fuels for manufacturing and transport, such as biofuels
* storage solutions to manage variable power consumption including batteries and hydrogen
* transport activities to replace fossil fuels with alternatives such as electric vehicles and hydrogen
* conversion of technologies in manufacturing, construction and housing from emissions-intensive sources such as coal and natural gas to electricity powered by renewable sources and which do not otherwise generate carbon dioxide emissions
* recycling and activities to extend and manage the end-of-life of materials
* other activities to reduce energy consumption and improve energy efficiency, especially in construction and housing, such as glazing and insulation
* preserving and restoring the natural environment
* carbon capture and storage activities
* activities that enable the development of the underpinning technologies and their application, including research in our universities and other research agencies, the teaching workforce in higher education and VET providers, alongside legal, financial, and planning services.

### Table 1: Collated definitions of green jobs from international sources

|  |  |
| --- | --- |
| Sources | Green jobs definitions |
| International Labour Organisation (ILO)[[1]](#footnote-2) | Defined as decent jobs that contribute to preserve or restore the environment, be they in traditional sectors such as manufacturing and construction, or in new, emerging green sectors such as renewable energy and energy efficiency. Green jobs help:   * improve energy and raw materials efficiency * limit greenhouse gas emissions * minimize waste and pollution * protect and restore ecosystems * support adaptation to the effects of climate change |
| United Nations Environment Programme (UNEP)[[2]](#footnote-3) | Green jobs are defined as work in agricultural, manufacturing, research and development (R&D), administrative and service activities that contribute substantially to preserving or restoring environmental quality. Specifically, but not exclusively, this includes jobs that help protect ecosystems and biodiversity; reduce energy, materials and water consumption through high-efficiency strategies; de-carbonize the economy; and minimize or altogether avoid generation of all forms of waste and pollution. |
| U.S Bureau Labour of Statistics[[3]](#footnote-4) | Green jobs are either:   * jobs in businesses that produce “goods” or “provide services” that benefit the environment or conserve natural resources * jobs in which workers’ duties involve making their establishment’s production processes more “environmentally friendly” or fewer natural resources |
| World Economic Forum[[4]](#footnote-5) | Green jobs are defined as roles that require specific “green skills” to perform them and are crucial for enabling a transition to a more sustainable economy. The term “green skills” largely falls under the following categories:   * sustainable farming * green architecture and building * environmental policy and analysis * clean energy * energy efficiency * climate change * ecology and resource management * nature conservation |

The terms of reference for this study focus on the workforce required for Australia’s transition from fossil fuel energy to renewable sources. While Australia will require each of the activities referred to above if we are to reach net zero by 2050, it is the shift to renewable fuel and energy sources that will make the most substantial contribution.

For example, electricity generation was the largest component of Australia’s gross emissions in 2020 (32%), followed by stationary energy (19%) and transport (18%).[[5]](#footnote-6) The transition to renewable sources will also have the greatest impact on an identifiable, existing workforce – those in fossil fuel electricity generation.

Ideally, we want to avoid adopting a definition of the clean energy workforce that is driven by data availability. A desktop review and early consultation across government indicates that issues with data limitations and definitions are conflated. The challenges encountered in defining the workforce relate to issues in measuring emerging or changing industries and occupations. Rather than limit our definition to what can be measured, there is merit in developing a universal definition as a ‘conceptual’ definition. We will seek to measure this concept with existing data in the first instance and identify gaps to recommend how this measurement could be improved in the future by addressing data limitations.

Our goal is to ensure the conceptual definition is specific enough to be meaningful, and our insights using this definition are actionable. A narrower definition will allow us to make practical recommendations that support workforce planning, policy design and program development to build a vibrant clean energy sector, rather than simply indicating future demand scattered across most sectors of the workforce, including where green skills are an optional or minor component of job roles.

## Proposed conceptual definition

For the purposes of this study, JSA is proposing the following definition of the clean energy workforce:

The clean energy workforce includes the workers involved in developing, generating, storing, transmitting and distributing energy generated from renewable, net-zero emissions sources (‘clean energy supply’), and installing and maintaining the technology that uses clean energy rather than fossil fuels (‘clean energy use’). This spans energy needed for electricity consumed by businesses and housing, transport and industrial processes.

When considering the clean energy workforce, all workers contributing to that activity will be in scope. For some components of the study (e.g. examining the barriers and enablers of the education and training pipeline), the scope will be restricted to those workers who require skills specific to adopting, developing, generating, distributing and supplying energy generated from renewable sources. For example, this would mean considering the skills required by wind turbine technicians, but not the accountant who works for a renewable energy business.

## What is clean energy?

For the purposes of this study, clean energy refers to the development, generation, storage, transmission, distribution, supply and application of energy generated from renewable sources, as set out in Division 3, Section 17 of the *Renewable Energy (Electricity) Act 2000*.[[6]](#footnote-7)

**Energy supply** covers the production, storage and distribution of energy. Production includes large scale electricity generation for the grid, but also things like rooftop solar on homes and businesses. This energy is then converted and stored using technologies like batteries, pumped hydroelectricity and electrolysis. Finally, energy is provided to distributed users through transmission lines, distribution lines and pipelines.

**Energy use** isabout transitioning away from fossil fuel powered machines to ones that use renewable, non-emitting sources. This includes:

using new fuels, like hydrogen and biofuels, to power our machines (e.g. a car powered by hydrogen instead of petroleum)

electrifying machines to run on electricity rather than fossil fuels (e.g. an electric hot water heat pump instead of a gas hot water system).

**Energy efficiency** is the process of using less energy to perform the same task. This can include steps like replacing our old appliances with newer ones that use less power and retrofitting our houses with improved insulation, glazing and screening to improve thermal performance. By reducing the amount of energy that we need to produce, efficiency measures can help Australia decarbonise and improve energy affordability.

The Department of Climate Change, Energy, the Environment and Water is currently developing a National Energy Performance Strategy to examine how to maximise the contribution of these activities to net zero. Currently, the skills and workers required to perform work such as insulation and glazing are an indistinguishable part of the larger Australian construction workforce, supported by emerging specialist roles such as sustainability specialists and energy auditors[[7]](#footnote-8).  If supported by further policy targets and initiatives, activities such as energy audits and housing energy efficiency retrofits are likely to emerge as a more distinct workforce.

### Figure 1. Clean energy workforce and adjacent sectors contributing to net zeroThis figure shows how the clean energy workforce can be grouped into four categories. Clean energy supply: generation (including renewables and hydrogen), transmission, distribution, biofuels, storage and charging. Clean energy use (electrification and new fuels): transport, machinery and production, cooking and heating. Enabling clean energy: research, teaching, legal and finance, manufacturing technology and exports. Reaching net zero by 2050: efficiency workforce, agriculture and land management, carbon capture and credits, recycling and waste.

The purpose of this study is to provide evidence and insights to support the workforce transition and transformation to a net zero economy by 2050. This focuses the study to understanding the skills profile of direct workers and identify education and skilling gaps. As the clean energy sector expands, more roles will require workers with specific clean energy skillsets, which may be gained by study in vocational education, in higher education, or by on-the-job skilling. Adjacent sectors of the economy will enable the adoption of clean energy, reduce our demand for energy, limit carbon emissions and expand opportunities to capture carbon above and below ground. Typically the skills in these sectors that are critical to net zero are only a small part of the current workforce and few job roles are primarily oriented towards clean energy and reducing carbon emissions. There are many roles across the economy which support the clean energy workforce that do not require skillsets specific to the sector (e.g. accountants). While contributing to decarbonisation, these enabling jobs are not the primary focus of the study. However, researchers working on clean energy technologies and educators and trainers delivering courses on renewable power installation, for example, are critical to the transition.

Likewise there are many roles in the construction, agriculture and manufacturing industries which will contribute towards the clean energy transition as existing practices and technologies move towards decarbonisation but not all will involve a change in demand or skill requirements. We are seeing the emergence of some specialised roles in clean energy and adjacent sectors such as energy performance and demand for some categories of workers, such as insulation installers, may grow depending on future policy settings. Rather than examining the whole construction, agriculture and manufacturing workforces, only the subset of workers directly and primarily involved in clean energy supply and conversion, energy efficiency and carbon will be considered part of the clean energy and adjacent workforces.

### Figure 2. The clean energy workforce*This figure shows that the clean energy workforce is a subset of 'green impacted jobs' which is itself a subset of all jobs.*

## Measuring the clean energy workforce

The measurement of the clean energy workforce may not be a perfect representation of the conceptual definition due to the data limitations associated with emerging industries and occupations. While certain industries are relatively well described (e.g. power distribution and transmission), many emerging industries are not well captured and are difficult to separate (e.g. the ANZSIC class ‘Other Electricity Generation’ groups all renewable except hydroelectricity). It is also difficult to identify which occupations are predominantly focused on clean energy. For example, solar installers are only captured in ANZSCO under the occupation ‘Electrician (general)’.

Due to these limitations it is difficult to accurately produce current and future estimates of the clean energy workforce. We will learn and build on other measurement approaches to better understand the proportion of the partial ANZSIC and ANZSCO categories that cover clean energy activities (see figure 3).

(The study will also identify and measure current and future employment in transitioning sectors that are currently part of the fossil-fuel supply chain, such as thermal coal mining and coal-fired electricity generation as well as sectors with industrial processes that also generate carbon dioxide, such as cement production.)

