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committee for economic development of australia

POWERING THE TRANSITION:

The **net-zero** workforce **challenge**

2023

About CEDA

CEDA is Australia's leading member-driven think tank. Our purpose is to achieve sustainable long-term prosperity for all Australians.

Our trusted independence, and a deep and broad membership base that extends across all sectors, states and territories, enables us to bring diverse perspectives and insights to guide and advance policy debate and development in the national interest.

We aim to influence future economic, social and environmental outcomes by:

Promoting public discussion of the challenges and opportunities facing Australia;

Enabling members to shape future outcomes through policy and their own actions;

Partnering and collaborating to tackle emerging opportunities and entrenched challenges; and

Advocating for policy change based on our independent research insights.

Our work is overseen by our independent Board of Directors and our research is guided and approved by an independent Research and Policy Committee whose members are leading economists, researchers and policy experts.

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Powering the transition: The net-zero workforce challenge (2023)

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Powering the transition: The net-zero workforce challenge continues CEDA's work on how to strengthen Australia's labour market at a time of chronic skill shortages and disruption across several key industries. This paper looks at opportunities in the energy sector in the transition to net-zero emissions by 2050.

This report focuses on how best to support workers and communities in traditional fossil-fuel industries. It outlines how Australia can get the best employment outcomes for displaced workers, as well as how to meet the current and future skills and training needs of the clean-energy sector.

Across all of its work, CEDA's purpose is to shape economic and social development for the greater good.

Powering the transition:

The net-zero workforce challenge

Governments should support workers and communities rather than subsidise businesses to get the best employment outcomes in the transition to net zero.

Between 2016 and 2021...

Employment in fossil-fuel electricity generation fell by **18%**

Employment in hydroelectric and other renewable generation increased by **81%**

Estimates suggest there will be a shortfall of 70,000 welders by 2030 due to the need to build new renewable-energy infrastructure.

The energy-efficiency and demand-management workforce will need to grow from just over 200,000 workers today to as many as 400,000 by 2030.

Australia's significant reserves of critical minerals needed to power the transition globally mean by 2040 we could generate as many as 100,000 jobs in this area.

More than half of all coal mining and oil and gas jobs in Australia are located in just eight of 107 regions of Australia.

NET-ZERO BY 2050

Regional opportunities in clean energy

Skilled migration

Long-term clean energy operations jobs

New opportunities around clean energy export hubs

Investment in clean energy export opportunities

Jobs in clean energy construction

Investment in clean energy

Retraining and personalised career advice

Other high-emissions jobs impacted

Loss of fossil fuel generation jobs

Concentrated job losses and lower wages in fossil-fuel regions

Mine and plant closures

Reduce high-emissions activities

Businesses

Communities

Workers

THE PATH TO NET-ZERO

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EXECUTIVE SUMMARY

43% by 2030

Australia's commitment to cut greenhouse gas emissions by 43 per cent from 2005 levels by 2030 and reach net-zero emissions by 2050 will require significant change to the way energy is generated and used

Australia's commitment to cut greenhouse-gas emissions by 43 per cent from 2005 levels by 2030 and reach net-zero emissions by 2050 will require significant change to the way energy is generated and used, and have wide-ranging implications for the skills and people needed in the labour market. There will be direct effects on those working in energy, but also for energy-using sectors such as buildings/construction, transport and agriculture.

Modelling suggests the energy transition will change the nature of jobs across a broad range of sectors, without having a big impact on the total number of jobs.

There will be opportunities for high quality work in renewables, electricity networks and energy performance across utilities, agriculture, mining and transport.

But those with low or medium skill levels in fossil-fuel industries will likely struggle to find jobs with similar wages, as a greater share of clean-energy roles require post-secondary education. Certain regions are also more exposed, as clean-energy jobs are likely to be more geographically dispersed than coal mining and power stations.

The level of disruption to workers in traditional energy jobs will be determined by how easily they can transfer their skills. This will vary considerably across roles. Our analysis finds that energy industries such as fossil-fuel generation and renewables require relatively similar skills on average, but it will be easier for high-skilled workers such as engineers to retrain than those in highly specialised roles such as power-plant operators.

Displaced employees with strong foundational skills (literacy, numeracy, communication and digital skills) will be best placed to retrain, ideally for jobs that use similar skills to their previous roles. Pervasive skill shortages in clean energy could delay the transition, making it doubly important to enable reskilling. Not all traditional energy employees will transition directly to clean-energy roles, however, as their skills will also be valued in other industries such as mining or construction.

Job mobility in Australia has declined over several decades and is low by international comparison. Removing barriers to changing jobs is thus critical. Governments must act immediately to remove regulatory barriers to developing new skills and training courses adapted to industry needs and the specific safety risks of new technologies. State-based occupational licensing needs to be updated, streamlined and nationally harmonised.

Immigration can help to fill skill shortages in clean energy and transfer expertise to local workers. Fast, simple pathways for highly skilled temporary workers should urgently be implemented. Governments must also improve the consistency of skills recognition. The separate processes to access a labour migration visa and satisfy occupational licensing are complex and burdensome.

Support for the most affected communities should prioritise assisting workers and communities rather than subsidies for businesses. Governments should avoid long-term income support, as this reduces incentives for diversification, and financial compensation for owners closing high-emissions facilities.

The Federal Government's May 2023 announcement that it will establish a new Net Zero Authority should help to smooth the transition for affected workers and communities. With clearly defined objectives and a more targeted function than initially proposed, the authority should complement and enable local initiatives by:

- Ensuring access to personalised support and career planning for all affected workers, concentrated on those with the greatest need;
- Coordinating across different levels of government, industry, unions and education and training providers to ensure new training meets demand;
- Investing in local initiatives to catalyse new job opportunities through economic diversification in the most severely affected communities; and
- Using data to evaluate and reprioritise transition policy.

Australia's low job mobility and mixed success during past structural adjustments, such as the end of car manufacturing, mean we must act now to enable as many people as possible to take advantage of new opportunities.

> *"Displaced employees with strong foundational skills (literacy, numeracy, communication and digital skills) will be best placed to retrain, ideally for jobs that use similar skills to their previous roles.*

RECOMMENDATIONS

1

SUPPORT FOR WORKERS AND COMMUNITIES

Governments should support workers and communities rather than businesses, and avoid policies that reduce incentives to move jobs and retrain, such as job guarantees.

2

NATIONALLY HARMONISE OCCUPATIONAL LICENCES

State and Federal governments must take immediate action to update, streamline and nationally harmonise relevant occupational licences to reduce barriers to labour mobility where this will not jeopardise safety. Licensing should enable modern training pathways in new technologies such as small-scale renewables and electric vehicles.

3

CLEAR OBJECTIVES FOR NET ZERO AUTHORITY

The new Net Zero Authority must have clear objectives to focus on the structural adjustment challenge in the most affected communities.

- Ensure all adversely affected workers receive personalised support and career planning;
- Coordinate across different levels of government, industry, unions and education and training providers to improve clarity around clean-energy skills and retraining pathways, and enable new courses to keep up with demand;
- Invest in locally-driven projects to create new jobs through economic diversification in the most severely affected communities; and
- Use data to evaluate and reprioritise transition policy.

4

REFORM TEMPORARY SKILLED MIGRATION

The Federal Government should proceed with risk-based reform of temporary skilled migration to enable fast, simple pathways for highly skilled clean energy workers, including via intra-company transfers.

5

COMMUNICATE THE TRANSITION CHALLENGE

Governments must do more to communicate the transition challenge through forward-looking policies to cut emissions, detailed jobs-market modelling and clearly outlining what the transition will look like in the most affected communities.

1. THE TRANSITION WILL CHANGE THE NATURE OF JOBS

The shift from fossil-fuel to clean-energy jobs has already begun.

Between 2016 and 2021, employment in fossil-fuel electricity generation fell by 1435 (18 per cent) to 6630, while employment in hydroelectric and other (renewable) generation increased by 1608 (81 per cent) to 3586, and employment in electricity transmission was up by 844 (32 per cent) to 3502.[1]

Broader measures provide higher estimates of the renewables workforce. The Australian Bureau of Statistics (ABS) estimates there were 26,850 jobs in renewables in 2018-19, an increase of 27 per cent from the previous year, with roof-top solar PV (excluded from the Census industry definition of 'other generation') accounting for nearly half of these jobs.[2]

Key clean energy jobs include solar and wind construction managers, site administrators, electrical and mechanical trades, machine operators and labourers (during the construction phase) and operations managers and electrical and mechanical trades/technicians (during the operations and maintenance phase).[3] A more detailed list of renewable occupations is available in Appendix A, based on US classifications.

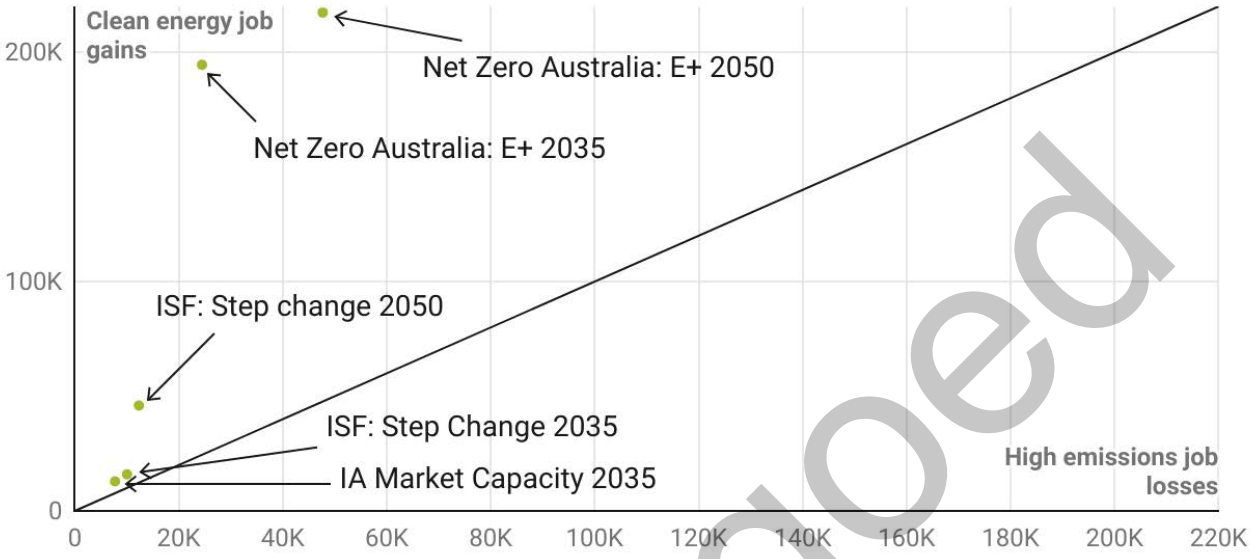
Estimates of the transition's employment effects vary significantly. Recent studies analysing the energy sector typically find that new clean-energy jobs created will outnumber the decline in traditional jobs, such as in fossil-fuel power generation (Figure 1).

Renewables construction is set to dominate new jobs over the next decade, with operations and management positions gradually increasing as the renewable generation fleet expands.[4] The importance of construction jobs could lead to large swings in employment, intense competition for skills with the infrastructure and housing sectors and boom-bust cycles if renewables construction does not proceed in a steady fashion.[5] Governments will need to take policy action to smooth these swings.

These estimates exclude new job opportunities in related sectors such as the critical minerals needed for products such as batteries, electric cars and solar panels to power the transition globally. Australia's significant reserves of these minerals mean we could generate as many as 100,000 jobs in this area by 2040.[6]

FIGURE 1

Energy sector modelling shows more job gains than losses



Each dot measures estimated clean energy job gains and job losses up to the stated year under the scenario noted. Dots to the left of the 45 degree line indicate more job gains in clean energy than job losses in old technologies.

