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People powering the future
Skilling Queenslanders
for the clean transformation

December 2021

Deloitte
Access **Economics**

Key findings

- **There is an unprecedented opportunity for Queensland to set up its workforce to take advantage of the global shift to a low-emissions future – the state economy could be 7% larger and create new jobs.**

  – If the net zero transformation of Queensland is managed well then the state economy could become 7% larger – a $780 billion economy – with a workforce employing over 3.6 million Queenslanders by 2050.

  – If the economic transformation is planned early, every region in Queensland will benefit from new jobs and economic growth.

  – North Queensland, Central Queensland and South East Queensland are the fastest growing economies under the scenario. In Central Queensland alone, employment in the clean electricity sector is expected to grow 7.8% every year until 2050.

  – Demand for clean economy jobs is forecast to grow 2.5% on average each year between now and 2030, and these jobs make up three quarters of the top growing occupations in this decade.

- **Most workers today will be in demand as the Queensland economy transforms to net zero, with pathways available for workers needing to switch roles, or industries.**

  – Most workers in Queensland won't be directly impacted by the economic transformation underway due to decarbonisation. The tasks performed by teachers, nurses, retail workers and small business owners, for example, won't materially change.

  – The fear that decarbonisation will result in large and permanent job losses is not borne out by this research, with more than 80% of the tasks required in clean economy jobs already being performed by workers today. Diversifying the economy, and creating growth in new industries, means there will be a place for workers.

  – Queenslanders whose jobs are disrupted can do on-the-job training (or a short course) to be ready for the new industries of a net zero economy. Workers have, on average, four alternative career pathways that they can immediately pursue using their current skill set.

  – Workers in emissions intensive industries will be exposed to structural changes during the net zero transformation, but this doesn't mean the demand for all such occupations will decline. For example, an electrician working in a coal mine can, relatively easily, work as an electrician in another growing industry.

- **If Queensland and Australia get the pace and scale of decarbonisation wrong, there will be increased costs to workers and the economy – in both lost jobs and growth, as well as worsening climate impacts.**

  – If the world doesn't put in place significant new policies – and global warming exceeds 3°C by 2070 – Queensland's economic growth to 2050 averages just over 2%. In the past thirty years, Queensland's economy has grown at an average of 3.8%. The slower and declining future growth rate reflects lower investment, innovation, productivity, and lost jobs.

  – However, the Queensland economy can transform under its own net zero target and in response to those of our trading partners. Proactive policy and coordination between industry, government and communities can minimise disruption and maintain Queenslanders' standard of living.

  – Failing to coordinate the net zero economic transformation or adapt the training system will increase economic costs, and disruption to workers, industries and businesses. Earlier and higher emission reductions and industrial shifts – if planned for and managed well – can improve employment outcomes and skill pathways.