Figure 3. Challenges in measuring the clean energy workforce

This figure shows that occupation and industry classifications do not easily capture the clean energy workforce. For example, all renewable energy generation, including biomass, is captured under one industry code and cannot be separated. There are also adjacent roles, like managers, that are important to the clean energy workforce but not the key focus of this study.

## Terminology

Terms like clean, green and renewable are often used interchangeably in the clean energy sector and there is no consistent approach across government. This is problematic because some terms have assumed different and/or multiple meanings to various actors, at times creating confusion and inconsistencies.

JSA will seek to use clearly defined and consistent terminology where possible in the study and welcomes any thoughts or feedback from interested stakeholders. Efforts are also underway to consolidate definitions of common terms across government.

**Discussion questions**

* Is the conceptual definition of the clean energy workforce ambiguous?   
  If so, how could it be more clearly defined?
* How could clean energy supply workers be identified in existing data? What are the gaps?
* How could workers involved with energy use be identified in existing data? What are the gaps?
* Which jobs require skills that are unique to the clean energy workforce?
* How do workers obtain skills that are unique to the clean energy workforce (VET/Higher Education/on-the-job skilling/other)?
* Are there any emerging occupations and industries in clean energy that aren’t well captured by current definitions?

# How this study relates to other work

There are a number of related activities currently underway across government, including workforce strategies, training initiatives and research programs. This study will contribute to these other activities by providing a common evidence base and definitional approach for workforce planning across government. There are also workforce activities being led by industry, the education and training sector and state and territory governments, which will be considered by JSA and explored in the final report.

### Commonwealth activities

The Government’s **Powering Australia Plan** is the overarching roadmap for energy transformation and emissions reduction. This plan sets the scale and pace of investment and will help inform the study’s workforce projections. Our findings will also support the **Powering the Regions Fund** by identifying emerging jobs and opportunities for successful transitions.

The **New Energy Apprenticeships** program provides direct financial assistance to Australian apprentices in the clean energy sector. The study will directly inform the next phase of this program by helping define the clean energy workforce and clarify eligibility requirements. Funding under **the New Energy Skills Program** includes development of training pathways for clean energy roles. The study will be made available to guide the contextualisation of this project.

**Jobs and Skills Councils** (JSCs) were established to provide industry with a stronger, more strategic voice in ensuring Australia’s VET sector delivers stronger outcomes for learners and employers. JSA will work closely with each JSC to help identify skills and workforce needs for their sectors. JSCs will be provided access to the study to determine activities to support industry and meet skills needs.

Earlier this year, the Australian Government launched the first **Australian Energy Employment Report (AEER)** survey to provide a sample of the energy workforce. Data from this initial opt-in survey may help inform elements of the Clean Energy Capacity Study, which will in turn highlight opportunities to broaden and expand the AEER as an ongoing dataset.

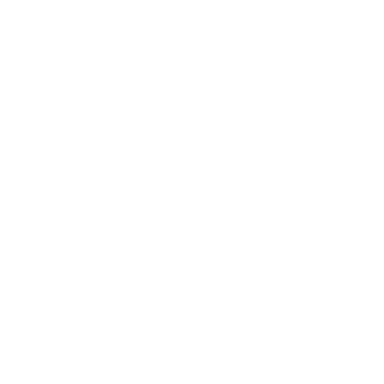
The Department of the Prime Minister and Cabinet’s **Net Zero Taskforce** was established to provide advice on how to best support regional communities as Australia transforms to a net zero economy. The findings from this cross-agency taskforce will guide the study in identifying regions in focus and best practice approaches to supporting worker transitions.

The Department of Climate Change, Energy, the Environment and Water is developing several **energy strategies** to guide government policy and foster new technologies and industries. These strategies will draw on the study where possible as a common evidence base and deliver on key workforce recommendations.

# This figure visualises the list of Australian Government activities on the previous page and shows that this study will input into each of these.

### State and territory activities

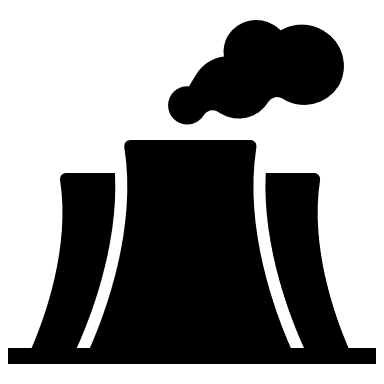
There are also workforce activities being led by state and territory governments, including across skilling, workforce planning and structural adjustment. A comprehensive mapping of activities will be included in the final report. Below are some illustrative examples.

**Training**

The **Victorian State Government’s** *Clean Economy Workforce Capacity Building Fund* was designed to enable training providers and industry to work together to develop new training methods and products. This fund will address short- to medium-term needs, while a longer-term Clean Economy Workforce Development Strategy is produced. The Victorian Government is also creating state-wide project-based workforce planning tools to provide insights to inform skills delivery.

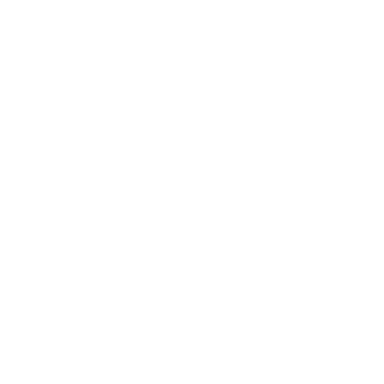
The **Queensland Government** is currently developing a Future Energy Workforce Roadmap for deliver in 2023 that will identify opportunities to build clean energy workforce capacity and build on the state’s dedicated Hydrogen Industry Workforce Development Roadmap 2022-2032. The Queensland Energy and Jobs Plan also includes a $90 million investment to establish two regional transmission and training hubs.

Energising Tasmania was established by the **Tasmanian Government** in 2019 to support the energy workforce to deliver major projects across transmission, infrastructure and renewable energy. It includes a Training Fund for endorsed RTOs to deliver fully subsided training for related sectors.

**Transitions**

The **NSW Government’s** *Royalties for Rejuvenation Fund* sets aside at least $25 million each year from mining royalties to support coal mining communities throughout the state. This funding will ensure that these communities can make targeted investments, including towards workforce development programs.

*Collie’s Just Transition Plan* is the **Government of Western Australia’s** commitment to working with the community to create a strong and sustainable future as Collie shifts away from a dependence on coal. The plan includes $200 million of funding to bring new and emerging industries to the region.

**New industries**

A *Hydrogen Jobs Plan* is being progressed by the **Government of South Australia** to help the state meet its ambition of constructing a hydrogen power station, electrolyser and storage facility by the end of 2025. The Hydrogen Jobs Plan includes 250 megawatts of electrolysers, 200 megawatts of power generation, and associated hydrogen storage.

**The Northern Territory Government’s** *Renewable Hydrogen Master Plan* explores partnering with Charles Darwin University and training organisations to create new skills development pathways and apprenticeships for emerging renewable hydrogen jobs.

The **ACT Government** is working with Tesla and other manufacturers to develop a new course to train Canberra’s first EV apprentices under a new Certificate III in Electrical Vehicle Technology in 2023.

# What we already know

JSA acknowledges the extensive research and analysis that has already been produced on the clean energy workforce by industry, academia, community advocates and governments. There are also a wide range of international experiences that Australia can learn from, particularly from those countries that have also traditionally relied on emissions-intensive forms of energy generation.

Our study will work to consolidate these efforts and present a coherent and comprehensive view of the workforce, identify key challenges and understand barriers to sufficient workforce participation. We will develop clear and actionable recommendations to government to address workforce shortages in the future and ensure the existing energy workforce is adequately supported to access new opportunities.

**Interested in further reading?**

JSA has compiled a resource library on our website to provide readers with reports, research and other resources about the clean energy workforce transition in Australia and internationally. This library will be updated throughout the course of the study and we welcome suggestions for additional resources to include. The resource library can be found at jobsandskills.gov.au/work/clean-energy-capacity-study/resource-library

NB: The library is not exhaustive.

## Australia

Australia is inarguably well-placed to benefit from the transition to net zero, as a country rich with clean energy source potential[[8]](#footnote-9) and established energy export capabilities and relationships[[9]](#footnote-10). However, this potential will not be fully realised without sufficient investment in understanding, supporting, educating and training the future clean energy workforce[[10]](#footnote-11).

The effective delivery of clean energy specific education and training will be vital to the Australia’s transition. This will necessarily include both the introduction of new, exclusively clean energy focused qualifications, the incorporation of clean energy skills and knowledge into existing qualifications (for example ensuring all electrical apprentices are skilled in rooftop solar installation and maintenance) and ensuring a sufficient supply of graduates from more generalised courses that will experience increased demand as a result of the transition to clean energy, such as many fields of engineering and science.

These efforts are underway but are not yet delivered at the scale and pace required and will take time to fully establish[[11]](#footnote-12). Further, some incentives to reskill existing workers and attract new students are also insufficient and marred by uncertainty and unmapped career pathways. Access to education and training is also inconsistent across regions, particularly in rural and remote areas where cost of delivery is high, markets are thin and attracting educators is difficult.

#### Participation

Analysis from Jobs and Skills Australia shows that occupations with skills shortages are likely to have significant gender imbalance in their workforce, particularly towards male-dominated industries. For example, only around 2% of Australia's electricians and 1% of lines workers are women. Historically, Australia’s energy workforce has been overwhelmingly male-dominated and homogenous, with low workforce participation of women, First Nations, LGBT+, people with disability and culturally and linguistically diverse (CALD) cohorts.