Source: Net Zero Australia (2023) Final Modelling Results; Institute for Sustainable Futures (ISF) (2023) The Australian Energy Workforce for the 2022 ISP Revision 1; Infrastructure Australia (2021) Market Capacity for Electricity Generation and Transmission Projects. • Created with Datawrapper

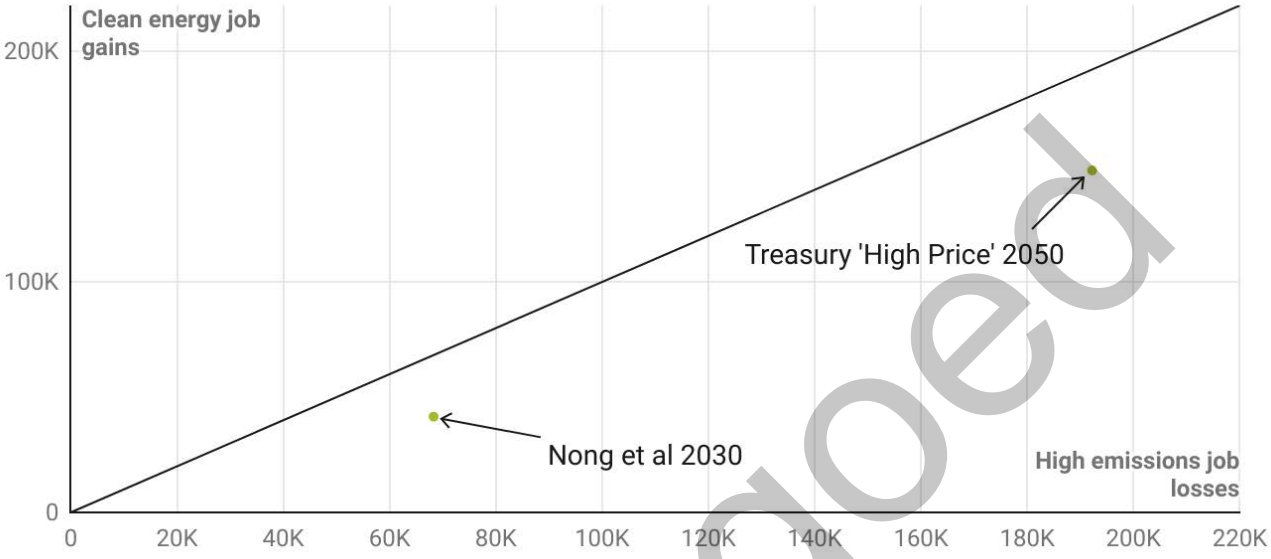
Broader economywide modelling provides a more balanced picture in terms of job gains and losses. While overall employment will continue to rise, there will be slightly more job losses in high-emissions industries than job gains in clean energy (Figure 2). A key advantage of this modelling approach is that it accounts for the limited overall pool of labour and the need to attract workers from other industries to take advantage of new opportunities in clean energy.

The challenge of accessing the required skills and workers is particularly relevant now given competing demands from the digital transformation, and infrastructure and defence projects, combined with shrinking labour supply due to the ageing population.

Given the lack of recent economywide modelling, work currently underway by Jobs and Skills Australia, by the Department of Climate Change, Energy, the Environment and Water on the Australia Energy Employment Report, and the development of climate-policy modelling capacity at Treasury is welcome. This work needs to clearly describe the scale of job transitions required to achieve net zero, including the occupations affected, the locations of these jobs, the characteristics of the people holding them and the extent of retraining needed.

FIGURE 2

Economywide models show slightly more job losses than gains



Each dot measures estimated clean energy job gains and job losses up to the stated year under the scenario noted. Dots to the right of the 45 degree line indicate more job losses in old technologies than gains in clean energy.

Source: Nong, D., Meng, S. and Siriwardana, M. (2017) An Assessment of a Proposed ETS in Australia by Using the MONASH-Green Model; Treasury (2011) Strong Growth, Low Pollution: Modelling a Carbon Price • Created with Datawrapper

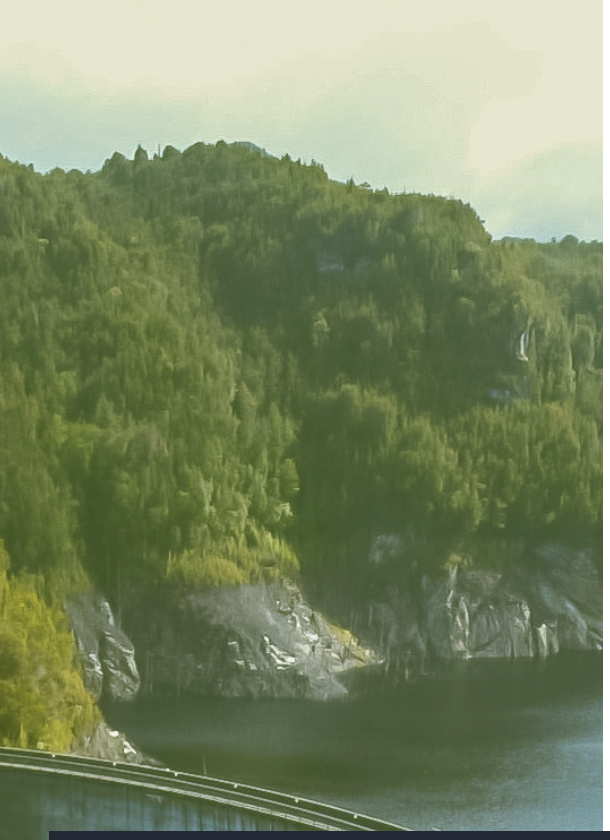
400k workers

The energy-efficiency and demand-management workforce will need to grow from just over 200,000 workers today to as many as 400,000 by 2030.

Aggregate employment will continue to grow and will change little due to the transition, but there will be big winners and losers across different industries.

There will be considerable job losses in high-emissions industries such as coal-fired power generation, coal mining (particularly brown-coal mining) and emissions-intensive manufacturing (such as chemical and metal-product manufacturing). Employment in gas supply, agriculture, construction and various modes of transport will also be affected, with differences across studies in the magnitude and direction of job changes.[7]

Demand will grow for labour and skills in clean-energy roles such as electricians and other trades such as welders. Estimates suggest there will be a shortfall of 70,000 welders by 2030 due to the need to build new renewable-energy infrastructure.[8] Mechanical and electrical engineers will also be in high demand, already forming a critical bottleneck for electricity network and hydroelectric development (Case study 1). And the energy-efficiency and demand-management workforce will need to grow from just over 200,000 workers today to as many as 400,000 by 2030.[9,10]



Not all employees in high-emissions industries will necessarily transition to clean energy roles. In past structural adjustments, employees have transitioned both to replacement and unrelated industries. The constant growth in Australian regional tourism, for example, has offered opportunities to former workers from manufacturing and primary industries. The skills available in fossil-fuel industries are also likely to be in demand by the mining, infrastructure and construction sectors.

Even with more and better modelling, there are inherent uncertainties around the employment outcomes of the transition due to uncertainty about the precise path to net zero, policy (particularly concerning key energy-using sectors such as transport and agriculture) and the rate of change in clean-energy technologies. This heightens the importance of resilient and dynamic labour markets that can adapt to change, and of support for those adversely affected.

CASE STUDY 1:

Australia needs new training approaches

As the energy system evolves, demand will increase for the engineers and technicians needed to expand and evolve the electricity network, to maintain existing hydroelectric generation and develop new renewable generation. Key employers such as Hydro Tasmania are already finding it challenging to fill roles given competition for key talent across the industry. Engineering skillsets used in distribution and transmission are increasingly hard to find, as are people with specific utilities and hydro experience.

How are organisations building skills?

A key participant in the WA electricity market is looking at ways to find transferable skills from outside the utilities sector. This approach has been promising for some roles such as project managers and contract managers, but is more difficult for the engineering skills that are in high demand. The organisation is also looking to grow internal capability and recruit outside WA, but this is also challenging as other jurisdictions and industries (such as mining) pursue similar transitions.

Hydro Tasmania is looking to increasingly undertake job-specific training in-house. Its in-house power and water consulting firm Entura trains domestic and international clients via the Entura Clean Energy and Water Institute.

What more could be done?

The education system has failed to keep up with the skills that are in high demand in the power sector, on both the number of graduates and the limited number of programs specifically targeted to the sector. Australia must broaden the supply of skills by growing the number of electrical engineers, streamlining the migration system and increasing the share of female engineers, which has stagnated.

2. INCOMES WILL FALL FOR SOME WORKERS

While the net labour-market effects of the transition may be small, creating opportunities as well as challenges, we cannot ignore the impacts on the most affected workers. Job loss due to environmental regulation can entail other social costs, such as the stigma experienced by displaced workers, long-term earnings losses, or the need for workers to relocate.[11] In the United States, while there were net societal benefits from the 1990 Clean Air Act, workers in affected sectors lost 20 per cent of their pre-regulatory earnings, with most of the losses falling upon displaced workers.[12]

The potential for income losses for displaced workers is heightened by the relatively high wages earned in affected industries in Australia. CEDA's analysis shows that in several key fossil-fuel sectors and relatively high-emissions manufacturing sectors, hourly wages are significantly higher than the average across the whole economy, after adjusting for the education and other characteristics of the workforce (Figure 3).

Despite not having characteristics such as education levels that support higher wages, coal-mining employees earn 25 per cent more than the average for all Australian employees. Similarly, wages are high in fossil-fuel electricity generation, with key roles such as power plant operators paying very high wages (Case study 2). Higher wages can compensate for safety risks,[13] though the rate of severe workplace injury in the mining and electricity, gas and water industries is around or just below the economywide average.[14] Other characteristics of these jobs, such as their location and the intensity of work, may also contribute to high wages.

Our analysis of wages is based on key industry groups particularly likely to be affected by the transition, rather than a complete analysis of all impacted occupations. In its Clean Energy Workforce Discussion paper,[15] Jobs and Skills Australia has noted there is no single definition of the clean-energy workforce and proposed a definition of clean-energy workers and "green-impacted" jobs that it will develop further for its final report.

Our analysis of wages is based on key industry groups particularly likely to be affected by the transition, rather than a complete analysis of all impacted occupations.

CASE STUDY 2:
How plant closures affect workers

The Hazelwood power station in Victoria's Latrobe Valley closed in March 2017 with just five months' notice. Many employees were unsure what they would do next, especially given high local unemployment.[16] Two years after the closure, less than half of the 850 workers who had participated in the local Worker Transfer Scheme established in response to the closure were in full-time work. More than 20 per cent were unemployed.[17] While overall unemployment in the Latrobe Valley declined considerably (and more than for Victoria as a whole) from mid-2018, there are concerns that "high-wage, high-skilled" power industry jobs continue to be replaced with lower wage positions.[18]