  – Businesses and workers need a flexible and modern training system that provides incremental upskilling, as well as access to the formal qualifications needed to keep businesses operating and workers employed over the course of their lifetime.
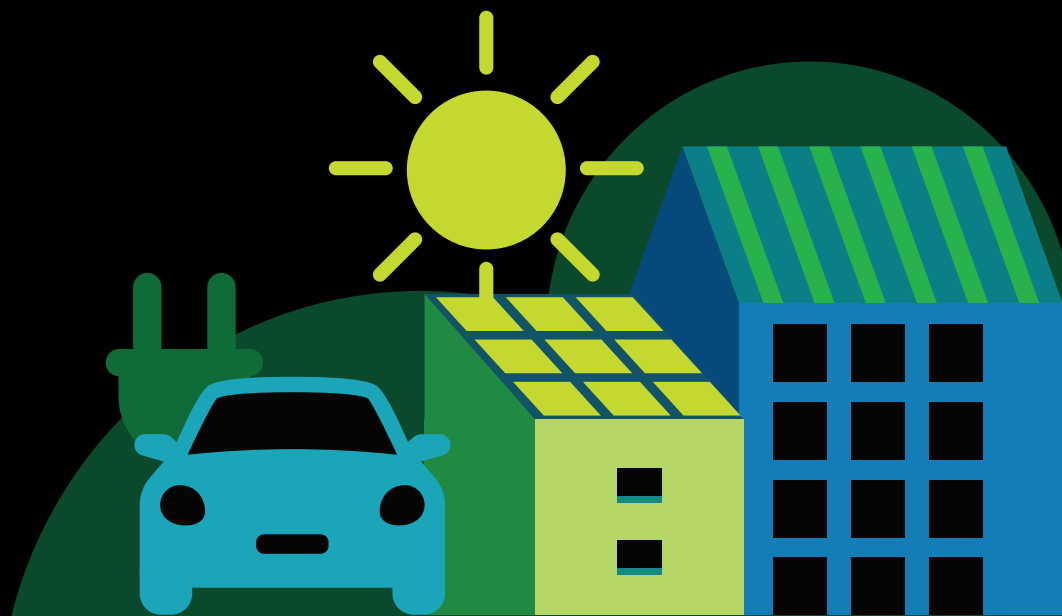
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Policy Makers Summary

This report outlines what the future of work for Queenslanders will be like in a decarbonising world. Often, governments, business and pundits assess the impact of climate policies assuming that the existing economy will continue to grow at trend, unaffected by the consequences of unchecked climate change.

Against this outlook, the economic impacts of policy options such as net zero emissions may appear to cost jobs and growth. In reality, Queensland's economic prosperity will be dependent on climate action and the transformation of the workforce and industries as the world responds to climate change.

Climate inaction is incredibly costly for Queensland jobs and growth.

The cost to Queensland of inaction on climate change, resulting in global warming of around 3°C towards the end of the century, sees Queensland's trend Gross State Product (GSP) growth to 2050 average just over 2%. Historically, Queensland GSP averaged growth over a similar period from 1990 to 2020 of around 3.8%. The cost of inaction is highly damaging to Queensland's economic potential.

With the right framework, and early action, Queensland can shift away from responding to increasing climate damage toward new growth in a net zero economy.

To avoid a climate-damaged future, the whole of Queensland needs to shift onto a new pathway of net zero economic growth.

By getting started now, the state can set the right direction, rate, and quality of growth to successfully transform its economy on the same scale as an industrial revolution within the next 30 years. In fact, under a well-managed net zero transformation, the state economy could become 7% larger – a $780 billion economy.

Decarbonising Queensland could transform sectors, strengthen economic resilience, and create tomorrow's jobs for today's workers.

If Queensland keeps up with the rest of the world as it decarbonises and meets its current commitment of net zero emissions by 2050, **the Queensland economy can experience 2.5% annual growth and have a workforce of over 3.6 million workers.**

In the transformation to net zero, getting the skills mix right within Queensland's workforce is critical. On its way to net zero, Queensland's production systems need to rapidly scale up low-emissions technologies. Emerging industries in this transformation will create new occupations with demand for clean economy jobs forecast to grow by 2.5% on average each year between 2021-2030. A transformed Queensland economy would also be well-positioned to capitalise on new global markets for exports in a net zero global economy.

By 2050 an additional 1 million jobs will be added to the Queensland labour market

2.6 million workers
2021

3.6 million workers
2050

Decarbonisation is one of many trends driving change in Queensland's skills needs.

In a larger future workforce, decarbonisation is just one trend driving change. Alongside automation, new industry development, technological advancements and increases in 'knowledge' and 'people-led' work – multiple trends will change how Queenslanders work, and what they work in. While economic disruption to Queensland is unavoidable, the impact on Queenslanders can be minimised.