The Australian Skills Guarantee is working to support women to achieve higher paying careers via vocational education and training pathways by setting ambitious workforce participation targets for trades occupations. Whilst the current Guarantee retains a focus on women in trades, future efforts are flagged to encourage improved participation of a range of priority cohorts across both trades and non-trade occupations in major projects[[12]](#footnote-13). Without addressing systematic barriers and creating genuine opportunities to lift participation, the clean energy workforce is unlikely to grow at the pace and scale required. In November 2022 the Government announced an independent Pathway to Diversity in STEM Review to determine how programs can better support diversity in STEM sectors, including clean energy[[13]](#footnote-14).

Early analysis of the demographic profile of the clean energy workforce is promising, with improved workforce participation of priority cohorts compared to the emissions-intensive energy sector. However, these representational gains have been most significant in junior to mid-level roles and priority cohorts remain underrepresented across senior leadership and board roles[[14]](#footnote-15). Efforts to support the diversification of the workforce must be conscious of reproducing biased workforce hierarchies and ensure that priority cohorts are not only represented within the workforce but also participating in a range of roles and levels.

#### The pace of change

There can be a lot of uncertainty around decarbonisation, particularly the pace of change and the many ways this change could occur. The Australian Government has now legislated an emissions reduction target of 43 per cent by 2030 and net zero by 2050, setting the nation’s transition trajectory and providing greater certainty. The Australian Energy Market Operator (AEMO), among others, has done a great deal of work to explore the various pathways to decarbonisation. This includes the different mix of energy, export opportunities and assumptions around the uptake of new technologies.[[15]](#footnote-16)

There are still uncertainties left to be explored, including the viability of new technologies, like hydrogen, to displace fossil fuels domestically.

In his book *The Superpower Transformation,* Professor Ross Garnaut suggests that in addition to exporting hydrogen (as covered in the AEMO superpower scenario), Australia could also become a major exporter of net-zero emissions manufactured goods. By using our own green hydrogen, Australia could refine and smelt iron ore and bauxite competitively. However, to realise this goal Australia would require around 10,000 terawatt-hours of annual power generation, which is over 50 times the current capacity of the National Energy Market (NEM) and 10 times the capacity required under AEMO’s hydrogen superpower scenario.[[16]](#footnote-17)

**AEMO transition scenarios**

**Slow change** – challenging economic environment following the COVID-19 pandemic, with greater risk of industrial load closures, and slower net-zero emissions action. This scenario would not reach the economy-wide decarbonisation objectives of Australia’s Emissions Reduction Plan.

**Progressive change** – delivering a net-zero emissions economy with a progressive build-up of momentum ending with deep cuts in emissions across the economy from the 2040s. The 2030s would see commercially viable alternatives to emissions-intensive heavy industry emerge, paving the way for stronger economy-wide decarbonisation and industrial electrification in the 2040s, and nearly doubling the total capacity of the National Energy Market (NEM). EVs become more prevalent over time and consumers gradually switch to using electricity to heat their houses and businesses.

**Step change** –moving much faster initially to fulfilling Australia’s net zero policy commitments that would further help to limit global temperature rise to below 2°C. Step change sees a consistently fast-paced transition from fossil fuel to renewable energy in the NEM. On top of the progressive change assumptions, there is also a step change in global policy commitments, supported by rapidly falling costs of energy production, including consumer devices. Increased digitalisation helps both demand management and grid flexibility, and energy efficiency is as important as electrification. By 2050, most consumers rely on electricity for heating and transport, and the global manufacture of internal-combustion vehicles has all but ceased. Some domestic hydrogen production supports the transport sector and is blended with pipeline gas, with some industrial applications after 2040.

**Hydrogen superpower** – nearly quadrupling the National Energy Market (NEM) energy consumption to support a hydrogen export industry. The technology transforms transport and domestic manufacturing, and renewable energy exports become a significant Australian export, retaining Australia’s place as a global energy resource. As well, houses with gas connections progressively switch to a hydrogen-gas blend before appliance upgrades achieve 100% hydrogen use.

#### Australia’s energy workforce

2021 census data captured approximately 91,500 workers in Australia’s emissions-intensive industries, with over half of these workers in the coal mining sector[[17]](#footnote-18). Whilst it is anticipated that employment opportunities in the clean energy sector will be abundant, and by various estimates outsize emissions-intensive employment by 2050, the skills required will not necessarily correspond with the skills of the current emissions-intensive energy workforce. Skills transferability analysis undertaken by the Australian Industry Energy Transitions Initiative estimates that approximately 47% of the existing energy workforce could transition to clean energy with minimal upskilling required. However, the location of these jobs is also likely to vary considerably and the geography of clean energy opportunities is not yet well understood[[18]](#footnote-19).

Competition for skilled workers is high, not just within the sector but across the entire labour market. Many key occupations, such as electricians, are also needed in other sectors like construction and manufacturing, drawing away potential workers[[19]](#footnote-20). In many clean energy projects, workforce demand is mostly concentrated in the construction phase and the long-term workforce profile is unclear. Further, the role of automation is not yet well understood and may affect future workforce demand[[20]](#footnote-21).

#### The size of the clean energy workforce

Estimating the size of the clean energy workforce beyond direct renewable energy supply is challenging. Different studies undertaken by industry, academia and advocacy groups have understood the workforce differently and therefore produced varied estimates. The estimation logic and projected future growth scenarios of key recent studies on the clean energy workforce are outlined below.

* The most recent ***Employment in Renewable Energy Activities*** report from the **Australian Bureau of Statistics** (ABS) estimates the direct renewable energy workforce at approximately 26,850 full-time equivalent (FTE), an increase of 27% on the previous year and 120% over the past decade. This growth has been consistent across all states and territories, with the highest proportion of the workforce concentrated in the eastern coastal states of New South Wales, Victoria and Queensland. Currently solar is the largest and fastest growing renewable energy employment source, accounting for more than 50% of direct renewable energy employment across both rooftop solar and large-scale solar projects[[21]](#footnote-22). However, it must be noted this report does not forecast growth, nor does it capture the effects of the COVID-19 pandemic.
* The ***Clean Energy at Work*** report by the **Clean Energy Council** adopts the three draft 2020 AEMO scenarios: central, step change and high DER (Distributed Energy Resources). This report estimates the renewable energy workforce at around 25,000 in 2020 and forecasts the scale and pace of growth between 2020 and 2035[[22]](#footnote-23). Whilst growth is predicted across all three scenarios, it is fastest and most significant in the high DER scenario, which assumes a consumer-demand led transition, with employment peaking at 46,000 in 2021 and again in 2035, with a low of 27,000 between 2024 and 2027. The step change scenario, which anticipates policy changes in line with the government’s commitments under the Paris Agreement[[23]](#footnote-24), also posits significant growth, although is forecast to peak at 44,000 in 2025 and trend downwards from there until 2031, at which point there is a modest upward turn, but long-term employment levels are not forecast to exceed 37,000. This report only estimates employment in the direct renewable energy workforce and does not consider construction of electricity networks, bioenergy or renewable hydrogen. This report also does not capture the effects of the COVID-19 pandemic.
* The **Institute of Sustainable Futures** (ISF) was commissioned to produce workforce projections for AEMO’s 2022 Integrated Systems Plan, which covers the NEM[[24]](#footnote-25). ISF used an employment factor (full-time equivalent job years per megawatt of installed capacity) based on current workforce estimates and projected this forward for each scenario. Due to information constraints, this work does not consider energy efficiency, demand-side energy management, electrification or the production of hydrogen. This work is also limited by the likelihood that workforce composition and requirements will change over time.

Under AEMO’s step change scenario, ISF projects that employment will grow from 19,000 in 2023 to a peak of 81,000 in 2049. Around 30% of employment is for onshore wind generation, 25% for rooftop solar and 18% for batteries, with NSW having the greatest share of employment, followed by Queensland, Victoria, South Australia and Tasmania. Trades and technicians are by far the largest occupation group, with electricians and mechanical trades and technicians in particularly high demand.

* The **Net Zero Australia** study (University of Melbourne, University of Queensland, Princeton University and Nous Group) models six scenarios across Australia’s domestic and export sectors between 2020 and 2060 over the five stages of manufacturing, construction and installation, production, operations and maintenance, and decommissioning. It examines their impacts on energy job creation in industries relevant to energy supply[[25]](#footnote-26). The study develops an employment factor metric which reflects average job creation per unit of energy activity. Whilst labour demand increases across all five electrification scenarios, excluding the reference scenario, opportunities for job growth are projected to be significantly greater and more sustained in the energy export sector, where growth is modelled from 40,000 to between 600,000 and 1m jobs by 2060. By comparison, the domestic sector growth is modelled from 100,000 to between 270,000 and 450,000 jobs by 2060. This study does not consider energy efficiency, appliances, vehicles, transport or downstream industrial processes, such as cement or steel manufacturing. This study also does not model labour supply.

## Regional experiences

The clean energy transition presents both opportunities and challenges to regional communities, including First Nations communities[[26]](#footnote-27), particularly those with an historical dependence on emissions-intensive energy generation[[27]](#footnote-28). These communities are especially vulnerable to the clean energy transition and will require substantial public and private support, including investments in reskilling and local diversification[[28]](#footnote-29).

Following the Jobs and Skills Summit in September 2022, a Net Zero Economy Taskforce in the Department of the Prime Minister and Cabinet was established to advise government on how to best support regional communities[[29]](#footnote-30). A First Nations Clean Energy Strategy was also established with support from the Indigenous Land and Sea Corporation and Energy Ministers[[30]](#footnote-31), and in collaboration with a range of community, industry, union and research partners[[31]](#footnote-32). This strategy ensures First Nations communities are well placed to drive, shape and benefit from clean energy generation on First Nations land[[32]](#footnote-33).