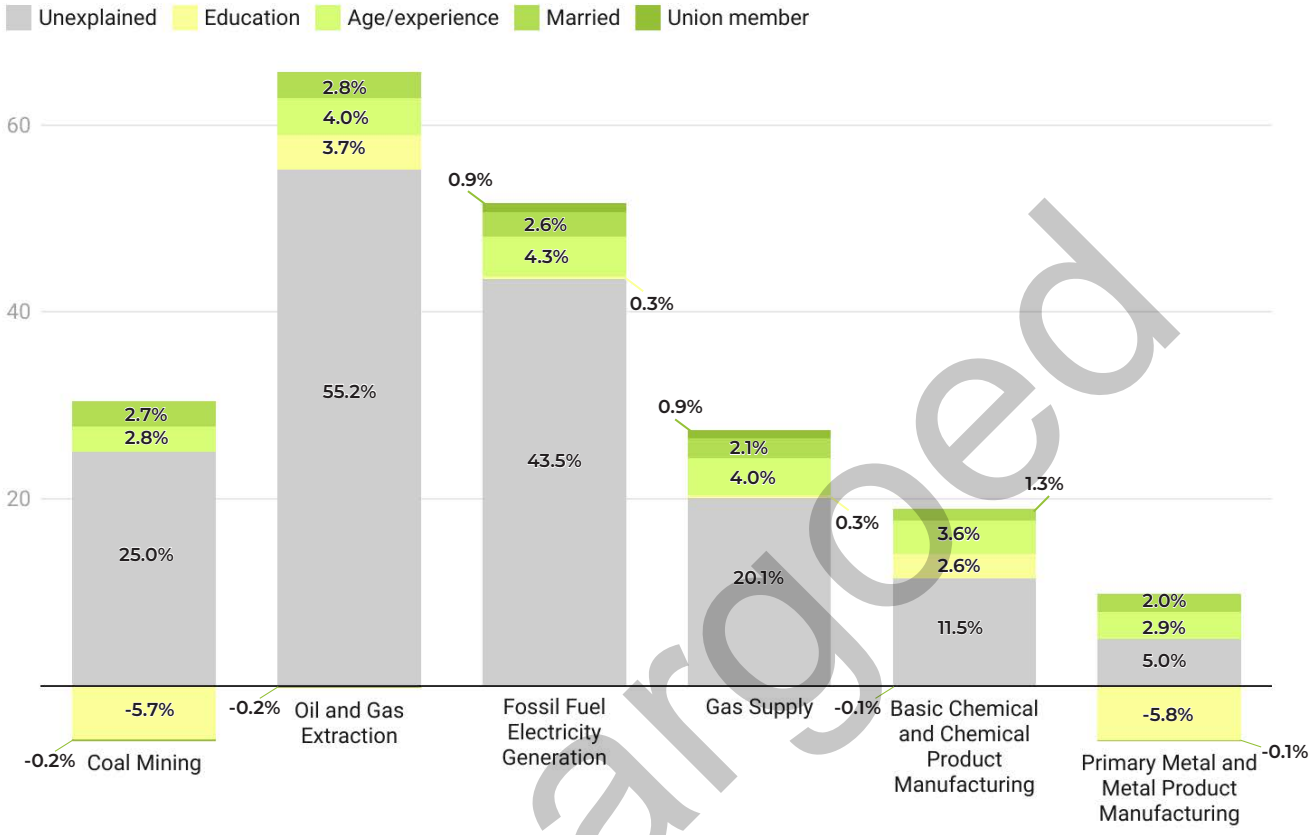
Chris Barfoot worked as an engineer and industrial chemist in brown-coal mining and power generation for 33 years before being made redundant with the Hazelwood closure. He found another job eight months later and now works as a Community Project Officer with the Gippsland Climate Change Network. This is a good application of his project management skills and did not require retraining. Though his income is substantially lower than at the power station, a redundancy payout proportional to his years of service smoothed the transition. Chris says for those around him, there was "considerable shock and little time to adjust" to the closure. Younger workers supporting families faced a tougher transition as they received less redundancy pay (none at all for maintenance contractors) and limited prospect of similarly high wages in a region with little major industry outside coal and paper. There was a lack of assistance with active career or retirement planning immediately after the closure was announced, though more resources were available once the Latrobe Valley Authority was established in late 2016. Chris says the extended multi-year notice period now required for National Electricity Market generator closures is a game changer, as it gives employees time to adjust, plan, retrain or to organise superannuation for retirement.

Glenn Richardson worked as an assistant unit controller at Hazelwood. In early 2017 he began 18 months of training (supported by a grant from his employer), which enabled him to open his own massage therapy business in August 2018. While he received career advice it was not necessarily personalised, and he made his own decision to leave the power sector. Like others at the plant, he had expected a more gradual closure with more time to transition. He had trouble accessing financial support when setting up his business: as a sole trader he was ineligible for funding from the Latrobe Valley Authority, but nor was he able to access support from an employment service provider because of when he signed up. Glenn says his new job provides less security than he had been used to: "As an employee you have regular leave, sick leave etc. Now If I don't work, I don't earn any money...working for yourself you rely on your own craftsmanship to retain clients." He has also taken a big hit in terms of wages, but after a long tenure at the power station he received a good redundancy package that enabled him to clear debts, and his wife was able to move from part-time to full-time work. He never considered moving out of the region, but notes there is a lack of replacement industry (despite repeated promises), and most local jobs are lower skilled positions.

FIGURE 3

High-emissions sectors pay high wages

Per cent deviation in hourly wages from economywide average



Source: ABS 2021 Census data and wage equation coefficients from Forbes et al (2010) and Waddoups (2005) • Created with Datawrapper

Coal-mining employees earn

25%

more than the average for all Australian employees, despite not having characteristics such as education levels that support higher wages

There will also be opportunities to earn high incomes in growing clean-energy industries, although educational qualifications and requirements in these industries are higher on average (Figure 4). International analysis consistently finds a higher average level of education among people working in clean-energy occupations.[19,20] This supports skill-biased technical change, whereby the demand for high-skilled workers increases at the onset of a new wave of technological change.[21] The critical importance of innovation and research and development for a successful energy transition[22] means that highly skilled employees are set to remain in high demand even as jobs around more mature technologies are codified and taken on by less qualified staff.

After controlling for higher skills and other personal characteristics, green-intensive occupations in the US and EU have an average earnings premium of almost seven per cent compared with pollution-intensive occupations.[23] This is consistent with Treasury analysis finding a five per cent wage premium for green jobs in Australia.[24] Around three-quarters of employees in clean-electricity industry groups are male, underlining the importance of policy measures to break

down gender occupational segregation[25] to provide access to skills that will enable the energy transition.

The loss of high-paying fossil fuel jobs will have concentrated effects in some regions. Renewable energy jobs are distributed more widely across regional areas than the coal sector, in which jobs are concentrated in a handful of regions.[26] More than half of all coal mining and oil and gas jobs in Australia are located in just eight of 107 Statistical Area Level 4 regions.[27] Regions with relatively high shares of employment in coal mining and coal-fired power generation are likely to be most affected, such as those listed in Table 1. Effects on these local economies will be amplified by the reliance of many other jobs on demand from the coal sector or its staff. In the Latrobe Valley, for example, for every coal job lost there are estimated to be an additional 1.2 jobs lost.[28] CEDA will consider the regional effects of the energy transition in more detail in a subsequent paper.

TABLE 1

Key coal mining and generation regions

Region	Population (2021)	Share of employment in coal mining or fossil fuel generation (2021)	Unemployment rate (2022)	Notes
Latrobe Valley, VIC	77,168	3%	5.4%	Unemployment peaked at 11.3% in December 2016, shortly after Hazelwood power plant closure announced
Hunter Valley (excl. Newcastle), NSW	291,946	9%	3.6%	Large share of coal produced for export
Central Queensland	228,246	8%	3.4%	Large share of metallurgical coal for export, also some coal-fired generation
Mackay – Isaac – Whitsunday QLD	180,894	15%	2.2%	Predominantly metallurgical coal for export
Collie, WA	8812	15%	7.9%	Activity concentrated in a relatively small region

Note: Unemployment rates are annual averages for 2022, when the national average rate was 3.7%.

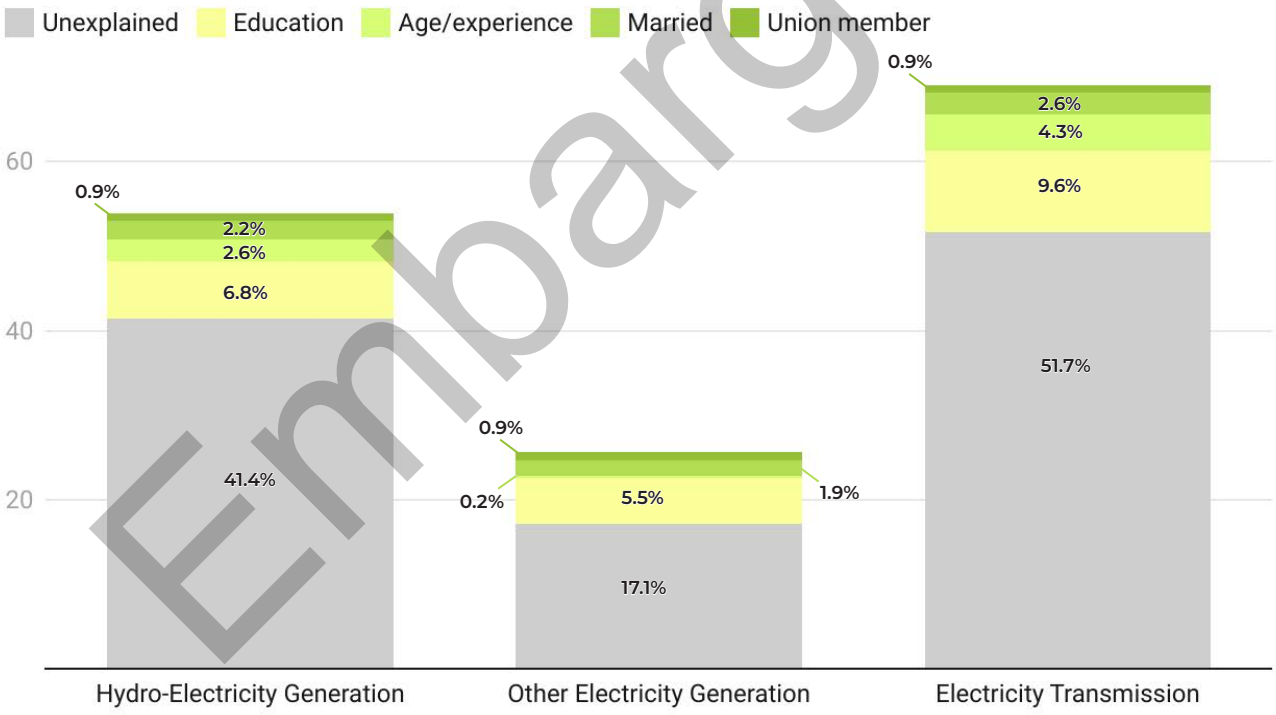
Sources: ABS 2021 Census; ABS Labour Force, Australia, Detailed; Jobs and Skills Australia Small Area Labour Markets data.

> *The critical importance of innovation and research and development for a successful energy transition means that highly skilled employees are set to remain in high demand even as jobs around more mature technologies are codified and taken on by less qualified staff.*

FIGURE 4

Wages are also high in key clean energy sectors

Per cent deviation in hourly wages from economywide average



Source: ABS 2021 Census data and wage equation coefficients from Forbes et al (2010) and Waddoups (2005) • Created with Datawrapper

3. SKILL TRANSFERS WILL HELP PEOPLE SHIFT JOBS

The ability to transfer skills will be critical as clean-energy jobs grow and emissions-intensive jobs decline, as the costs of finding a new job depend on the similarity of skills between occupations.[29] Overall, crossover in the skills required in fossil-fuel and renewable industries will help to smooth the transition for affected workers.

Key skills required in clean energy or green roles can be grouped into four categories: engineering and technical, operation management, monitoring and science.[30] Our analysis shows that on average, people in fossil-fuel occupations have similarly high skills in these categories to those in renewables (Figure 5). Further, fossil-fuel and renewables workers have higher average skill levels in these four categories than the average in these categories across all occupations.