There is an unprecedented opportunity for Queensland to set up its workforce to be ready to embrace the jobs and growth of a decarbonising economy, so that people and industries keep up with the pace of change. While certain jobs, in certain industries, may evolve over time as the economy moves to net zero – workers and their skills aren't going anywhere. Identifying the skills and jobs that won't change, as well as those that will, can ensure all workers have a place in the economy as it changes.

In a growing and decarbonising Queensland economy, there is strong demand for skilled workers in traditional and emerging industries.

This report finds that most workers in Queensland are not directly impacted by the economic transformation due to decarbonisation. The tasks performed by teachers, nurses, retail workers and small business owners do not directly change due to increased renewable energy, for example. This means the majority of occupations and the skills of workers today will be in demand in a decarbonised economy.

For workers who are directly impacted by the change, there are pathways to match their skills to new jobs as the economy decarbonises. Skill pathway mapping shows that **over 80% of tasks required in clean economy jobs are already being performed in the current world of work** in Queensland. This means that some workers may only require upskilling (i.e. on-the-job training or short course) rather than retraining (i.e. obtain a new qualification) to remain in their current role as the economy changes. Policy makers have a key role to play in mapping out these changes and ensuring the transition for industries and workers is a smooth one.

Getting the transformation right means:

1. Recognising that keeping pace with the rate of global decarbonisation is an economic necessity and should inform, not just decisions around emissions reduction targets, but also whole-of-government planning for the Queensland of the future.

2. Disruption is not overwhelming – the fear that decarbonisation will result in large job losses is not supported through the findings of this project. In fact, **most Queenslanders have the skills to move to the growing parts of the future economy with marginal, though important, skill updates.**

3. Failure to coordinate the broader economic transformation and update the training system to offer required skills, will increase the cost of transformation. For **employment and skilling outcomes to be beneficial across regions, new low-emissions industries and technologies need to be more competitive, and investment in catalytic infrastructure needs to occur early.** The larger and quicker the investment today, the lower the cost of transformation tomorrow. This means earlier and more ambitious emissions reductions and industrial shifts – if planned for – can increase employment outcomes and skill pathways.

4. Vulnerability of skills to trends and external economic factors means that businesses will need to remain vigilant to the incremental skill requirements that are needed to keep businesses operating and workers employed over the course of their lifetimes. This reinforces the need to ensure that the basic skills Queenslanders have and develop are relevant to the changing nature of the economy. **The training system should be flexible enough to provide both structural skill sets (via qualifications) as well as incremental skills (via mechanisms such as short courses).**

1 Queensland's new economic potential

The Queensland economy will transform under its own net zero target and those of our trading partners. Proactive policy and coordination are required to minimise disruption and maintain the standard of living of all Queenslanders as we decarbonise.

Changing economic landscape

Queensland's economy has always been made strong by the sum of its parts, not any one sector. This has made it resilient to disruptive global trends in the past and will underpin its success in achieving the Queensland Government's net zero commitment and adapting to the structural adjustment that will result from the emissions targets of our trading partners.

But planning, coordination, investment and policy development is required to get this right.

The majority of Australia's trading partners now have a net zero commitment, and there is an accelerated global pivot to remake low-emissions economies.[1] This means that the preferences of our major buyers are changing and *Queensland can't sell what the world no longer wants.*

Of course, the decoupling of carbon emissions from global growth may take decades, but then again so does restructuring an economy's key sources of growth.

There are areas of the Queensland economy that are heavily reliant on the use and sale of fossil fuels, which will inevitably decline under emissions reduction targets. This decline will need to be matched by growth in other areas of the economy. Growth in the renewable energy sector will be part of the solution, but so will our established industries that continue to innovate and grow.

Getting this restructure right requires a coordinated push across government, businesses and regions to ensure the transformation is successful.

This report

This project is not about forecasting the jobs that will be created in the future, though they are accounted for. The focus is on the skills needed and how these can help create that future.