Both within and beyond Australia the notion of just transitions has been widely deployed, supported by labour movements and the 2015 Paris Agreement, as a framework to ensure policy responses and government planning pay adequate attention to the transition needs and socio-economic outcomes of individuals and communities currently employed in or reliant on emissions-intensive industries[[33]](#footnote-34).This study is committed to drawing on these efforts to better understand the unique and critical demographic, geographic and socio-cultural factors shaping the transition to a clean energy workforce through case studies of particular regional communities.

## International experiences

Clean energy transitions are trending globally, with the International Energy Agency (IEA) estimating that just over 50% of the 65 million global energy workforce is employed in clean energy-related activities. Clean energy also accounts for virtually the entire 6% annual employment growth forecast in the energy sector. However, this growth is not consistent across regions, with the largest and fastest growing clean energy workforce in China, and the Asia Pacific region more generally.[[34]](#footnote-35)

There is a sense of both collaboration and competition as nations around the world race towards to a clean energy future. Governments are working to meet their own energy needs, achieve decarbonisation commitments and develop lucrative new export opportunities[[35]](#footnote-36). Decarbonisation is expected to transform global power relations and geopolitics as new ‘energy superpowers’ emerge[[36]](#footnote-37).

Common transition approaches centre on both developing new education and training pathways for the existing energy workforce, while also attracting a new generation of workers with the requisite skills to service the sector into the future[[37]](#footnote-38). Actioning this is forecast to require significant public investment in education and training.

International analysis has also highlighted that skills transferability potential is varied across different skill levels and regions, with higher-skilled, urban energy workers having greater access to emerging clean energy labour market opportunities than lower-skilled and/or regional workers[[38]](#footnote-39).

The study will establish a sound understanding of international best practice in order to consider how Australia can:

* draw on the experiences, contemporary and historical, of energy workforce transitions around the world to ensure workers and communities are effectively supported throughout the transition
* develop and incentivise new education and training pathways to attract future workers to the sector
* attract and prioritise skilled migrants with relevant skills, qualifications and experience to meet workforce needs where Australians are unavailable
* identify education and training gaps[[39]](#footnote-40) on the international market and leverage its position as an education exporter to fill these gaps and be the supplier of choice.

**Discussion questions**

**Australia**

* What are the main barriers to employers recruiting and retaining workers with the skills required to support the clean energy transition?
* What barriers do priority social cohorts, including women, First Nations Australians, people with disability, and culturally and linguistically diverse people face in entering the clean energy workforce?
* What accredited clean energy education and training pathways (qualifications and course components) are currently available in Australia?
* What barriers do students and prospective workers face in accessing education and training specific to clean energy?
* What barriers do education and training providers face in delivering courses specific to clean energy at the scale and pace required?

**Regional experiences**

* Which regional and First Nations communities should JSA engage with to better understand and address the impacts of the clean energy workforce transition?
* What information and assistance do communities need to prepare and harness the opportunities of future clean energy industries?
* What programs and initiatives have worked well to support workers transition out of in emissions-intensive industries?

**International experiences**

* What international experiences should JSA look at to establish an understanding of international best practice in relation to:
  + supporting workforce transitions
  + developing education training opportunities and incentives

# Analytical approach

JSA will use a range of data to establish an overview of the current state of the clean energy workforce and suitable transition pathways. This will include census and labour force data from the ABS, education and training data, as well as various other sources, to understand job vacancies and mobility.

The study will also analyse future workforce demand and supply over 10, 20 and 30 years based on different transition scenarios. These scenarios will help identify a range of possible workforce outcomes based on the pace and trajectory of change. While the purpose of the study is to examine the clean energy workforce, our modelling will also quantify the likely impacts on the broader workforce under each of these transition scenarios, which existing projections are largely yet to take into account. The scale of economic transformation required will have implications for other industries as clean energy takes a greater share of capital and labour and creates new demand for supporting goods and services.

## Limitations of existing data

As the clean energy sector is still emerging, there are a number of limitations with existing workforce and skills data, including:

* the inability to differentiate between clean and traditional workforces, particularly in construction and energy efficiency sectors
* many new clean energy industries, like solar and wind, aren’t disaggregated in labour market classifications, and some emerging technologies are missing entirely, like hydrogen production and electric vehicles
* longitudinal analysis isn’t possible with newer roles and industries that are only starting to appear
* some roles are currently very small, particularly specialised ones, making them difficult to find in the data
* inconsistent definitions and terminology limit our ability to combine and compare data sets.

### An opportunity to improve the data landscape

While the study will address these limitations where possible, longer-term solutions will be needed to truly improve the data landscape for this critical sector. The first *Australian Energy Employment Report* and the ongoing ANZSCO and ANZSIC reviews by the ABS are a promising start to this process but are unlikely to remediate the problem entirely[[40]](#footnote-41). JSA is actively considering what other work will be required following this study to identify, measure and analyse the clean energy workforce, and welcomes input from interested parties.

**Discussion questions**

* What do you consider to be the most significant information gaps in this sector?
* How can government better work with industry to measure the workforce?
* Are there existing data sources that could be better leveraged or improved?

# Getting involved

## Our consultation approach

JSA was established with a commitment to work closely with state and territory governments, industry, unions and education and training providers. In line with this commitment, the study will be supported by extensive consultation and genuine partnerships. We will:

* ensure stakeholders and experts have opportunities to inform the study
* test insights and analysis to refine our research
* be transparent in the way we work and the decisions we make.

This discussion paper is the first element in our consultation approach. Over the following months we will also begin meeting with stakeholders and hosting roundtables on different elements of the study.

### **Project Steering Group**

JSA’s interim Director, Professor Peter Dawkins AO, has established a Project Steering Group to support the study. The role of the Steering Group is to provide subject matter expertise and technical advice, while also helping connect JSA with interested partners. Members are drawn from industry groups, unions, training providers, state governments and research backgrounds.

#### **Stakeholder Reference Groups**

JSA will also establish Stakeholder Reference Groups that will allow us to share regular project updates and consult with larger groups of participants. These targeted groups will be used to organise further engagements, including roundtables, forums, and interviews.

This image shows the timeline for consultation.

Terms of reference feedback was open from 22 December 2022 to 16 January 2023. 

Discussion paper submissions are open from 4 April 2023 to 2 May 2023.

Stakeholder Reference Groups are established from April 2023 onwards.

Insights and findings will be shared from May 2023 onwards.

## How to make a submission

JSA welcomes feedback on the discussion paper from all interested parties.

You can submit responses to the questions in this paper and/or provide supplementary information and views by emailing the Clean Energy Capacity Study team at [CleanEnergyWorkforce@jobsandskills.gov.au](mailto:CleanEnergyWorkforce@jobsandskills.gov.au).

## How to keep updated

You can register your interest in receiving updates on the Capacity Study by emailing [CleanEnergyWorkforce@jobsandskills.gov.au](mailto:CleanEnergyWorkforce@jobsandskills.gov.au).

Jobs and Skills Australia also issues a regular e-newsletter on its broader work including this study. To subscribe, visit jobsandskills.gov.au, scroll to the bottom of the page and provide your email under the heading ‘Stay up to date’.

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# Attachment A - Terms of Reference

## Overview

The Government has commissioned Jobs and Skills Australia to undertake a capacity study on the workforce needs for Australia’s transition to a clean energy economy. The Capacity Study will provide critical evidence and insights to support workforce planning, policy development and program design, needed to build a strong and vibrant Clean Energy sector, and contribute to the Government’s Powering Australia Plan.

It is expected that the Capacity Study will form the basis of further work to inform the Government’s strategy for workforce planning as it pertains to delivering the energy transition and the transformation to a net zero economy by 2050.

The Capacity Study will build on existing research and deepen understanding of the clean energy sector, the skills profile of existing workforces, levels of skills transferability across industries and role types and forecasts of future supply and demand for clean energy related roles.

## Scope

## The Clean Energy Workforce Capacity Study will identify and analyse occupations, supply and demand factors and geographical considerations to support Australia’s transition from ‘brown’ to ‘green’ energy. It will:

1. Develop an appropriate definition of the Australian clean energy workforce
2. Establish an overview of the current state of the clean energy workforce – including its demographic and geographic composition, occupation, skill level, job mobility, numbers of employers, job vacancies, sector pay and working conditions, apprenticeship numbers, reliance on international specialists, and safety and licensing standards.
3. Analyse future demand (at the national, state and regional level) for clean energy roles over 10, 20 and 30 years based on different transition scenarios, alongside the impact on demand for employment in high-emitting sectors undergoing transition.
4. Analyse the potential supply (at the national, state and regional level) of clean energy workers over the next 10, 20 and 30 years by:
5. identifying the skills required by job roles in the clean energy workforce.
6. assessing the extent to which the required skills can be met by existing workers, particularly from transitioning sectors, and explore mobility and skills transferability between different roles and sectors.
7. examine the education, training and professional development pathways that will support workers entering the clean energy workforce, including new entrants, workers from transitioning industries and migrants, and assess the adequacy of their scope and scale.
8. consider international labour supply factors, such as the impact of international initiatives on the global skilled workforce, the recognition of foreign qualifications in the sector and the impact of targeted migration programs. Consider how regional labour mobility programs and Australian VET and higher education providers can build clean energy skills within our region (particularly the Pacific).
9. Identify the enablers and barriers faced by universities, TAFEs and other education and training providers to developing and delivering courses for the clean energy workforce and supporting research, including collaboration across education sectors and the capacity of the teaching and training workforce, and explore opportunities for innovation and reform to resolve any barriers.
10. Explore sector specific enablers and barriers faced by small, medium, and large employers in employing and retaining a skilled, diverse workforce in the clean energy sector.
11. Explore opportunities for, and barriers to, full participation in the clean energy sector for priority cohorts, including women, First Nations Australians, people with a disability and culturally and linguistically diverse Australians.
12. Explore through case studies of particular regions the critical place-based factors to supporting the transition to a clean energy workforce.
13. Consider the experiences of the transition to clean energy in other countries, especially those that have also traditionally relied on high-emissions forms of energy generation.