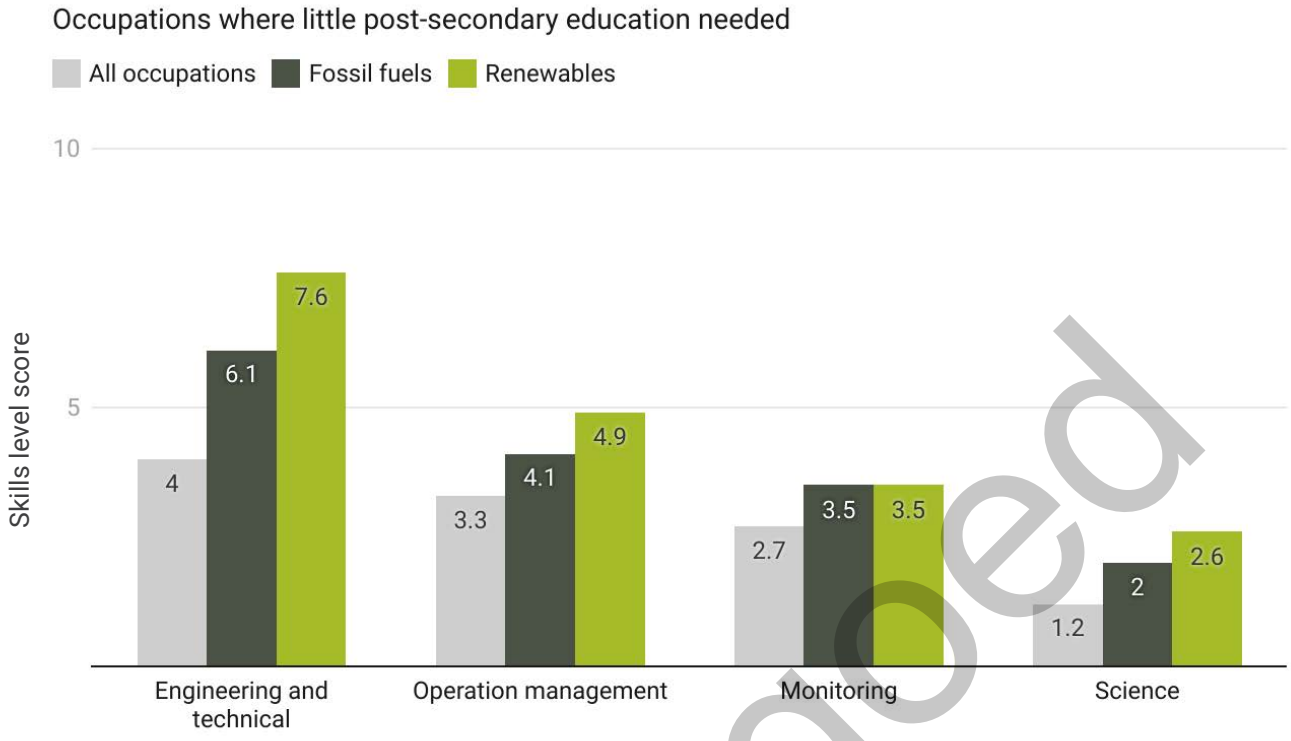
This analysis is based on detailed skills mapping by the US Department of Labour, selecting fossil fuel and renewables occupations that are currently relevant in Australia (for example, we have excluded occupations associated with nuclear generation. See Appendix A for details). It is consistent with analysis indicating that 80 per cent of the skills required in the short-to-medium term to transition to net zero are already in use today.[31]

The extent of retraining required will vary substantially. Some people in highly specialised roles, such as coal power plant operators, will need considerable retraining to transfer their skills to clean energy (Case study 3). Many electrical roles that will be in high demand during the transition require considerable job-specific learning. For example, training a Certificate 3 transmission lineworker usually takes four years, with much longer periods of on-the-job training to ensure safety, as it is a high-risk activity.[32] Upskilling riggers requires one to three years depending on experience.[33] More analysis is needed to better understand the extent of retraining that will be required across a broader range of occupations.

> *Overall, crossover in the skills required in fossil-fuel and renewable industries will help to smooth the transition for affected workers.*

Fossil fuel and renewable occupations require similar skills

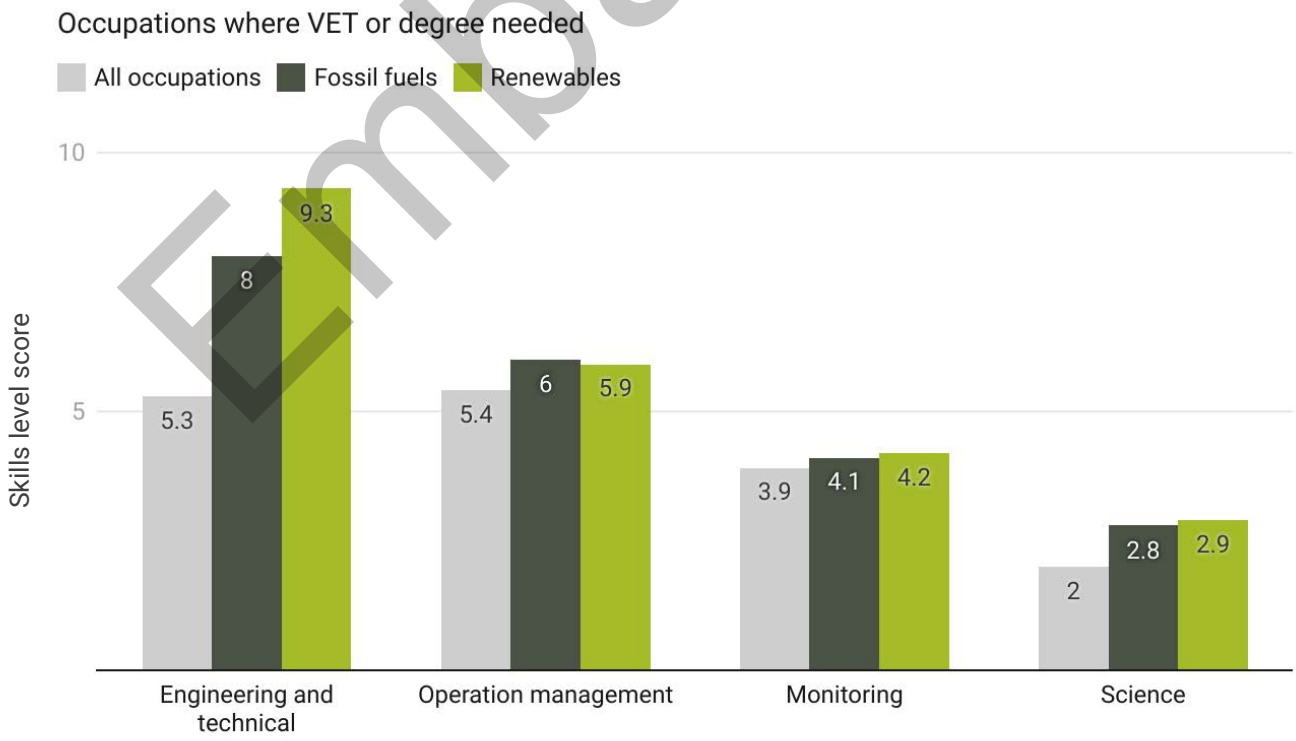
FIGURE 5A



*Skills, knowledge and work activities from O*Net data collapsed into aggregate score of skills particularly relevant for green occupations using Principal Components Analysis published in Vona et al (2018). Fossil fuel and renewables occupations listed in Appendix A.*

Source: US Department of Labor O*Net data; Vona et al. (2018) • Created with Datawrapper

FIGURE 5B



*Skills, knowledge and work activities from O*Net data collapsed into aggregate score of skills particularly relevant for green occupations using Principal Components Analysis published in Vona et al. (2018). Fossil fuel and renewables occupations listed in Appendix A.*

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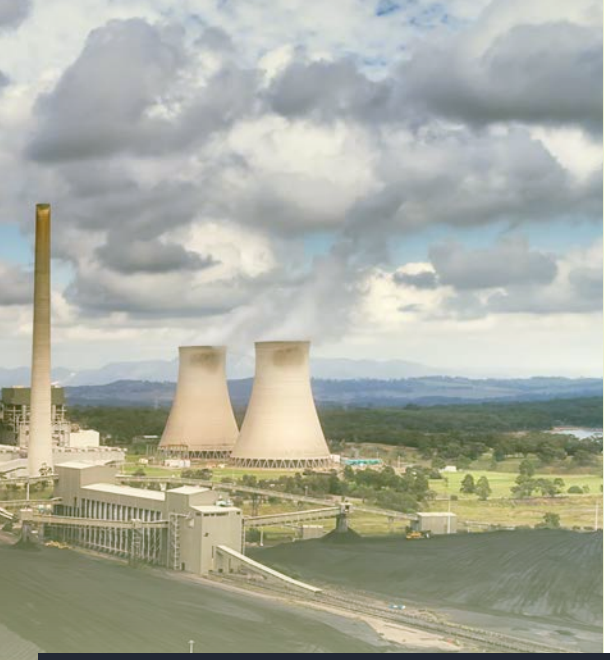

There is no direct renewable energy match for the core coal-mining workforce of semi-skilled machine operators, so displaced coal-mining workers will likely face particular challenges with upskilling and finding similar quality work.[34] The number of people employed as "Drillers, Miners and Shot Firers" is likely to fall dramatically.[35] Other occupations with similar skill needs, such as in mining of critical minerals, may provide greater opportunities. Offshore wind development zones are often located close to fossil fuel activity (such as in Gippsland). Internationally, offshore wind has created opportunities for people to transfer skills such as civil and electrical engineering, health and safety and specialist offshore knowledge.

CASE STUDY 3

Planning for power-station closures at AGL

AGL owns and operates several large fossil-fuel power stations that will close over the next dozen years. This includes power stations in the Hunter Valley (Liddell, which closed in April 2023, and Bayswater, scheduled to close between 2030 and 2033), the Latrobe Valley (Loy Yang A, to close in 2035) and Torrens Island 'B' Power Station near Adelaide (to close in 2026). These closures will directly affect AGL's workforce, but will also require structural adjustment in affected regions, particularly the Hunter and Latrobe Valleys, where there is a concentration of these jobs.

Forward planning at Liddell

Closure of the Liddell power station was announced more than seven years in advance, enabling detailed planning and discussion with affected staff. AGL developed a 'Future U' hub for personalised discussions. Over the past two years, affected staff have developed a transition plan for reskilling, upskilling or financial planning. Continued operation of the nearby Bayswater plant helped to ease the transition: of 160 staff working at Liddell, around 100 have transferred to similar roles at Bayswater and 40 have chosen to take voluntary redundancies or early retirement. For the next two years a staff of around 100 (many of whom will be contractors) will oversee the decommissioning, demolition and rehabilitation process. The plant's connection point will be used for a grid-scale battery expected to create around 250 construction jobs.

AGL is using Liddell's closure as a blueprint for future closures. Many opportunities were identified for the affected workforce, with this work primarily done independently by AGL. There is potentially scope for benefits from more collaboration with TAFEs and other vocational education providers in future.

Regional transitions must be managed proactively

Several related workforces will be affected by the closures in the Hunter and Latrobe Valleys. Maintenance contractors, who have been in high demand amid outages at ageing generators, will need to find alternative work. Mining operations that serve power stations will wind down, particularly for brown-coal mines not used for exports. Local businesses such as hotels and restaurants will be adversely affected by the closures, as the plants paid high salaries and brought a sizeable contractor workforce during outages. AGL has begun planning "open day" forums with local industrial partners, renewable-energy companies and state and local governments, examining opportunities for affected regions.

The scope and scale of the workforce transition in the most affected regions warrants a framework for collaboration between federal, state and local governments, industry and education providers. Many people do not want to leave these regions; the location has been a strong attraction for many AGL employees and helped with staff retention. With renewable power jobs set to be more dispersed, new industrial opportunities will be needed and the new jobs created will potentially not be as highly paid as those in fossil-fuel power plants. Skills and capabilities of the local workforce should be mapped to ensure they are used or built upon for new opportunities, rather than lost.

The greater share of clean-energy roles with higher educational requirements will provide opportunities for highly skilled professionals. For example, engineers are in demand (Case study 1) and there will be opportunities for electricians, mechanical and electrical engineers to upskill in clean-energy roles with relatively little additional training.

Uncertainty around energy policy over the past 15 years has contributed to a shortage of power system skills, underlining the importance of forward-looking policy and clear communication of job opportunities. There is a real risk that skill shortages may delay Australia's energy transition and undermine security of supply, making it doubly important to enable workers in traditional energy industries to reskill.

More generally, people with strong foundational skills will be best placed to retrain, as adult learners need literacy, numeracy, communication and technology skills to be able to retain learning and apply it. This is true whether the skills are built through vocational education or at university (Case study 4).