A key element in achieving net zero rests on the ability of businesses, individuals, and communities to make this transformation in response to multiple global trends. This analysis seeks to understand how skills can be used as a key input in a successful transformation that balances the achievement of the Queensland Government's net zero target with economic and employment goals. To do this, the report offers four core analytical components:

- Regionally identifying the industry structures that are most impacted by global, domestic, and state-based decarbonisation trends.

- The workforce implications of the structural adjustment impacts – both in terms of the demand for workers and skills, and the supply.

- Identifying the jobs that will change, the ones that will stay the same and the new jobs that will emerge out of the net zero transformation.

- Employment and training pathways into new roles that will emerge out of the transformation.

What does a successful economic transformation to net zero look like in Queensland?

In a coordinated and least-cost transformation, there is need for the skills of workers to be aligned to new economic opportunities and industry shifts in response to decarbonisation. By aligning the skills of the current workforce to the changing needs of industries, the Queensland economy will be able to decarbonise in a way that minimises trade-offs between emissions targets and economic goals.

In a successful transformation to a net zero economy, there is a role for government, skilling organisations and businesses to coordinate in the early stages of Queensland's adjustment at the right pace and scale.

If Queensland and Australia get the pace and scale in response to decarbonisation wrong, there are increased costs to the economy – in both jobs and growth. **Deloitte Access Economics estimates the decarbonisation cost over the next decade could be 45% higher for Australia under a scenario where the world acts to decarbonise and Australia does not.** In this estimate, carbon border adjustment costs are imposed on Australia, creating additional costs in the order of $15 billion to the economy and over 70,000 fewer jobs created by 2030. As a large exporting and emissions intensive state, Queensland wears a large share of this cost.

Queensland has the fundamentals for successful transformation in a low-emissions world – it has a long history of economic strengths outside of fossil fuels, strong growth in emerging industries and technologies, and a highly skilled workforce. This will depend on making the right decisions, investments and coordinating policy settings to redirect these strengths to areas of high future growth.

2 A resilient and mobile workforce

The tasks that workers are expected to perform in some jobs will change under the forces of decarbonisation and broader technology change. This will result in new jobs being created and some significantly changing, but will not impact the majority of roles.

Labour market dynamics of structural change

The impacts of climate change and decarbonisation, as well as broader trends such as digitalisation and automation, will remake Queensland's labour market in the years out to 2050. These trends do not work solely to replace or remove jobs, they instead augment the future labour force structure.

Structural changes lead to increased demand for some occupations and decreased demand for others. Where this sits on balance is up to the policy settings that are put in place to facilitate the adjustment. If done successfully, minimal jobs will be replaced during the transformation period, with many more created after the structural adjustment to a net zero economy has occurred.

Deloitte Access Economics expects that most of the labour market transformation will occur in the short to medium-term (e.g. starting from around 2025) as Queensland and the rest of the world increases investments in decarbonisation activities and disinvestment in fossil fuels – leading to the establishment of new businesses, jobs and skills. During this ramp up adjustment period, it is essential that the required skills are available to industry as they decarbonise and restructure.
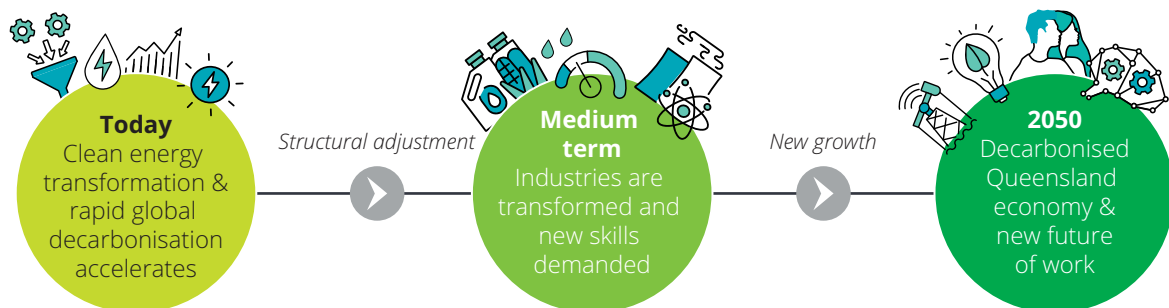
Finding out what these skills are and where gaps may exist, is crucial to informing public policy that supports a successful workforce transformation.