## Governance and Consultation

The Capacity Study will be underpinned by close consultation and collaboration with State and Territory governments and industry stakeholders, including peak bodies, employers, unions, Jobs and Skills Councils, universities, and TAFEs and training providers.

Jobs and Skills Australia will establish a Project Steering Group, with membership to include representatives from other key Australian Government agencies, State and Territory governments, industry peak bodies and employers, unions, universities, and training providers. The draft terms of reference will be reviewed by the Steering Group.

Jobs and Skills Australia will also provide opportunities for stakeholders to contribute to the study through submissions and stakeholder forums.

Jobs and Skills Australia will regularly brief the Australian Minister for Skills and Training on the study’s progress and interim findings, so that ministerial colleagues in the Australian Government and the Skills Ministers Meeting can be kept informed.

## Process

Jobs and Skills Australia will deliver an interim report by May 2023 and a final report by July 2023.

## Attachment: Complementary policy settings

The Capacity Study will complement work being undertaken by other parts of the Commonwealth Government including the Australian Energy Employment Report (AEER), the National Battery Strategy and the National Energy Workforce Strategy.

In undertaking the Capacity Study, Jobs and Skills Australia should have regard to current and potential training packages, existing skills programs across the Commonwealth and States and Territories, and contemporary policy settings and labour market needs, noting:

1. The Australian Government and states and territorieshave agreed to accelerate the delivery of 465,000 additional fee-free TAFE places, with 180,000 to be delivered next year.
2. National Cabinet have endorsed the vision and principles for longer-term VET reform under a new 5-year National Skills Agreement.
3. The Australian Government and states and territories have committed to negotiating a National Skills Agreement which provides critical and emerging industries at a national, state and local level with the skilled workers they need and secures a domestic workforce to deliver on current and future priorities.
4. From January 2023, Jobs and Skills Councils will provide industry (employers and unions) with a stronger, more strategic voice and greater participation in the VET sector to address workforce challenges.
5. A VET workforce blueprint is being developed by the Australian Government and states and territories to develop a comprehensive blueprint to support and grow a quality VET workforce.
6. The introduction of 20,000 additional Commonwealth-supported university places for under-represented groups (including rural and regional Australians) in areas of skills shortages.
7. The establishment of the Australian University Accord to drive lasting reform at Australian universities that will drive accessibility, affordability, quality, certainty, sustainability and prosperity to the higher education sector and the country.
8. Post-study work rights – the Australian Government will allow two additional years of stay in Australia for recent international graduates with select degrees in areas of verified skills shortages.
9. National Reconstruction Fund will provide finance for projects that diversify and transform Australia’s industry and economy.
10. The introduction of Workforce Australia in July 2022 which reformed Commonwealth employment services.