Vocational education has a particularly important role to play, partly because those with lower skills will face the most difficult transition, and partly because its close links to work can help to deliver curricula that match market needs during the net-zero transition.[36] The training system will need to be flexible enough to provide foundational skill sets (via qualifications) as well as incremental skills (via mechanisms such as short courses).[37]

80%

of the skills required in the short-to-medium term to transition to net zero are already in use today

CASE STUDY 4:

More cooperation needed to meet skills demand

The evolution of skills needed in electrical and other trades has occurred so quickly that training packages are often not keeping up with industry demand. Even for core vocations such as electricians, there are insufficient apprenticeships underway now, raising the risk of worsening shortages in several years' time.

New courses are being developed, but there are barriers to uptake

TAFE Queensland has developed a number of new programs in renewables, sustainability and other emerging industries. It has run battery electric programs in apprentice and post-trade programs since 2014, and has now developed resources for the two newest electric-vehicle qualifications, AUR32721 Certificate III in Electric Vehicle Technology and AURSS00064 Battery Electric Vehicle Inspect and Service Skillset. However, many emerging programs are only pilots, with few students and limited funding. In other cases, industry remains more likely to select apprentices graduating from established courses such as electrical technology, than in new courses such as sustainable energy. Light and heavy vehicle qualifications for electric vehicles will be necessary, but there are regulatory constraints on the pathways to develop electrical competencies.

Cooperation of industry is essential to developing new courses, both to access industry information and intellectual property, and to support take-up of new courses.

Smaller offerings can upskill the existing workforce

More needs to be done to enable upskilling in a targeted manner. The existing vocational training system has been built largely around full qualifications, with a development time of three to five years. The current rate of change, particularly in energy, is too fast for such an approach. People who are upskilling need more discrete courses to top-up foundational learning. Funding for advanced apprenticeships or diplomas is also important, to develop applied skills for people who already have a degree.

SkillsIQ, as a national advocate for training to support industry needs, highlights the big opportunity for vocational education to enable people to upskill rather than start again during the energy transition. This requires strong foundational skills, as developed during an apprenticeship or degree. The purpose of building foundational skills needs to be explained and when this occurs through the vocational education system, it should be done in an applied manner. It will be necessary to engage individually with those who need to reskill, to map out their competencies and foundational skills, what is transferable and what new skills they need. This must occur on-the-ground in the communities most affected by the transition.

TAFE Queensland notes that there may be opportunities to better manage transitions such as fossil-fuel generator closures by engaging early with local TAFEs to develop reskilling packages that avoid redundancies. The Queensland Future Skills Partnership between BHP Mitsubishi Alliance, TAFE Queensland and CQUniversity – designed to fast-track the delivery of automated technology pathways and skill sets in open-cut mining operations in Queensland – is a good example of early engagement to develop new skills as technology changes.

Nationally consistent solutions

TAFE Queensland now benefits from economies of scale when rolling out new courses since the merger of its 13 constituent bodies. Given the energy transition will be taking place across Australia, there is scope for similar gains through national development of new courses. Different state licensing arrangements can be a barrier to this, highlighting the potential benefits of harmonisation.

4. POLICY MUST SUPPORT THE WORKFORCE TRANSITION

The energy transition is a profound structural adjustment that will affect the Australian workforce over the next three decades. It will have important interactions with other shifts, notably digital transformation and ageing of the population. For this to occur as smoothly as possible, we must apply the lessons of past adjustments, enable a dynamic labour market so people can seize new opportunities, offer individual planning to negatively affected workers, and improve coordination between governments, industry, unions and education providers.

Learning from past adjustments

The effects of the energy transition will be felt broadly and go beyond the energy sector to industries such as transport, manufacturing and agriculture. The nature of the changes will be different from previous structural adjustments due to the global nature of the shift to net zero (increasing the risk of skill and supply-chain shortages, while expanding the opportunities of supplying raw materials), the scale of economic impacts, the central role of governments in driving emissions reduction and the regions affected. Nonetheless, there are important lessons from previous adjustments in Australia and abroad.

Australia

Work for the Rural Industries Research and Development Corporation,[38] building on frameworks from the Productivity Commission[39] and Professor John Freebairn,[40] reviewed 35 examples of rural and regional adjustment experiences. Examples include environmental water reallocation, regional (mostly agricultural) industries in transition, live cattle and sheep export, and expansion of the coal seam gas industry. Less than a quarter were found to have generally positive outcomes. Key findings included:

- Intervention that seeks to avoid change is both inefficient and inequitable as it increases public and private costs and can mask available alternatives. Continuous adjustment in small steps has proven more beneficial than delaying adjustment until a major crisis occurs;
- Early warning and a good understanding of the adjustment underway can greatly increase the quality of any government response;
- If there is sufficient economic diversity and opportunity in a region, as well as adaptive capacity, negative impacts may be largely mitigated;

- Any specific assistance should focus on the needs of communities and assist them in adjusting to new conditions rather than supporting the status quo;
- Equitable solutions promote flexibility, mobility and adaptive capacity in communities and regions so they can take advantage of new opportunities;
- Government may have a strong rationale (or even responsibility) for intervening to support those most affected where government policy is causing the adjustment pressure. Outcomes have generally been more positive when government policy initiatives have driven change, though success has sometimes come at high public cost; and
- Monitoring and evaluation of structural adjustment outcomes has been insufficient. There should be specific budget allocations for monitoring, evaluation and review.

Another recent example is the mining boom. Australia's resources workforce more than trebled between 2002 and 2012, adding 180,000 new jobs.[41] New workers were drawn predominantly from industries with similar and thus transferable skills, notably manufacturing and construction, enabled by the concurrent loss of jobs in manufacturing and drawn in by faster-than-average wages growth in a sector that already paid high wages.[42]

An important factor was the willingness of mining workers to move geographically, with an increase in interstate migration to Queensland and Western Australia coupled with an increase in fly-in fly-out work. The mining industry also relied heavily on temporary skilled migration. Barriers to further labour mobility during the mining boom included the lack of affordable housing close to jobs (exacerbated by inefficient land-use processes and stamp duties), the design of employment services, income and housing support measures and barriers to moving interstate due to different occupational licensing requirements.[43]

Finally, the closure of Australia's remaining car-making facilities between 2014 and 2017 saw around 45,000 workers lose their jobs. Roughly one-third of workers maintained their careers, one-third dropped back to less skilled jobs and one-third did not return to the labour force.[44]

$30bn

of transitional assistance to car makers between 1997 and 2012 slowed but ultimately did not prevent job losses

There were some successful examples of skills transfer: some former Ford workers transitioned to apprenticeships in the construction industry,[45] some Holden employees successfully transitioned to medical technology manufacturing, while cyber-security company VeroGuard Systems employed a number of ex-automotive workers in management and manufacturing roles.[46]

But many opportunities were missed: 40 per cent of those who found new work indicated that it was worse than their previous job.[47] Automotive shutdowns affected these people's lives and had concentrated effects among communities where automotive plants were located. A broader lesson was that decades of transitional assistance to car makers, estimated at $30 billion between 1997 and 2012, slowed but ultimately did not prevent job losses.[48]

United States

A well-studied example of structural adjustment internationally is the China trade shock in the United States. This refers to the impact of rising Chinese imports after it joined the World Trade Organisation in 2001. While increased trade lowered prices, provided opportunities for exporters and supported technological advancement,[49] local labour markets that relied heavily on manufacturing suffered from reduced wages[50] and as many as 2 million job losses.[51] (Local effects on manufacturing employment were also experienced in Australia, translating into up to 80,000 jobs lost,[52] but a key difference here was the strong growth in mining exports to China over the same period.[53]) Beyond the social security system, little was done to protect US workers from mass layoffs, with Trade Adjustment Assistance too small to have mattered in aggregate for workers who lost their jobs.[54]

In the US, regionally concentrated losses of employment and declines in wages have been linked to substantial social disruption, including increases in poverty, single parenthood, drug and alcohol mortality and political support for nationalist-populist political leaders.[55] Important aspects are the concentration of earnings losses among lower skill/wage workers, who were less able to find comparable quality work outside the manufacturing sector, and the stunningly slow adjustment of local labour markets, with low participation and elevated unemployment rates for a decade or more.[56]

As these examples show, we must consider whether support should go beyond the generally available safety net. Workers displaced due to structural adjustment have access to the same safety net as others looking for work through unemployment benefits (JobSeeker), employment assistance (Workforce Australia) and subsidised health and education services. Selective measures have been controversial, raising questions as to why special assistance should be available to a minority of areas and causes of structural change, the risk of encouraging costly rent-seeking and holding out against inevitable change.[57]

In the case of the energy transition, however, the central role of government policy in driving change and the negative effects on specific regions and workers are arguments for support beyond the safety net. Governments must ensure this support enables affected workers and communities to advance the transition, rather than work against change. For example, long-term income support should be avoided as it lowers incentives to change by making participants less responsive to price signals (such as higher incomes available in expanding sectors) and pressures for diversification.[58]

A dynamic and resilient labour market to enable new opportunities

A gradual, phased and well-planned transition will reduce costs and minimise labour-market disruption. As noted above, policy must enable rather than impede the transition, particularly given the US evidence of how slow local labour markets can be to adjust.

With bipartisan agreement on the net-zero emissions target for 2050, any further delay will require more sudden and disruptive change to meet Australia's abatement goals. But with proper planning, earlier and more ambitious emissions reduction and industrial shifts can improve employment outcomes and skill pathways.[59]

Enabling the transition also requires a well-functioning jobs market where people can easily seize new opportunities. Yet CEDA's submission to the federal Employment White Paper shows job mobility has been declining and is low by international comparison. Policy reforms are needed to increase access to mid-career training, make long-service leave portable, increase Jobseeker payments, scale up training for hard-to-place jobseekers, reduce occupational gender segregation, standardise occupational licensing nationally and reduce housing-affordability barriers to labour mobility.[60] Such reforms would contribute to a more dynamic labour market that can more readily adapt to adjustments such as the energy transition.

Recent CEDA research also underlines the importance of dynamic management capabilities within businesses. Firms with stronger dynamic capabilities are more resilient, productive and profitable, enabling them to support more innovative cultures and transform themselves in times of change.[61] This will be particularly important in sectors most affected by the energy transition.

A more dynamic labour market would enable more people to take advantage of opportunities offered by the transition. This should be pursued through securing workers' employability and income rather than their jobs.[62] The record number of new apprenticeships being offered in 2024 by Energy Queensland is a good example of how the transition can contribute to more skilling and jobs, with a plan to ramp up from 460 to almost 1000 apprentices by 2030 by growing its intake by 10 per cent every year. Conversely, depending on how they are structured, job guarantees can work against the transition by reducing the incentive to explore new job opportunities and develop new skills.

Immigration can be an important source of skills

Almost one third of Australia's clean-energy workforce was born outside Australia,[63] with a strong reliance on skills acquired internationally as renewable production ramps up. As during the mining boom, foreign labour and skills will likely be needed to enable further expansion of the clean-energy sector, particularly for technologies such as offshore wind that are new to Australia but have been developed extensively elsewhere.

Migration can assist the Australian economy in adapting to structural change from the transition by meeting short-term skills shortages and transferring knowledge to the Australian workforce.[64] Competition for talent is likely to be intense, as countries around the world undergo their own energy transitions, increasing the importance of immediate action to complement the training of local workers.

An efficient and effective immigration system will be essential to help Australia to attract clean-energy skills in high demand. A first step is to improve consistency in recognition of skills in occupations such as electricians. Currently, migrants can satisfy a skills assessment to receive an occupation-specific visa but still fail to meet licensing requirements.[65] The whole process of electrical trade recognition and licensing can cost more than $9000 and take up to 18 months. The Federal Government's 2023 migration review panel concluded that complex and burdensome skills recognition processes prevent migrants from realising their full potential, and may deter them from coming to Australia.[66]

Proposed reforms to the temporary-migration system should be implemented to enable fast, simple pathways for the specialised highly-skilled workers needed to build the jobs of the future.[67] An updated, risk-based system needs to enable intra-company transfers of highly skilled staff,[68] as international mobility is high within multinational renewable-energy companies.[69]

Almost

one third

of Australia's clean-energy workforce was born outside Australia, with a strong reliance on skills acquired internationally as renewable production ramps up.