In this way, skills and training – whether formal or informal, tertiary level or an apprenticeship – are often considered to be an output of economic activity. That is, the skills and training that workers need are a function of what the 'market' and broader economy demands. Increasingly though, economic growth policy can use skills and training as an input into creating and shaping economic growth trajectories.

Over time, industries and jobs change; some disappear while new growth areas emerge. However, the skills of workers remain constant and flexible, such that they can adapt to new opportunities.

The challenge will be on Queensland's ability to harness and redirect these skills during decarbonisation, so that they can support the adoption of new innovative technology and maintain their employment objectives.

Figure 2.1: How decarbonisation will influence economic growth

Today
Clean energy transformation & rapid global decarbonisation accelerates

Structural adjustment

Medium term
Industries are transformed and new skills demanded

New growth

2050
Decarbonised Queensland economy & new future of work

> ## How large is the change?
>
> Technology has been the greatest disrupter in recent history. Incorporating new technology and processes into workplaces has changed how tasks are performed and the skills required to perform in roles. For example, the adoption of computer technologies has rapidly changed the tasks performed in professional services jobs, which has required workers to gain new skills (e.g. computer literacy, data analytics etc.). These changes have made individual workers more productive over time.
>
> A change in the tasks required to perform in a role requires new skills and knowledge. Most changes are minor with workers undertaking on-the-job training to learn the new processes, technology or systems. This is how workers develop new knowledge and skills over time and how businesses innovate. There are some jobs where the fundamental tasks for a job will change significantly. In these instances, workers typically require formal or informal training to upskill in order to perform the key tasks of the role. When there are large changes to tasks, new occupations may emerge as a subset of the original occupation.

The jobs created during decarbonisation

Most workers in Queensland will not be professionally impacted by decarbonisation. Labour market and skilling impacts from decarbonisation activities are expected to be minor for the majority of workers, as demand for employment in most occupations is detached from the emissions intensity of the industry in which they operate. This is true for occupations such as teachers, nurses, accountants, retail and administrative workers, where the decarbonisation of the economy is unlikely to change the set of tasks undertaken and therefore the skills required to perform in the role.

While the majority are not directly impacted, any decarbonisation trajectory for Queensland and the rest of the world will increase demand for 'clean economy' skills through the following trends[2]:

- **New decarbonisation activities** and emissions offsetting technologies will create new or renewed occupations and related qualifications and skill sets.

- The **realignment of sectors** in response to energy switching and electrification – such as fossil fuels down, renewables up and green hydrogen supporting hard-to-abate industries to decarbonise. These changes shift what and how industries produce things, and the movement of workers between sectors as a result (and the need for on-the-job training to account for differences in work context).

As new tasks and skills emerge, jobs in decarbonising economies can be classified into occupations in the following categories[3]:

- **Broader economy jobs –** jobs that are not likely to be directly impacted by decarbonisation activities, such as teachers and nurses.

- **Induced demand clean economy jobs –** decarbonisation investments increase demand for these jobs, but do not fundamentally change the role. These jobs include *electricians, environmental scientists, and insulation installers,* for example.

- **Evolving clean economy jobs –** decarbonisation creates significant change to the work and worker requirements of existing occupations. Workers in these roles need to enhance their skill sets as the underlying tasks of the role change. This includes those employed as *electrical engineers, crop farmers and truck drivers,* for example.