# Attachment B – Draft ANZSIC mapping

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Level | Code | ANZSIC Name | Clean Energy Workforce | Notes |
| 1 | B | Mining | Adjacent – partial - enabling materials | Materials involved in clean energy machines and infrastructure |
| 2 | 06 | Coal Mining | Transitioning - fossil fuels |  |
| 3 | 060 | Coal Mining | Transitioning - fossil fuels |  |
| 4 | 0600 | Coal Mining | Transitioning - fossil fuels |  |
| 2 | 07 | Oil and Gas Extraction | Transitioning - fossil fuels |  |
| 3 | 070 | Oil and Gas Extraction | Transitioning - fossil fuels |  |
| 4 | 0700 | Oil and Gas Extraction | Transitioning - fossil fuels |  |
| 2 | 08 | Metal Ore Mining | Adjacent – partial - enabling materials |  |
| 3 | 080 | Metal Ore Mining | Adjacent – partial - enabling materials |  |
| 4 | 0801 | Iron Ore Mining | Adjacent – partial - enabling materials |  |
| 4 | 0802 | Bauxite Mining | Adjacent – partial - enabling materials | Includes aluminium |
| 4 | 0803 | Copper Ore Mining | Adjacent – partial - enabling materials |  |
| 4 | 0804 | Gold Ore Mining | Transitioning - fossil fuels |  |
| 4 | 0805 | Mineral Sand Mining | Transitioning - fossil fuels |  |
| 4 | 0806 | Nickel Ore Mining | Adjacent – partial - enabling materials |  |
| 4 | 0807 | Silver-Lead-Zinc Ore Mining | Adjacent – partial - enabling materials |  |
| 4 | 0809 | Other Metal Ore Mining | Adjacent – partial - enabling materials | Includes platinum group metals |
| 2 | 09 | Non-Metallic Mineral Mining and Quarrying | Adjacent – partial - enabling materials |  |
| 3 | 091 | Construction Material Mining | Transitioning - fossil fuels |  |
| 4 | 0911 | Gravel and Sand Quarrying | Transitioning - fossil fuels |  |
| 4 | 0919 | Other Construction Material Mining | Transitioning - fossil fuels |  |
| 3 | 099 | Other Non-Metallic Mineral Mining and Quarrying | Transitioning - fossil fuels |  |
| 4 | 0990 | Other Non-Metallic Mineral Mining and Quarrying | Adjacent – partial - enabling materials | Includes silica |
| 2 | 10 | Exploration and Other Mining Support Services | Transitioning - fossil fuels |  |
| 3 | 101 | Exploration | Transitioning - fossil fuels |  |
| 4 | 1011 | Petroleum Exploration | Transitioning - fossil fuels |  |
| 4 | 1012 | Mineral Exploration | Transitioning - fossil fuels |  |
| 3 | 109 | Other Mining Support Services | Transitioning - fossil fuels |  |
| 4 | 1090 | Other Mining Support Services | Transitioning - fossil fuels |  |
| 1 | C | Manufacturing | Adjacent – partial - enabling materials |  |
| 2 | 17 | Petroleum and Coal Product Manufacturing | Transitioning - fossil fuels |  |
| 3 | 170 | Petroleum and Coal Product Manufacturing | Transitioning - fossil fuels |  |
| 4 | 1701 | Petroleum Refining and Petroleum Fuel Manufacturing | Transitioning - fossil fuels |  |
| 4 | 1709 | Other Petroleum and Coal Product Manufacturing | Transitioning - fossil fuels |  |
| 2 | 18 | Basic Chemical and Chemical Product Manufacturing | Adjacent – partial - enabling materials |  |
| 3 | 181 | Basic Chemical Manufacturing | Adjacent – partial - enabling materials |  |
| 4 | 1811 | Industrial Gas Manufacturing | Clean energy - partial | Manufacturing industrial organic and inorganic gas in compressed, liquid or solid forms (includes hydrogen) |
| 4 | 1812 | Basic Organic Chemical Manufacturing | Clean energy - partial | Manufacturing organic acids and industrial alcohols such as ethanol (biofuel) |
| 2 | 21 | Primary Metal and Metal Product Manufacturing | Adjacent – partial - enabling materials | Metals involved in clean energy machines and infrastructure |
| 3 | 211 | Basic Ferrous Metal Manufacturing | Adjacent – partial - enabling materials |  |
| 4 | 2110 | Iron Smelting and Steel Manufacturing | Adjacent – partial - enabling materials and exports | Green steel manufacturing |
| 3 | 212 | Basic Ferrous Metal Product Manufacturing | Adjacent – partial - enabling materials |  |
| 4 | 2121 | Iron and Steel Casting | Adjacent – partial - enabling materials |  |
| 4 | 2122 | Steel Pipe and Tube Manufacturing | Adjacent – partial - enabling materials |  |
| 3 | 213 | Basic Non-Ferrous Metal Manufacturing | Adjacent – partial - enabling materials | Includes silicon |
| 4 | 2133 | Copper, Silver, Lead and Zinc Smelting and Refining | Adjacent – partial - enabling materials |  |
| 4 | 2139 | Other Basic Non-Ferrous Metal Manufacturing | Adjacent – partial - enabling materials |  |
| 3 | 214 | Basic Non-Ferrous Metal Product Manufacturing | Adjacent – partial - enabling materials |  |
| 4 | 2149 | Other Basic Non-Ferrous Metal Product Manufacturing | Adjacent – partial - enabling materials |  |
| 2 | 22 | Fabricated Metal Product Manufacturing | Adjacent – partial - enabling materials | Metals involved in clean energy machines and infrastructure |
| 3 | 221 | Iron and Steel Forging | Adjacent – partial - enabling materials |  |
| 4 | 2210 | Iron and Steel Forging | Adjacent – partial - enabling materials |  |
| 3 | 222 | Structural Metal Product Manufacturing | Adjacent – partial - enabling materials |  |
| 4 | 2221 | Structural Steel Fabricating | Adjacent – partial - enabling materials |  |
| 4 | 2229 | Other Structural Metal Product Manufacturing | Adjacent – partial - enabling materials |  |
| 3 | 223 | Metal Container Manufacturing | Adjacent – partial - enabling materials |  |
| 2 | 23 | Transport Equipment Manufacturing | Adjacent – partial - enabling materials |  |
| 3 | 231 | Motor Vehicle and Motor Vehicle Part Manufacturing | Adjacent – partial - enabling materials |  |
| 4 | 2311 | Motor Vehicle Manufacturing | Clean energy - partial | Includes Hydrogen, fuel cell, hybrid or electric vehicle manufacturing |
| 2 | 24 | Machinery and Equipment Manufacturing | Adjacent – partial - enabling materials |  |
| 3 | 241 | Professional and Scientific Equipment Manufacturing | Adjacent – partial - enabling materials |  |
| 4 | 2419 | Other Professional and Scientific Equipment Manufacturing | Adjacent – partial - enabling materials |  |
| 3 | 242 | Computer and Electronic Equipment Manufacturing | Adjacent – partial - enabling materials |  |
| 4 | 2422 | Communications Equipment Manufacturing | Adjacent – partial - enabling materials |  |
| 4 | 2429 | Other Electronic Equipment Manufacturing | Adjacent – partial - enabling materials |  |
| 3 | 243 | Electrical Equipment Manufacturing | Adjacent – partial - enabling materials |  |
| 4 | 2431 | Electric Cable and Wire Manufacturing | Adjacent – partial - enabling materials |  |
| 4 | 2432 | Electric Lighting Equipment Manufacturing | Adjacent – partial - enabling materials |  |
| 4 | 2439 | Other Electrical Equipment Manufacturing | Adjacent – partial - enabling materials | Includes solar panel manufacturing |
| 3 | 244 | Domestic Appliance Manufacturing | Adjacent – partial - enabling materials |  |
| 4 | 2449 | Other Domestic Appliance Manufacturing | Adjacent – partial - enabling materials |  |
| 3 | 245 | Pump, Compressor, Heating and Ventilation Equipment Manufacturing | Adjacent – partial - enabling materials |  |
| 4 | 2451 | Pump and Compressor Manufacturing | Adjacent – partial - enabling materials |  |
| 4 | 2452 | Fixed Space Heating, Cooling and Ventilation Equipment Manufacturing | Adjacent – partial - enabling materials |  |
| 3 | 246 | Specialised Machinery and Equipment Manufacturing | Adjacent – partial - enabling materials |  |
| 4 | 2463 | Machine Tool and Parts Manufacturing | Adjacent – partial - enabling materials |  |
| 4 | 2469 | Other Specialised Machinery and Equipment Manufacturing | Adjacent – partial - enabling materials |  |
| 3 | 249 | Other Machinery and Equipment Manufacturing | Adjacent – partial - enabling materials |  |
| 4 | 2499 | Other Machinery and Equipment Manufacturing n.e.c. | Adjacent – partial - enabling materials | Wind turbine manufacturing |
| 1 | D | Electricity, Gas, Water and Waste Services | Clean energy - partial |  |
| 2 | 26 | Electricity Supply | Clean energy - partial |  |
| 3 | 261 | Electricity Generation | Clean energy - partial |  |
| 4 | 2611 | Fossil Fuel Electricity Generation | Transitioning - fossil fuels |  |
| 4 | 2612 | Hydro-Electricity Generation | Clean energy - complete |  |
| 4 | 2619 | Other Electricity Generation | Clean energy - complete |  |
| 3 | 262 | Electricity Transmission | Clean energy - partial |  |
| 4 | 2620 | Electricity Transmission | Clean energy - partial |  |
| 3 | 263 | Electricity Distribution | Clean energy - partial |  |
| 4 | 2630 | Electricity Distribution | Clean energy - partial |  |
| 3 | 264 | On Selling Electricity and Electricity Market Operation | Clean energy - partial |  |
| 4 | 2640 | On Selling Electricity and Electricity Market Operation | Clean energy - partial |  |
| 2 | 27 | Gas Supply | Clean energy - partial | Hydrogen blending in gas distribution network |
| 3 | 270 | Gas Supply | Clean energy - partial | Hydrogen blending in gas distribution network |
| 4 | 2700 | Gas Supply | Clean energy - partial | Hydrogen blending in gas distribution network |
| 1 | E | Construction | Clean energy - partial |  |
| 2 | 30 | Building Construction | Adjacent – partial – energy efficiency |  |
| 3 | 301 | Residential Building Construction | Adjacent – partial – energy efficiency |  |
| 4 | 3011 | House Construction | Adjacent – partial – energy efficiency |  |
| 4 | 3019 | Other Residential Building Construction | Adjacent – partial – energy efficiency |  |
| 3 | 302 | Non-Residential Building Construction | Adjacent – partial – energy efficiency |  |
| 4 | 3020 | Non-Residential Building Construction | Adjacent – partial – energy efficiency |  |
| 2 | 31 | Heavy and Civil Engineering Construction | Clean energy - partial |  |
| 3 | 310 | Heavy and Civil Engineering Construction | Clean energy - partial | Railways, dams, pipelines |
| 2 | 32 | Construction Services | Adjacent – partial – energy efficiency |  |
| 4 | 3224 | Structural Steel Erection Services | Clean energy - partial | Electricity transmission towers |
| 3 | 323 | Building Installation Services | Clean energy - partial |  |
| 4 | 3231 | Plumbing Services | Adjacent – partial – energy efficiency |  |
| 4 | 3232 | Electrical Services | Clean energy - partial | Installation of electrical wiring, installation of appliances |
| 4 | 3233 | Air Conditioning and Heating Services | Clean energy - partial | Installation of heating equipment, refrigeration equipment, air conditioning equipment |
| 4 | 3245 | Glazing Services | Adjacent – partial – energy efficiency |  |
| 1 | I | Transport, Postal and Warehousing | Clean energy - partial |  |
| 3 | 502 | Pipeline and Other Transport | Clean energy - partial |  |
| 4 | 5021 | Pipeline Transport | Clean energy - partial | Transportation of hydrogen via pipelines |
| 1 | M | Professional, Scientific and Technical Services | Clean energy - partial |  |
| 3 | 691 | Scientific Research Services | Adjacent - partial - enabling services |  |
| 4 | 6910 | Scientific Research Services | Adjacent - partial - enabling services |  |
| 4 | 6923 | Engineering Design and Engineering Consulting Services | Clean energy - partial | Design, development and utilisation of machines, materials, instruments, structures, processes and systems |
| 3 | 693 | Legal and Accounting Services | Adjacent - partial - enabling services |  |
| 4 | 6931 | Legal Services | Adjacent - partial - enabling services |  |
| 4 | 6932 | Accounting Services | Adjacent - partial - enabling services |  |
| 1 | N | Administrative and Support Services | Adjacent - partial - enabling services |  |
| 3 | 729 | Other Administrative Services | Adjacent - partial - enabling services |  |
| 4 | 7291 | Office Administrative Services | Adjacent - partial - enabling services |  |
| 2 | 77 | Public Order, Safety and Regulatory Services | Adjacent - partial - enabling services |  |
| 3 | 772 | Regulatory Services | Adjacent - partial - enabling services |  |
| 4 | 7720 | Regulatory Services | Adjacent - partial - enabling services | Licensing and inspection activities (not including electricity markets) |
| 1 | P | Education and Training | Adjacent - partial - enabling services |  |
| 2 | 81 | Tertiary Education | Adjacent - partial - enabling services |  |
| 3 | 810 | Tertiary Education | Adjacent - partial - enabling services |  |
| 4 | 8101 | Technical and Vocational Education and Training | Adjacent - partial - enabling services |  |
| 4 | 8102 | Higher Education | Adjacent - partial - enabling services |  |
| 1 | S | Other Services | Adjacent - partial - enabling services |  |
| 2 | 94 | Repair and Maintenance | Adjacent - partial - enabling services |  |
| 3 | 941 | Automotive Repair and Maintenance | Adjacent - partial - enabling services |  |