Occupational licensing can slow the adjustment

Occupational licensing is important to protect consumer safety, but overly-restrictive licensing can impede workers seeking to adjust to the net zero transition.[70] Where licensing goes beyond what is needed to protect safety, it pushes up wages for those in licensed professions while reducing competition, labour reallocation and productivity, generally without evidence of significant quality improvements for consumers.[71]

There must be an immediate and coordinated effort by federal and state governments to update licensing – and regulation more generally – to enable nationally accredited skillsets that are proportionate and properly calibrated to the safety risks of new technologies. The costs of not recognising relevant skills or requiring unrelated skills are particularly high at a time of such significant transition and skill shortages.

Simply expanding coverage of existing licensing regimes risks exacerbating skill shortages and pushing up costs by creating shortages of licensed trades, notably electricians. For example, the Queensland Government held consultations in June 2023 on recommendations that only licensed electrical workers should be able to carry out electrical work on the electrical components of electric vehicles, and that licenced electrical workers should be required to supervise locating, mounting and fixing of solar PV modules that are designed to be interconnected.[72,73] While there are legitimate safety concerns around high-voltage systems, such changes would be a tightening of licensing relative to other states and diverge from regulatory settings that enabled Australia's rapid rollout of solar rooftop generation.

Blanket regulations requiring licensed electricians to service construction and mining mobile-plant equipment are already creating inefficiencies in operations and acting as a barrier to training tailored to the safety risks of new technologies (Case study 5). A better approach would be to provide training pathways targeted at the different services required in the safe installation and service of new technologies, such as the hybrid and electric-vehicle training (including high-voltage safety) offered by TAFE Queensland (Case study 4).

For example, updates to vocational training in small-scale renewables by the Australian Industry Skills Committee made in late 2022 should ease strong demand for electricians by creating formal training for technicians – in this case renewable installers and designers – to expand their skills and safety knowledge.[74]

Differences in occupational licensing across states for electricians and other trades also create a further barrier to geographical job mobility.[75] We must harmonise safety and licensing requirements across states to remove barriers to people moving for better job opportunities. As described above, there must be greater consistency in the recognition of skills for migration and licensing purposes.

CASE STUDY 5

New technologies require new skills

The skills required in key energy-using industries such as transport, construction and mining mobile-plant equipment will change as electrification becomes widespread. For example, the role of a mechanic will evolve as electric vehicle use grows. Tasks such as changing oil will become less common, while electrical and technology skills will become more important to service these vehicles.

How is this affecting firms?

Hastings Deering is at the forefront of these changes, as a firm that supplies and services mining and construction equipment. As part of Sime Darby Berhad, it is targeting a 30 per cent reduction in scope 1 and 2 emissions by 2030. It has begun transitioning towards battery-electric mobile-plant equipment, through selling and servicing diesel/electric hybrid machines.

How does regulation need to adapt?

Current regulations reduce opportunities to develop an appropriate workforce. Hastings Deering has a large workforce of qualified mobile-plant technicians trained to work on diesel-powered machines. Across the industry, they face licensing limitations that can prevent upskilling to work on electrified mobile plant. For example, servicing electrified mobile equipment currently requires the applied skills of mobile-plant technicians as well as licensed electricians. A licensed electrician requires a four-year apprenticeship to become qualified, with the learning focused on some skills unrelated to mobile plant, such as rewiring houses.

Firms such as Hastings Deering consequently need people with dual apprenticeships as mobile-plant technicians and electricians – a rare combination requiring eight years of training – or to deploy electricians in extremely limited and inefficient ways. As electric equipment and transport become more common, there would be benefits from reviewing regulations to support safety through aligning training to the specific risks of mobile-plant applications, rather than requiring unrelated electrical expertise.

Hybrid and battery-electric machines typically have safe-design features that limit technicians' exposure to electrical risks, for example, multiple redundant methods of identifying when voltage exceeds safe levels. They also have safe methods of isolation of energy to prevent electric shocks. In other parts of the world, these tasks are designed to be carried out by upskilling and training a mobile-plant technician workforce to follow strict servicing and safety procedures, on an inherently safe design.

Australia's car industry faced similar workforce challenges and regulations with the introduction of hybrid and battery-electric vehicles. The industry currently has an exemption based on safe-vehicle design and completion of nationally accredited skillsets confirming workforce capability.

How does education need to adapt?

The education system must provide mobile-plant technicians with the skills and knowledge to safely work with electrified mobile plant. These workers will increasingly require a broader range of skills, notably in mechanical, electrical and technology streams. Foundational Science, Technology, Engineering and Mathematics (STEM) skills will also become more important. There is a need to embed STEM skills in an applied manner within vocational education providers and schools. Collaboration between education providers, industry, unions, regulators and government is necessary to develop programs focused on workforce sustainability and attainment of new skills through education packages that reflect technological change.

Better coordination is needed

Coordination across different levels of government, industry, unions and education and training providers will be essential to enable the transition to proceed as smoothly as possible, given the scope and scale of the workforce transition in the most affected regions (Case study 3), the lack of clarity around clean-energy workforce skills and retraining pathways (Case study 6) and the failure of vocational courses to keep up with demand for new skills (Case study 4). Greater cooperation between industry and local training institutions could improve the responsiveness of training offerings, reducing the need for organisations to develop their own in-house training (Case study 1).

CASE STUDY 6

Retraining and redeploying workers at Eraring Power Station

Coal-fired power generators have larger and more geographically concentrated workforces than the renewable generators that will replace them. Australia's biggest coal-fired power plant, Origin Energy's Eraring Power Station, is scheduled to close in August 2025. The 2880MW plant supplies around a quarter of NSW's power needs. It employs around 230 employees and 200 contractors on a full-time-equivalent basis. They will be largely displaced from their current roles when the plant closes.

What options are being offered to workers and the community?

Plans have been developed for all potentially impacted people employed at Eraring by Origin through individual consultation, formal advice and consultation with unions. Origin has also held career-information sessions and provided access to financial advice, along with health and well-being support. Some workers will take redundancy payments as a contribution to their retirement. Others are being retrained and redeployed within Origin. Some are retraining in fields as diverse as teaching or aviation, with Origin contributing to the cost of training.

There is very little renewable-focussed trade training in Australia at this stage. A clear pathway is required for existing trades to reskill via post-trade vocational qualifications. It is not clear who will be able to deliver this training and when. Better leadership and co-ordination across all levels of government is required to help communities and workers navigate the transition.

There are plans to build a 700MW battery on the site, capitalising on existing transmission and other infrastructure. This project will employ around 200 construction workers. Many roles will be required for site repurposing, including operation of the Eraring battery and site rehabilitation, both of which will be informed by a site master plan.

Origin says it will honour existing community commitments and has also established a $5 million community investment fund, which will support initiatives until 2032. Proximity to the larger centres of Newcastle and Sydney should support local resilience through access to a diverse range of alternative jobs, but there will likely be fewer well-paid jobs available locally.

Internationally, the experiences of the coal-mining regions of Wales and Germany's Ruhr Valley are instructive examples. The transition in the Ruhr Valley was more successful as it featured: better coordination between national and local policy; provision of training and short-term placements to avoid unemployment; and help for workers to find alternative work in fields that required similar skills.[76] Successful examples of structural adjustment in Germany, Singapore and the Netherlands have seen government take a strong role in planning for transition, coordination, skills development (with a central role for education providers) and infrastructure investment.[77]

Achieving coordination across a range of stakeholders with different objectives has proved challenging in the past. While rooftop solar in Australia provides a good example of an industry scaling up to meet demand, skill shortages had been identified as a significant risk to the clean-energy transition. Despite this, it took until 2022 for the first comprehensive training upgrades in the sector in more than 10 years to occur. This included changes to increase access to formal training, provide pathways for non-electricians to design small-scale systems and improve sustainability in the industry.[78]

Individual planning is essential

Experience with plant closures in Australia underlines the need for personalised consultation and advice for affected workers. Individual plans must identify competencies and foundational skills, motivation, financial situation, willingness to move geographically, transferable skills and skills gaps (Case study 7). Notification well in advance of recent (Case study 3) and forthcoming (Case study 6) coal power-station closures allowed operators to consult individually with workers and develop training plans, though there is potentially scope for more collaboration with TAFEs and other vocational education providers in developing retraining plans. Historical examples show the futility of pushing people into occupations that are not in demand locally, or into unrelated sectors that may be growing but do not use or build upon their existing skills.

CASE STUDY 7:

The importance of personalised planning

As a provider of talent solutions that helps organisations negotiate workforce adjustments, Lee Hecht Harrison (LHH) has seen the importance of personalised planning before plant closures. LHH worked with a major car manufacturer when it closed its Victorian operations, and with a major mining company developing comprehensive support programs when it ceased operations at various sites, with more than 800 employees impacted.

Individual plans need to identify the strengths, weaknesses, motivation and transferable skills of affected workers. For those seeking new work, plans must link to an available job outcome, considering the individual's capabilities and willingness to move. Where people have strong local links, there must be extensive research in the region to match employees and their skills to local employment opportunities. Workers need to be given as much certainty as possible about closure timing and what it will mean for them – uncertainty can create low morale, distrust and put at risk safe and stable operations until closure.

The Net Zero Authority can play an important role

In May 2023 the Federal Government announced it would establish a new Net Zero Authority to ensure the workers, industries and communities that have traditionally powered Australia can seize the opportunities of the net-zero transformation. It is proposed that the new authority will fulfil three primary roles:

- Support workers in emissions-intensive sectors to access new employment, skills and support as the transformation continues;
- Coordinate programs and policies across government to support regions and communities to attract and take advantage of new clean-energy industries and set those industries up for success; and
- Help investors and companies to engage with net-zero transformation opportunities.

Establishing the Net Zero Authority is a crucial move to provide greater planning and coordination of the transition at a national level, while still allowing implementation to be driven locally. Regarding its first role, the authority should have a clear objective to smooth the transition for adversely affected workers. This will help to evaluate outcomes and ensure the most effective programs are carried forward.

As illustrated by the case studies and international examples in this report, planning and coordination is critical and has been lacking to date. The detailed design for the authority should build on these international lessons as well as local transition authorities such as the Latrobe Valley Authority, Hunter Expert Panel and Collie Delivery Unit.[79]

In its second role, the authority should complement rather than replace local initiatives, as local actors will have a far better understanding of local strengths and opportunities. For example, the WA Government's Collie Transition Package has taken a proactive approach to planning for coal power-station retirements between now and 2029. The package contains $4.4 million to enable coordination via the Collie Delivery Unit, more than $20 million to expand workforce-transition services and training, $300 million for power-station decommissioning and $200 million for an Industrial Transition Fund.

Effective coordination will be important to avoid the fragmentation, duplication and proliferation of ad hoc responses seen in previous Australian regional-development programs.[80] The OECD has highlighted the importance of high-level coordinating mechanisms, clear mandates, adequate resourcing, as well as governance arrangements and working methods that support effective communication across different bodies.[81] Structuring the authority as an independent body under the Federal Department of Climate Change, Energy the Environment and Water would enable this coordinating role to be combined with subject matter expertise and removed from the politics of the day.

The authority's third role – to help investors and companies with transformation opportunities – should be dropped or reformulated. It is too broad for an institution that should focus on smoothing the transition for those adversely affected. The equity argument to help workers and regions does not extend to companies, and many of the opportunities will be in regions that are not facing substantial adjustment challenges (conversely, some new opportunities in adversely affected regions will be outside the energy sector).

Historically, some of the least effective forms of government financial assistance have been those that indiscriminately subsidise business investment or prioritise financial compensation for owners closing high-emissions facilities over the direct interests of their workers and communities.[82]

There is already a large number of policy approaches that help investors and companies to reduce emissions, including renewable energy targets, public funding of abatement projects and tax concessions for clean investments.[83] There may be a role for governments to plan and coordinate the massive rollout of clean-energy technologies required to achieve net zero, but this should be handled by a separate body with expertise in energy network and infrastructure planning. To be successful, the Net Zero Authority needs to have tightly a defined role and accountability.