- **Emerging clean economy jobs –** specific jobs that will emerge out of decarbonisation activities. These jobs are not currently prevalent enough to warrant their own ANZSCO code but are expected to 'emerge' within this framework as it gets updated and the Australian economy transitions to net zero. Examples of these jobs include *energy auditors, hydroelectric plant technicians and recycling coordinators.*
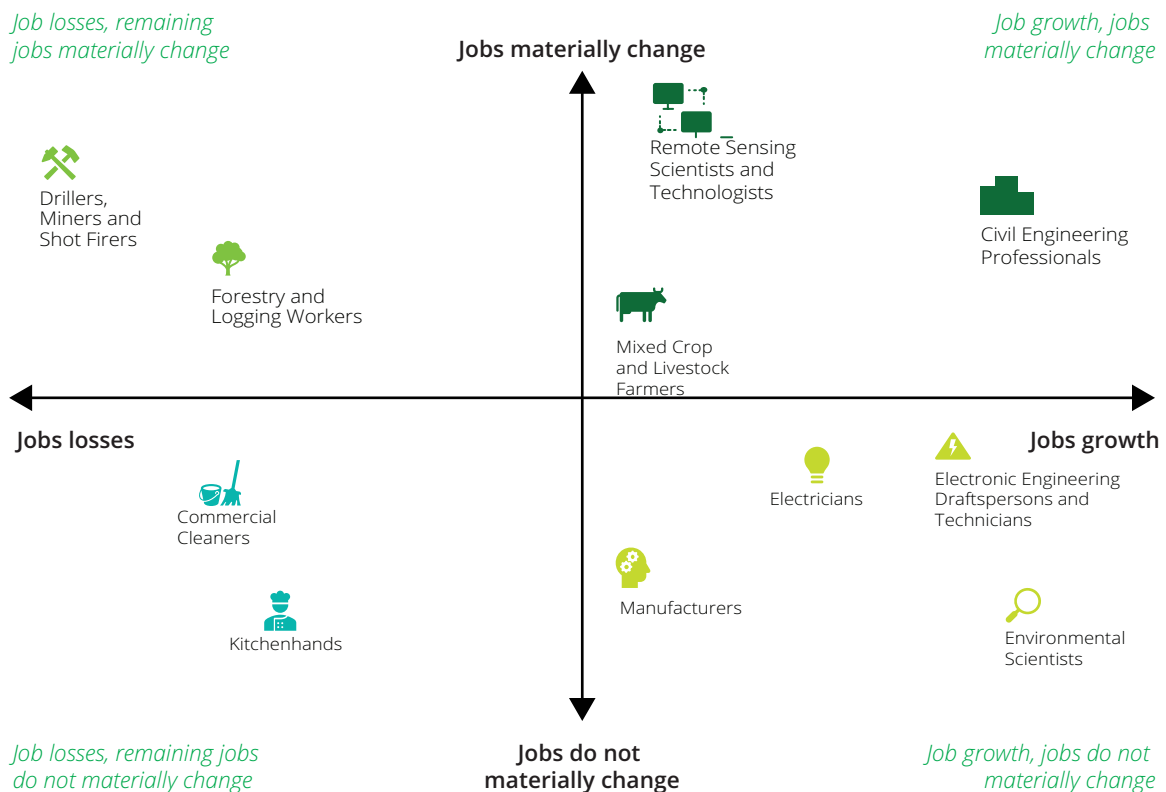
Figure 2.2 shows an illustrative example of how these classifications and changing tasks create new jobs and materially change others. Shifts in the occupation composition between these categories at the industry level is shown in the regional case studies and Chapter 4.

Classifying an 'emerging' job

Although there are some emerging clean economy jobs that exist today, they are not easily identifiable in the Australian occupation framework (ANZSCO) – they are captured in the framework, but do not have their own ANZSCO code. Take Fuel Cell Engineers for example. Although this occupation 'exists' it is not currently prevalent enough to be classified individually in the ANZSCO framework (i.e. have its own code). They are potentially captured in ANZSCO codes such as 'Other Engineering Professionals'.