# Attachment C – Draft ANZSCO mapping

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Level | Code | ANZSIC Name | Clean Energy Workforce | Notes |
| 1 | 1 | Managers | Adjacent - partial - enabling |  |
| 2 | 13 | Specialist Managers | Adjacent - partial - enabling |  |
| 3 | 133 | Construction, Distribution and Production Managers | Adjacent - partial - enabling |  |
| 4 | 1331 | Construction Managers | Adjacent - partial - enabling |  |
| 6 | 133111 | Construction Project Manager | Adjacent - partial - enabling | Coordinates construction of engineering and building projects, and all resources involved in the construction process |
| 6 | 133112 | Project Builder | Adjacent - partial - enabling | Plans, organises, directs, controls and coordinates the construction, alteration and renovation of dwellings and other buildings, and the physical and human resources involved in the building process |
| 4 | 1332 | Engineering Managers | Adjacent - partial - enabling |  |
| 6 | 133211 | Engineering Manager | Adjacent - partial - enabling |  |
| 4 | 1334 | Manufacturers | Adjacent - partial - enabling |  |
| 6 | 133411 | Manufacturer | Adjacent - partial - enabling |  |
| 6 | 133513 | Production Manager (Mining) | Transitioning - fossil fuels |  |
| 4 | 1344 | Other Education Managers | Adjacent - partial - enabling |  |
| 6 | 134412 | Regional Education Manager | Adjacent - partial - enabling | coordinates educational approaches and policy and curriculum resources and development for preschool, primary, middle or intermediate school, secondary, TAFE or polytechnic teachers and administrators. |
| 6 | 139912 | Environmental Manager | Adjacent - partial - enabling | Plans, organises, directs, controls and coordinates the development and implementation of an environmental management system within an organisation by identifying, solving and alleviating environmental issues, such as pollution and waste treatment, in compliance with environmental legislation and to ensure corporate sustainable development. |
| 1 | 2 | Professionals | Adjacent - partial - enabling/energy efficiency |  |
| 4 | 2211 | Accountants | Adjacent - partial - enabling |  |
| 6 | 221111 | Accountant (General) | Adjacent - partial - enabling |  |
| 4 | 2254 | Technical Sales Representatives | Adjacent - partial - enabling |  |
| 4 | 2312 | Marine Transport Professionals | Clean energy - partial | As relevant to offshore wind |
| 6 | 231299 | Marine Transport Professionals nec | Clean energy - partial | As relevant to offshore wind |
| 3 | 232 | Architects, Designers, Planners and Surveyors | Adjacent – partial – energy efficiency |  |
| 4 | 2321 | Architects and Landscape Architects | Adjacent – partial – energy efficiency |  |
| 6 | 232111 | Architect | Adjacent – partial – energy efficiency |  |
| 6 | 232112 | Landscape Architect | Adjacent – partial – energy efficiency |  |
| 4 | 2322 | Surveyors and Spatial Scientists | Adjacent – partial – energy efficiency |  |
| 6 | 232212 | Surveyor | Adjacent – partial – energy efficiency |  |
| 4 | 2326 | Urban and Regional Planners | Adjacent – partial – energy efficiency |  |
| 6 | 232611 | Urban and Regional Planner | Adjacent – partial – energy efficiency |  |
| 3 | 233 | Engineering Professionals | Adjacent – partial – energy efficiency |  |
| 4 | 2331 | Chemical and Materials Engineers | Clean energy - partial |  |
| 6 | 233111 | Chemical Engineer | Clean energy - partial |  |
| 6 | 233112 | Materials Engineer | Clean energy - partial |  |
| 4 | 2332 | Civil Engineering Professionals | Clean energy - partial |  |
| 6 | 233211 | Civil Engineer | Adjacent - partial - enabling |  |
| 6 | 233212 | Geotechnical Engineer | Adjacent - partial - enabling materials |  |
| 6 | 233215 | Transport Engineer | Adjacent – partial – energy efficiency |  |
| 4 | 2333 | Electrical Engineers | Clean energy - partial |  |
| 6 | 233311 | Electrical Engineer | Clean energy - partial |  |
| 4 | 2334 | Electronics Engineers | Adjacent - partial - enabling materials/energy efficiency |  |
| 6 | 233411 | Electronics Engineer | Adjacent - partial - enabling materials/energy efficiency |  |
| 4 | 2335 | Industrial, Mechanical and Production Engineers | Adjacent – partial – energy efficiency |  |
| 6 | 233511 | Industrial Engineer | Adjacent - partial - enabling materials/energy efficiency |  |
| 6 | 233512 | Mechanical Engineer | Clean energy - partial |  |
| 6 | 233513 | Production or Plant Engineer | Adjacent - partial - enabling materials/energy efficiency |  |
| 4 | 2336 | Mining Engineers | Adjacent - partial - enabling materials |  |
| 4 | 2339 | Other Engineering Professionals | Adjacent - partial - enabling materials |  |
| 6 | 233914 | Engineering Technologist | Adjacent - partial - enabling materials |  |
| 6 | 234313 | Environmental Research Scientist | Adjacent - partial - enabling |  |
| 4 | 2344 | Geologists, Geophysicists and Hydrogeologists | Clean energy - partial | Includes hydroelectricity and hydrogen storage |
| 6 | 234411 | Geologist | Clean energy - partial |  |
| 6 | 234412 | Geophysicist | Clean energy - partial |  |
| 6 | 234413 | Hydrogeologist | Clean energy - partial |  |
| 4 | 2349 | Other Natural and Physical Science Professionals | Adjacent - partial - enabling materials |  |
| 6 | 234912 | Metallurgist | Adjacent - partial - enabling materials |  |
| 2 | 24 | Education Professionals | Adjacent - partial - enabling |  |
| 3 | 242 | Tertiary Education Teachers | Adjacent - partial - enabling |  |
| 4 | 2421 | University Lecturers and Tutors | Adjacent - partial - enabling |  |
| 6 | 242111 | University Lecturer | Adjacent - partial - enabling |  |
| 6 | 242112 | University Tutor | Adjacent - partial - enabling |  |
| 4 | 2422 | Vocational Education Teachers / Polytechnic Teachers | Adjacent - partial - enabling |  |
| 6 | 242211 | Vocational Education Teacher / Polytechnic Teacher | Adjacent - partial - enabling |  |
| 2 | 27 | Legal, Social and Welfare Professionals | Adjacent - partial - enabling |  |
| 3 | 271 | Legal Professionals | Adjacent - partial - enabling |  |
| 6 | 271299 | Judicial and Other Legal Professionals nec | Adjacent - partial - enabling |  |
| 1 | 3 | Technicians and Trades Workers | Clean energy - partial |  |
| 2 | 31 | Engineering, ICT and Science Technicians | Clean energy - partial |  |
| 3 | 312 | Building and Engineering Technicians | Adjacent - partial - enabling |  |
| 4 | 3121 | Architectural, Building and Surveying Technicians | Adjacent - partial - enabling/energy efficiency |  |
| 6 | 312111 | Architectural Draftsperson | Adjacent - partial - enabling | Performs technical functions to assist construction managers, architects and surveyors. |
| 6 | 312113 | Building Inspector | Adjacent - partial - enabling | Specialisation: Electrical Installation Inspector |
| 6 | 312199 | Architectural, Building and Surveying Technicians nec | Adjacent – partial – energy efficiency | Occupations in this group include: Energy Assessor, roof truss detailer, structural steel detailer |
| 4 | 3122 | Civil Engineering Draftspersons and Technicians | Adjacent - partial - enabling |  |
| 6 | 312211 | Civil Engineering Draftsperson | Adjacent - partial - enabling | Prepares detailed drawings and plans for civil engineering work in support of Civil Engineering Professionals and Engineering Technologists. |
| 6 | 312212 | Civil Engineering Technician | Adjacent - partial - enabling |  |
| 4 | 3123 | Electrical Engineering Draftspersons and Technicians | Adjacent – partial – energy efficiency |  |
| 6 | 312311 | Electrical Engineering Draftsperson | Adjacent – partial – energy efficiency | Prepares detailed drawings and plans of electrical installations and circuitry in support of Electrical Engineers and Engineering Technologists. Registration or licensing may be required. |
| 6 | 312312 | Electrical Engineering Technician | Adjacent – partial – energy efficiency |  |
| 4 | 3124 | Electronic Engineering Draftspersons and Technicians | Adjacent - partial - enabling |  |
| 6 | 312411 | Electronic Engineering Draftsperson | Adjacent - partial - enabling |  |
| 6 | 312412 | Electronic Engineering Technician | Adjacent – partial – energy efficiency | Conducts tests of electronic systems, collects and analyses data, and assembles circuitry in support of Electronics Engineers and Engineering Technologists. Registration or licensing may be required. |
| 4 | 3125 | Mechanical Engineering Draftspersons and Technicians | Adjacent - partial - enabling |  |
| 6 | 312511 | Mechanical Engineering Draftsperson | Adjacent - partial - enabling |  |
| 6 | 312512 | Mechanical Engineering Technician | Adjacent - partial - enabling |  |
| 4 | 3126 | Safety Inspectors | Adjacent - partial - enabling | Re below: inspection for equipment to run smoothly from a regulatory compliance view - to help the (Adjacent - partial - enabling) workforce in remaining compliant for the transition to clean energy |
| 6 | 312611 | Safety Inspector | Adjacent - partial - enabling | Inspects machines, equipment, working conditions and public places to ensure compliance with government and industry standards and regulations, in relation to occupational health and safety. Registration or licensing may be required. |
| 4 | 3129 | Other Building and Engineering Technicians | Adjacent - partial - enabling materials | This unit group covers Building and Engineering Technicians not elsewhere classified. It includes Maintenance Planners, Metallurgical or Materials Technicians, and Mine Deputies. |
| 6 | 312912 | Metallurgical or Materials Technician | Adjacent - partial - enabling materials |  |
| 6 | 312914 | Other Draftsperson | Adjacent – partial – energy efficiency | Prepare detailed drawings, technical plans, maps, and illustrations to precise specifications. Registration or licensing may be required |
| 6 | 313212 | Telecommunications Field Engineer | Adjacent - partial - enabling |  |
| 6 | 313214 | Telecommunications Technical Officer or Technologist | Adjacent – partial – energy efficiency | Carries out specialised design and support functions in telecommunications engineering including optimisation and performance monitoring of telecommunications networks, diagnosis and repair of faults, and the selection and installation of equipment. |
| 2 | 32 | Automotive and Engineering Trades Workers | Adjacent - partial - enabling |  |
| 3 | 321 | Automotive Electricians and Mechanics | Adjacent - partial - enabling |  |
| 4 | 3211 | Automotive Electricians | Adjacent - partial - enabling |  |
| 6 | 321111 | Automotive Electrician | Adjacent - partial - enabling | Maintenance of electric cars |
| 3 | 322 | Fabrication Engineering Trades Workers | Adjacent - partial - enabling materials |  |
| 4 | 3221 | Metal Casting, Forging and Finishing Trades Workers | Adjacent - partial - enabling materials |  |
| 6 | 322112 | Electroplater | Adjacent - partial - enabling materials | Controls plating processes and maintains solutions used to coat metal articles and other parts with non-ferrous metals. |
| 6 | 322114 | Metal Casting Trades Worker | Adjacent - partial - enabling materials |  |
| 4 | 3222 | Sheetmetal Workers | Adjacent - partial - enabling/enabling materials | Falls in between adjacent - partial - enabling or adjacent - enabling materials (depending on the tasks) |
| 6 | 322211 | Sheetmetal Worker | Adjacent - partial - enabling/enabling materials |  |
| 4 | 3223 | Structural Steel and Welding Trades Workers | Adjacent - partial - enabling |  |
| 6 | 322311 | Metal Fabricator | Adjacent - partial - enabling |  |
| 6 | 322312 | Pressure Welder | Adjacent - partial - enabling | Assembles, welds and repairs pressure vessels and pipes to relevant standards. |
| 6 | 322313 | Welder (First Class) (Aus) / Welder (NZ) | Adjacent - partial - enabling | Fabricates and repairs metal products using various welding techniques. |
| 3 | 323 | Mechanical Engineering Trades Workers | Clean energy - Partial |  |
| 4 | 3231 | Aircraft Maintenance Engineers | Clean energy - Partial |  |
| 6 | 323111 | Aircraft Maintenance Engineer (Avionics) | Clean energy - Partial |  |
| 6 | 323112 | Aircraft Maintenance Engineer (Mechanical) | Adjacent – partial – energy efficiency | Inspects, tests, repairs and installs aircraft hydromechanical and flight system components and aircraft engines, subassemblies and components. Registration or licensing may be required. |
| 6 | 323113 | Aircraft Maintenance Engineer (Structures) | Adjacent - partial - enabling materials | Inspects, dismantles and reassembles aircraft structures, and repairs and replaces components of aircraft frames. Works with both metal and carbon fibre composite materials |
| 4 | 3232 | Metal Fitters and Machinists | Adjacent - partial - enabling |  |
| 6 | 323211 | Fitter (General) | Adjacent - partial - enabling |  |
| 6 | 323212 | Fitter and Turner | Adjacent - partial - enabling |  |
| 6 | 323213 | Fitter-Welder | Adjacent - partial - enabling |  |
| 4 | 3242 | Vehicle Body Builders and Trimmers | Adjacent - partial - enabling |  |
| 6 | 324211 | Vehicle Body Builder | Adjacent - partial - enabling |  |
| 2 | 33 | Construction Trades Workers | Clean energy - Partial |  |
| 3 | 331 | Bricklayers, and Carpenters and Joiners | Adjacent – partial – energy efficiency |  |
| 4 | 3311 | Bricklayers and Stonemasons | Adjacent – partial – energy efficiency |  |
| 6 | 331111 | Bricklayer | Adjacent – partial – energy efficiency | Laying double bricks for residential homes for better insulation |
| 3 | 333 | Glaziers, Plasterers and Tilers | Adjacent – partial – energy efficiency |  |
| 4 | 3331 | Glaziers | Adjacent – partial – energy efficiency |  |
| 6 | 333111 | Glazier | Adjacent – partial – energy efficiency |  |
| 4 | 3332 | Plasterers and Renderers | Adjacent – partial – energy efficiency |  |
| 6 | 333211 | Plasterer (Wall and Ceiling) | Adjacent – partial – energy efficiency |  |
| 6 | 333212 | Renderer (Solid Plaster) | Adjacent – partial – energy efficiency |  |
| 3 | 334 | Plumbers | Clean energy - Partial | Airconditioning and Mechanical Services Plumber |
| 4 | 3341 | Plumbers | Clean energy - Partial | Airconditioning and Mechanical Services Plumber |
| 6 | 334112 | Airconditioning and Mechanical Services Plumber | Clean energy - Partial |  |
| 6 | 334114 | Gasfitter | Transitioning - fossil fuels |  |
| 2 | 34 | Electrotechnology and Telecommunications Trades Workers | Clean energy - Partial |  |
| 3 | 341 | Electricians | Clean energy - Partial |  |
| 4 | 3411 | Electricians | Clean energy - Partial |  |
| 6 | 341111 | Electrician (General) | Clean energy - Partial | Hot water solar system installers and Labourers who install solar panels are excluded from this unit group. Hot water solar system installers are included in Unit group 8214, Insulation and Home improvement installers. Labourers are included in Unit group 8999, Other Miscellaneous Labourers. |
| 6 | 341112 | Electrician (Special Class) | Clean energy - Partial |  |
| 3 | 342 | Electronics and Telecommunications Trades Workers | Clean energy - Partial |  |
| 4 | 3421 | Airconditioning and Refrigeration Mechanics | Clean energy - Partial |  |
| 6 | 342111 | Airconditioning and Refrigeration Mechanic | Clean energy - Partial |  |
| 4 | 3422 | Electrical Distribution Trades Workers | Clean energy - Partial |  |
| 6 | 342211 | Electrical Linesworker / Electrical Line Mechanic | Clean energy - Partial |  |
| 6 | 342212 | Technical Cable Jointer | Clean energy - Partial |  |
| 4 | 3423 | Electronics Trades Workers | Clean energy - Partial |  |
| 6 | 342314 | Electronic Instrument Trades Worker (General) | Clean energy - Partial |  |
| 6 | 342315 | Electronic Instrument Trades Worker (Special Class) | Clean energy - Partial |  |
| 4 | 3992 | Chemical, Gas, Petroleum and Power Generation Plant Operators | Transitioning - fossil fuels |  |
| 6 | 399211 | Chemical Plant Operator | Transitioning - fossil fuels |  |
| 6 | 399212 | Gas or Petroleum Operator | Clean energy - partial | Electricity generation from hydrogen |
| 6 | 399213 | Power Generation Plant Operator | Clean energy - partial | Includes hydroelectricity |
| 1 | 5 | Clerical and Administrative Workers | Adjacent - partial - enabling |  |
| 4 | 5619 | Other Clerical and Office Support Workers | Adjacent - partial - enabling |  |
| 6 | 561999 | Clerical and Office Support Workers nec | Adjacent - partial - enabling |  |
| 2 | 59 | Other Clerical and Administrative Workers | Adjacent - partial - enabling |  |
| 4 | 5999 | Other Miscellaneous Clerical and Administrative Workers | Adjacent - partial - enabling |  |
| 6 | 599999 | Clerical and Administrative Workers nec | Adjacent - partial - enabling |  |
| 1 | 7 | Machinery Operators and Drivers | Adjacent - partial - enabling materials |  |
| 4 | 7123 | Engineering Production Workers | Adjacent - partial - enabling materials |  |
| 6 | 712311 | Engineering Production Worker | Adjacent - partial - enabling materials |  |
| 4 | 8214 | Insulation and Home Improvement Installers | Adjacent – partial – energy efficiency | Hot water solar system installers are included in Unit Group 8214, Insulation and Home Improvement Installers. |
| 6 | 821411 | Building Insulation Installer | Adjacent – partial – energy efficiency |  |
| 6 | 821713 | Steel Fixer | Adjacent - partial - enabling |  |
| 6 | 821714 | Structural Steel Erector | Adjacent - partial - enabling |  |
| 4 | 8322 | Product Assemblers | Adjacent - partial - enabling |  |
| 6 | 832211 | Product Assembler | Adjacent - partial - enabling |  |
| 3 | 839 | Miscellaneous Factory Process Workers | Adjacent - partial - enabling materials |  |
| 4 | 8391 | Metal Engineering Process Workers | Adjacent - partial - enabling materials |  |
| 6 | 839111 | Metal Engineering Process Worker | Adjacent - partial - enabling materials |  |
| 4 | 8994 | Motor Vehicle Parts and Accessories Fitters | Adjacent - partial - enabling |  |