Based on the analysis and case studies in this report, the Net Zero Authority should play the following roles:

- Develop a framework that ensures that all affected workers receive **personalised support and career planning** based on robust data on local job opportunities, whether they work directly in high-emissions industries, as a contractor, or for a related business in a different sector such as hospitality, in the most adversely affected regions. Career advice should look first to use and build upon the skills of displaced workers rather than pushing people into jobs that are not in demand locally or into growing sectors where their skills are not well-used. Support should be proportionate, so that it is concentrated toward those in greatest need.
- **Coordination between governments, industry, unions and education and training providers** to provide clarity around clean-energy workforce skills and retraining pathways and enable new courses to keep up with demand for new skills. Predicting skill needs is difficult and new occupations can be difficult to conceptualise where they rely on new technologies.[84] Nonetheless, the direction of change is clear, as are many of the key technologies.
- **Investment in local initiatives to catalyse new job opportunities** through economic diversification in the most severely affected communities, for example via investment in infrastructure and education that can help to develop new industry clusters building on local strengths. One-size-fits-all approaches have failed in

> *"Historically, some of the least effective forms of government financial assistance have been those that indiscriminately subsidise business investment or prioritise financial compensation for owners closing high-emissions facilities over the direct interests of their workers and communities.*

the past and should be avoided.[85] Each region will face different challenges and opportunities that should be uncovered through broad consultation. Place-based projects should be locally driven, but federal funding can help to avoid poor socioeconomic outcomes that could undermine the transition and increase the burden on the Federal Budget.

One potential opportunity is through rehabilitating and re-using mining and industrial sites, including for batteries, pumped hydro, bioenergy or manufacturing projects that can use existing network assets. Another is microfinance initiatives to overcome credit constraints for young businesses. Previous regional job-creation programs have been evaluated infrequently, but evidence suggests they have had little success in creating local jobs.[86]

- **Using data to evaluate transition policy,** so that the most successful approaches can be scaled up and unsuccessful approaches discontinued. A lack of data has hindered previous evidence-based policymaking with respect to regional development around power-station closures.[87] There may be benefits from partnering with agencies such as the Australian Bureau of Statistics to use timely data that can inform regional transitions, such as highly disaggregated and longitudinal data on labour-market transitions.

Next steps

More work is needed to better understand the regional and labour-market effects of the energy transition and inform proactive policy. Jobs and Skills Australia's Clean Energy Capacity Study should clearly describe the scale of the job transitions required to achieve net zero, including the occupations affected, the locations of these jobs and the characteristics of the people holding them.

There must also be more analysis to understand the extent of retraining that will be required, with regular updating as technology and the training system evolves.

CEDA is planning further work focusing on the regional aspects of the transition. An important element here is the extent to which measures such as place-based initiatives can successfully smooth the transition in the most affected communities. Good evaluation frameworks and ongoing monitoring will be critical to ensure that government initiatives achieve their objectives.

APPENDIX A: RENEWABLE ENERGY AND FOSSIL FUEL OCCUPATIONS

To analyse the transferability of skills between renewable energy and fossil fuels in Figures 5a and 5b, we identified key occupations from the US Department of Labor's O*Net data. We selected occupations currently relevant to Australia (for example, we excluded nuclear-energy roles).

Renewables	Fossil fuels	Electrical
Biofuels Production Managers	Power Plant Operators	Electrical Engineers
Biomass Power Plant Managers	Stationary Engineers and Boiler Operators	Electronics Engineers, Except Computer
Hydroelectric Production Managers	Energy Engineers, Except Wind and Solar	Electrical and Electronics Drafters
Biofuels/Biodiesel Technology and Product Development Managers	Petroleum Engineers	Electrical and Electronic Engineering Technologists and Technicians
Geothermal Production Managers	Derrick Operators, Oil and Gas	Electro-Mechanical and Mechatronics Technologists and Technicians
Wind Energy Development Managers	Rotary Drill Operators, Oil and Gas	Electricians
Wind Energy Engineers	Service Unit Operators, Oil and Gas	Helpers--Electricians
Solar Energy Systems Engineers	Roustabouts, Oil and Gas	Electric Motor, Power Tool, and Related Repairers
Solar Sales Representatives and Assessors	Helpers--Extraction Workers	Electrical and Electronics Installers and Repairers, Transportation Equipment
Solar Energy Installation Managers	Gas Plant Operators	Electrical and Electronics Repairers, Commercial and Industrial Equipment
Solar Thermal Installers and Technicians	Petroleum Pump System Operators, Refinery Operators, and Gaugers	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay
Solar Photovoltaic Installers	Gas Compressor and Gas Pumping Station Operators	Electronic Equipment Installers and Repairers, Motor Vehicles
Geothermal Technicians	Pump Operators, Except Wellhead Pumpers	Electrical Power-Line Installers and Repairers
Biomass Plant Technicians	Wellhead Pumpers	Electrical and Electronic Equipment Assemblers
Hydroelectric Plant Technicians	Mining and Geological Engineers, Including Mining Safety Engineers	Electromechanical Equipment Assemblers
Biofuels Processing Technicians		Power Distributors and Dispatchers
Wind Energy Operations Managers		Power Plant Operators
Wind Turbine Service Technicians		Stationary Engineers and Boiler Operators

References

1 ABS, "TableBuilder: Census Datasets" (Canberra, 2023).

2 Australian Bureau of Statistics, "Employment in Renewable Energy Activities, Australia" (Canberra, 2020), https://www.abs.gov.au/statistics/labour/employment-and-unemployment/employment-renewable-energy-activities-australia/latest-release.

3 UTS Institute for Sustainable Futures, "Renewable Energy Employment in Australia: Methodology," Prepared for the Clean Energy Council, 2020

4 J Rutovitz et al., "The Australian Electricity Workforce for the 2022 Integrated System Plan: Projections to 2050," RACE for 2030 Industry Report (UTS Institute for Sustainable Futures, 2023); Julian McCoy et al., "Employment Impacts – Modelling Methodology & Preliminary Results" (Net Zero Australia, 2022).

5 Rutovitz et al., "The Australian Electricity Workforce for the 2022 Integrated System Plan: Projections to 2050," RACE for 2030 Industry Report (UTS Institute for Sustainable Futures, 2023)

6 Accenture, "Sunshot in 2023: Accelerating towards Australia's Renewable Exports Opportunity," Commission by ACF, ACTU, BCA and WWF, 2023, https://www.actu.org.au/media/1450275/sunshot-in-2023-final-report.pdf.

7 Treasury, "Strong Growth, Low Pollution: Modelling a Carbon Price" (Canberra, 2011); Duy Nong, Sam Meng, and Mahinda Siriwardana, "An Assessment of a Proposed ETS in Australia by Using the MONASH-Green Model," *Energy Policy* 108 (September 2017): 281–91, https://doi.org/10.1016/j.enpol.2017.06.004; Australian Government, "Australia's Long-Term Emissions Reduction Plan: Modelling and Analysis" (Canberra, 2022).

8 Weld Australia, "2023 Member Survey: Results Analysis," 2023, https://weldaustralia.com.au/wp-content/uploads/2023/04/Weld-Australia-2023-Member-Survey-Results-FINAL.pdf.

9 Rutovitz et al., "The Australian Electricity Workforce for the 2022 Integrated System Plan: Projections to 2050," RACE for 2030 Industry Report (UTS Institute for Sustainable Futures, 2023)

10 Green Energy Markets, "Energy Efficiency Employment in Australia," Report commissioned by the Energy Efficiency Council and Energy Savings Industry Association, 2019, https://www.eec.org.au/uploads/Projects/Energy%20Efficiency%20Employment%20in%20Australia%20-%20full%20report.pdf.

11 Francesco Vona et al., "Environmental Regulation and Green Skills: An Empirical Exploration," *Journal of the Association of Environmental and Resource Economists* 5, no. 4 (October 2018): 713–53, https://doi.org/10.1086/698859.

12 W. Reed Walker, "The Transitional Costs of Sectoral Reallocation: Evidence From the Clean Air Act and the Workforce*," *The Quarterly Journal of Economics* 128, no. 4 (November 1, 2013): 1787–1835, https://doi.org/10.1093/qje/qjt022.

13 Zac Reynolds, Daehoon Nahm, and Craig MacMillan, "Compensating Wage Differentials for Job Fatality and Injury Risk in Australia*," *Economic Record* 98, no. 321 (2022): 152–65, https://doi.org/10.1111/1475-4932.12660.

14 Safe Work Australia, "Australian Workers' Compensation Statistics 2020-21" (Canberra, 2022), https://www.safeworkaustralia.gov.au/doc/australian-workers-compensation-statistics-2020-2021.

15 Jobs and Skills Australia, "Australia's Clean Energy Workforce: Discussion Paper" (Canberra, 2023), https://www.jobsandskills.gov.au/sites/default/files/2023-04/Clean%20Energy%20Capacity%20Study%20-%20Discussion%20Paper.pdf.

16 9NEWS, "Hazelwood Power Station: Hundreds of Workers Left without Jobs as Owner Confirms Plant Will Close next Year," *National News*, n.d., https://www.9news.com.au/national/hazlewood-power-station-shut-down-hours-away/c5a6bfc5-ac7a-45c4-a1f2-25771adfa02f.

17 John Wiseman et al., "After the Hazelwood Coal Fired Power Station Closure: Latrobe Valley Regional Transition Policies and Outcomes 2017-2020" (Crawford School of Public Policy: Centre for Climate and Energy Policy, 2020), https://ccep.crawford.anu.edu.au/sites/default/files/publication/ccep_crawford_anu_edu_au/2020-11/ccep20-10_wiseman_workman_fastenrath_jotzo_after_hazelwood.pdf.

18 ibid

19 Molly Broome et al., "Net Zero Jobs" (The Resolution Foundation, 2022).

20 IMF, "A Greener Labor Market: Employment, Policies, and Economic Transformation," in *World Economic Outlook April 2022* (Washington DC, 2022), https://www.imf.org/en/Publications/WEO/Issues/2022/04/19/world-economic-outlook-april-2022#Chapters.

21 Francesco Vona et al., "Environmental Regulation and Green Skills: An Empirical Exploration," *Journal of the Association of Environmental and Resource Economists* 5, no. 4 (October 2018): 713–53, https://doi.org/10.1086/698859.

22 International Energy Agency, "Technology Innovation to Accelerate Energy Transitions," Final Report for G20 Energy Transitions Working Group, 2019, https://iea.blob.core.windows.net/assets/c578edac-2b69-4a5b-b8a9-0d007a9a8106/Technology_Innovation_to_Accelerate_Energy_Transitions.pdf.

23 IMF, "A Greener Labor Market: Employment, Policies, and Economic Transformation," World Economic Outlook, April 2022

24 Australian Government, "Budget Paper No. 1: Budget Strategy and Outlook," Budget 2023-24 (Canberra, 2023), https://budget.gov.au/content/bp1/index.htm.

25 Sebastian Tofts-Len and Andrew Barker, "Occupational Gender Segregation," CEDA Submission to Employment White Paper (Perth, 2023), https://cedakenticomedia.blob.core.windows.net/cedamediacontainer/kentico/media/attachments/occupational-gender-segregation-ceda_1.pdf.

26 C Briggs et al., "Renewable Energy Jobs in Australia - Stage 1" (Prepared for the Clean Energy Council by the Institute for Sustainable Futures, University of Technology Sydney, 2020), https://www.uts.edu.au/sites/default/files/2020-06/Renewable-Jobs-Australia-ISF%20F.pdf.

27 ABS, "2021 Census," 2022.

28 Committee for Gippsland, "Our Region Our Future: Securing an Economic Future for Gippsland and Latrobe Valley," 2016.

29 Francesco Vona et al., "Environmental Regulation and Green Skills: An Empirical Exploration," *Journal of the Association of Environmental and Resource Economists* 5, no. 4 (October 2018): 713–53, https://doi.org/10.1086/698859.