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3. [Measuring Green Jobs](https://www.bls.gov/green/home.htm) 2013 *U.S Bureau Of Labour Statistics* [↑](#footnote-ref-4)
4. [Jobs of Tomorrow: Social and Green Jobs for Building Inclusive and Sustainable Economies](https://www.weforum.org/whitepapers/jobs-of-tomorrow-social-and-green-jobs-for-building-inclusive-and-sustainable-economies/) 2023 World Economic Forum [↑](#footnote-ref-5)
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13. [Diversity in STEM Review](https://www.industry.gov.au/science-technology-and-innovation/diversity-stem-review) 2022 Department of Industry, Science and Resources [↑](#footnote-ref-14)
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16. *The Superpower Transformation* 2022 Ross Garnaut [↑](#footnote-ref-17)
17. [Skilling Australian industry for the energy transition](https://arena.gov.au/assets/2023/02/skilling-australian-industry-for-the-energy-transition-accenture-report-for-australian-industry-eti-phase-3.pdf) **2023** Australian Industry Energy Transitions Initiative [↑](#footnote-ref-18)
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24. [The Australian Electricity Workforce for the 2022 Integrated System Plan: Projections to 2050](https://aemo.com.au/en/energy-systems/major-publications/integrated-system-plan-isp/2022-integrated-system-plan-isp) 2022 Institute for Sustainable Futures. Does not consider the energy markets in Western Australia or the Northern Territory. [↑](#footnote-ref-25)
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32. [Clean energy agreement making on First Nations land: What do strong agreements contain?](https://caepr.cass.anu.edu.au/sites/default/files/docs/2021/11/Clean_Energy_Company_Guide.pdf) 2021 Centre for Aboriginal Economic Policy Research [↑](#footnote-ref-33)
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