30 Ibid

31 Deloitte, "Work toward Net Zero: The Rise of the Green Collar Workforce in a Just Transition," 2022, https://www2.deloitte.com/content/dam/Deloitte/fr/Documents/sustainability-services/Deloitte_Work_toward_net_zero_Nov22.pdf.

32 Infrastructure Australia, "Market Capacity for Electricity Generation and Transmission Projects," A report from Infrastructure Australia's Market Capacity Program (Infrastructure Australia and University of Technology Sydney, 2021).

33 Ibid

34 C Briggs et al., "Renewable Energy Jobs in Australia - Stage 1" (Prepared for the Clean Energy Council by the Institute for Sustainable Futures, University of Technology Sydney, 2020), https://www.uts.edu.au/sites/default/files/2020-06/Renewable-Jobs-Australia-ISF%20F.pdf.

35 Deloitte Access Economics, "People Powering the Future: Skilling Queenslanders for the Clean Transformation" (Brisbane, 2021), https://www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-economics-people-powering-the-future-140622.pdf.

36 OECD, *Net Zero+: Climate and Economic Resilience in a Changing World* (OECD, 2023), https://doi.org/10.1787/da477dda-en.

37 Deloitte Access Economics, "People Powering the Future: Skilling Queenslanders for the Clean Transformation" (Brisbane, 2021).

38 Aither, "Structural Adjustment in Regional Australia," National Rural Issues (Rural Industries Research and Development Corporation, 2015), https://aither.com.au/wp-content/uploads/2019/04/15-110-NRI-Structural-Adjustment_online.pdf.

39 Productivity Commission, "Structural Adjustment: Key Policy Issues," Commission Research Paper (Canberra, 2001).

40 John Freebairn, "Structural Changes in Regional Economies," *Australian Economic Review* 44, no. 2 (June 2011): 189–95, https://doi.org/10.1111/j.1467-8462.2011.00634.x.

41 Productivity Commission, "Looking Back on Structural Change in Australia: 2002-2012," Supplement to Annual Report 2011-12 (Canberra, 2013), https://www.pc.gov.au/about/governance/annual-reports/2011-12/supplement/annual-report-2011-12-supplement.pdf.

42 Ibid

43 Productivity Commission, *Geographic Labour Mobility*, Research Report (Canberra, 2014), https://www.pc.gov.au/inquiries/completed/labour-mobility/report/labour-mobility.pdf.

44 Jacob Irving et al., "Plant Closures in Australia's Automotive Industry: Continuity and Change," *Regional Studies, Regional Science* 9, no. 1 (December 31, 2022): 5–22, https://doi.org/10.1080/21681376.2021.2016071.

45 "Toyota and Holden Factories to Close, End of the Line for Autoworkers," *ABC News*, October 2, 2017, https://www.abc.net.au/news/2017-10-02/toyota-and-holden-factories-to-shut-down/9008312.

46 Andrew Spence, "Car Workers Find New Start in Cyber Security Manufacturing," The Lead South Australia, February 27, 2018, https://theleadsouthaustralia.com.au/industries/manufacturing/car-workers-find-new-start-cyber-security-manufacturing/.

47 Jacob Irving et al., "Plant Closures in Australia's Automotive Industry: Continuity and Change," *Regional Studies, Regional Science* 9, no. 1 (December 31, 2022): 5–22, https://doi.org/10.1080/21681376.2021.2016071.

48 Productivity Commission, *Australia's Automotive Manufacturing Industry* (Canberra: Inquiry Report No. 80, 2014), https://www.pc.gov.au/inquiries/completed/automotive/report/automotive.pdf.

49 Nicholas Bloom, Mirko Draca, and John Van Reenen, "Trade Induced Technical Change? The Impact of Chinese Imports on Innovation, IT and Productivity," *The Review of Economic Studies* 83, no. 1 (January 1, 2016): 87–117, https://doi.org/10.1093/restud/rdv039.

50 David H. Autor, David Dorn, and Gordon H. Hanson, "The China Syndrome: Local Labor Market Effects of Import Competition in the United States," *American Economic Review* 103, no. 6 (October 2013): 2121–68, https://doi.org/10.1257/aer.103.6.2121.

51 Daron Acemoglu et al., "Import Competition and the Great US Employment Sag of the 2000s," *Journal of Labor Economics* 34, no. S1 (January 2016): S141–98, https://doi.org/10.1086/682384.

52 Aaron Blanco et al., "The Impact of Growth in Manufactured Imports from China on Employment in Australia *," *Economic Record* 97, no. 317 (June 2021): 243–66, https://doi.org/10.1111/1475-4932.12604.

53 Michael Coelli, James Maccarrone, and Jeff Borland, "The Dragon Down Under: The Regional Labour Market Impact of Growth in Chinese Imports to Australia," *Regional Studies*, March 15, 2023, 1–16, https://doi.org/10.1080/00343404.2023.2176477.

54 David Autor, David Dorn, and Gordon H. Hanson, "On the Persistence of the China Shock" (Brookings Papers on Economic Activity, 2021), https://www.brookings.edu/wp-content/uploads/2021/09/15985-BPEA-BPEA-FA21_WEB_Autor-et-al-Online-Appendix.pdf.

55 Ibid

56 David Autor, David Dorn, and Gordon H. Hanson, "The China Shock: Learning from Labour Market Adjustment to Large Changes in Trade" (NBER Working Paper 21906, 2016), https://www.nber.org/system/files/working_papers/w21906/w21906.pdf.

57 John Freebairn, "Structural Changes in Regional Economies," *Australian Economic Review* 44, no. 2 (June 2011): 189–95, https://doi.org/10.1111/j.1467-8462.2011.00634.x.

58 D Harris, "Sharing Experiences of Structural Adjustment Policies in the Agricultural Sector: Seminar Report" (APEC Agricultural Technical Cooperation Working Group, 2008).

59 Deloitte Access Economics, "People Powering the Future: Skilling Queenslanders for the Clean Transformation" (Brisbane, 2021).

60 Andrew Barker and Sebastian Tofts-Len, "Employment White Paper Submission," 2023, https://www.ceda.com.au/ResearchAndPolicies/Research/Workforce-Skills/Employment-white-paper-submission.

61 Melissa Wilson, R Agarwal, and C Bajada, "Dynamic Capabilities: How Australian Firms Can Survive and Thrive in Uncertain Times" (CEDA and UTS Sydney, 2023).

62 OECD, *Net Zero+: Climate and Economic Resilience in a Changing World* (OECD, 2023), https://doi.org/10.1787/da477dda-en.

63 Clean Energy Council, "International Talent," 2022, https://www.cleanenergycouncil.org.au/advocacy-initiatives/workforce-development/careers-guide/international-talent.

64 Martin Parkinson, Joanna Howe, and John Azarias, "Review of the Migration System 2023," FInal Report, 2023, https://www.homeaffairs.gov.au/reports-and-pubs/files/review-migration-system-final-report.pdf.

65 Productivity Commission, "5-Year Productivity Inquiry: A More Productive Labour Market," Inquiry Report (Melbourne, 2023).

66 Parkinson, Howe, and Azarias, "Review of the Migration System 2023."

67 Department of Home Affairs, "A Migration System for a More Prosperous and Secure Australia: Outline of the Government's Migration Strategy" (Australian Government, 2023), https://immi.homeaffairs.gov.au/programs-subsite/files/migration-strategy-outline.pdf.

68 Jarrod Ball, "Australia's Future Migration System," CEDA Submission to Federal Government Migration Policy Review (Melbourne, 2022), https://cedakenticomedia.blob.core.windows.net/cedamediacontainer/kentico/media/attachments/australia-s-future-migration-system.pdf.

69 Clean Energy Council, "International Talent," 2022, https://www.cleanenergycouncil.org.au/advocacy-initiatives/workforce-development/careers-guide/international-talent.

70 OECD, *Net Zero+: Climate and Economic Resilience in a Changing World* (OECD, 2023), https://doi.org/10.1787/da477dda-en.

71 Andrew Barker, "Skills Recognition," CEDA Submission to Employment White Paper (Brisbane, 2022), https://cedakenticomedia.blob.core.windows.net/cedamediacontainer/kentico/media/attachments/ceda-skills-recognition.pdf.

72 Electrical Safety Office, "A Response to the Review of Queensland's Electrical Safety Act 2002 – Key Definitions and Emerging Technologies," Discussion Paper (Brisbane, 2023), https://www.oir.qld.gov.au/sites/default/files/2023/documents/es-act-review-discussion-paper.pdf.

73 R.L. Williams, "Review of Queensland's Electrical Safety Act 2002," Review requested by the Minister for Industrial Relations (Brisbane, 2022), https://www.oir.qld.gov.au/system/files/2023-05/ea-act-2002-review-final-report.pdf.

74 Clean Energy Council, "Clean Energy Council Review Drives the First Comprehensive Update to Vocational Training in Rooftop Solar & Storage for More than 10 Years," 2022, https://www.cleanenergycouncil.org.au/news/vocational-training-renewables-update.

75 Andrew Barker, "Skills Recognition," CEDA Submission to Employment White Paper (Brisbane, 2022), https://cedakenticomedia.blob.core.windows.net/cedamediacontainer/kentico/media/attachments/ceda-skills-recognition.pdf.

76 Molly Broome et al., "Net Zero Jobs" (The Resolution Foundation, 2022).

77 Peter Sheldon, Raja Junankar, and Anthony De Rosa Pontello, "The Ruhr or Appalachia: Deciding the Future of Australia's Coal Power Workers and Communities," UNSW Industrial Relations Research Centre for CFMEU Mining and Energy, 2018.

78 Clean Energy Council, "Clean Energy Council Review Drives the First Comprehensive Update to Vocational Training in Rooftop Solar & Storage for More than 10 Years," 2022, https://www.cleanenergycouncil.org.au/news/vocational-training-renewables-update.

79 Amanda Cahill, "Transforming Queensland: The Case for a New Transition Authority," Report on Consultation Results (Brisbane: The Next Economy, 2022).

80 Productivity Commission, "Transitioning Regional Economies," Study Report (Melbourne, 2017).

81 OECD, "OECD Knowledge Platform on Policy Coherence for Sustainable Development: Policy Coordination," 2019, https://www.oecd.org/governance/pcsd/toolkit/guidance/policycoordination/.

82 Peter Sheldon, Raja Junankar, and Anthony De Rosa Pontello, "The Ruhr or Appalachia: Deciding the Future of Australia's Coal Power Workers and Communities," UNSW Industrial Relations Research Centre for CFMEU Mining and Energy, 2018.

83 Productivity Commission, "5-Year Productivity Inquiry: Managing the Climate Transition," Inquiry Report, Inquiry Report No. 100 (Canberra, 2023).

84 Productivity Commission, "5-Year Productivity Inquiry: From Learning to Growth," Inquiry Report - volume 8 (Melbourne, 2023).

85 John Wiseman et al., "After the Hazelwood Coal Fired Power Station Closure: Latrobe Valley Regional Transition Policies and Outcomes 2017-2020" (Crawford School of Public Policy: Centre for Climate and Energy Policy, 2020), https://ccep.crawford.anu.edu.au/sites/default/files/publication/ccep_crawford_anu_edu_au/2020-11/ccep20-10_wiseman_workman_fastenrath_jotzo_after_hazelwood.pdf.

86 John Daley, "Critiquing Government Regional Development Policies," in *A Greater Australia: Population, Policies and Governance* (CEDA, 2012).

87 John Wiseman et al., "After the Hazelwood Coal Fired Power Station Closure: Latrobe Valley Regional Transition Policies and Outcomes 2017-2020" (Crawford School of Public Policy: Centre for Climate and Energy Policy, 2020), https://ccep.crawford.anu.edu.au/sites/default/files/publication/ccep_crawford_anu_edu_au/2020-11/ccep20-10_wiseman_workman_fastenrath_jotzo_after_hazelwood.pdf.

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