In this study we have tried to break out these occupations from their broad ANZSCO groupings to understand the skills required for these occupations and the suitability of current workers for these roles as they emerge and become more prominent in the Queensland workforce.

Figure 2.2: Examples of changing demand and tasks of jobs in a clean economy

Job losses, remaining jobs materially change

Jobs materially change

Job growth, jobs materially change

Remote Sensing Scientists and Technologists

Drillers, Miners and Shot Firers

Civil Engineering Professionals

Forestry and Logging Workers

Mixed Crop and Livestock Farmers

Jobs losses

Jobs growth

Electronic Engineering Draftspersons and Technicians

Commercial Cleaners

Electricians

Kitchenhands

Manufacturers

Environmental Scientists

Job losses, remaining jobs do not materially change

Jobs do not materially change

Job growth, jobs do not materially change

Source: Deloitte Access Economics

Mapping of tasks shows that over 80% of the tasks required in evolving clean economy jobs and emerging clean economy jobs are currently being performed in the current world of work (Figure 2.3). This means that current workers who are employed in evolving clean economy jobs and emerging clean economy jobs may be more likely to only require upskilling (i.e. on-the-job training or short course) rather than retraining (i.e. obtain a new qualification) to remain in their current role as the economy changes.

There are also now documented examples of emerging tasks which are required as economies continue to develop the renewable energy sector and the related emerging industries that support economy-wide electrification and the industrial decarbonisation of hard-to-abate industries. Examples of emerging sectors and the tasks required to support their growth are shown in Table 2.2

Figure 2.3: Task composition of evolving and emerging clean jobs

19%

New tasks required in a clean economy

81%

Existing tasks that will continue to be demanded in a clean economy

Source Deloitte Access Economics; O*NET.

Table 2.1: Examples of new tasks for emerging industries in decarbonised economies

Emerging sector	Examples of new tasks to support emerging industry occupations
Hydrogen	Define specifications for fuel cell materials.
	Develop or evaluate systems or methods of hydrogen storage for fuel cell applications.
	Evaluate the power output, system cost, or environmental impact of new hydrogen or non-hydrogen fuel cell system designs.
Biofuels	Adjust temperature, pressure, vacuum, level, flow rate, or transfer of biofuels to maintain processes at required levels.
	Monitor transportation and storage of flammable or other potentially dangerous feedstocks or products to ensure adherence to safety guidelines.
	Operate chemical processing equipment for the production of biofuels.

Source: Deloitte Access Economics; O*NET

These new skills and tasks will need to be introduced into the labour market either through on-the-job training or as part of formal qualifications (see Section 2.3). To ensure that skills are an input to the transformation rather than an afterthought, it is essential that the education and training system is structured in a way that is highly predictive and responsive to the changing needs of sectors as they decarbonise.

The degree to which these new skills disrupt the nature of work will differ depending on whether employment in the occupation is concentrated to a particular sector and whether this sector is emissions intensive (or not).

Do all emissions intensive jobs disappear?

The short answer is no. But there is more to the story of what happens to workers and their skills in emissions intensive industries.

Jobs that operate in emissions intensive industries will be exposed to structural changes during the net zero transformation. With the most common example being that of the decarbonisation of electricity generation globally seeing coal mining jobs decline over the next 30 years. However, this does not necessarily mean that demand for these coal mining occupations decline overall. For example, an electrician currently working in a coal mine can, relatively easily, work as an electrician in another industry if the demand is there.

Further diversifying the economy and creating growth in other industries means there will be a place for a worker's skills, knowledge and experience elsewhere in the economy – **minimising disruption of workers as the economy transforms.**

While the demand for many occupations that are currently in emissions intensive industries will grow over the transformation period, some will not. The number of people employed as Drillers, Miners and Shot Firers, for example, will likely fall overall. This is due to the routine and manual nature of the role, which leaves the occupation vulnerable to automation. This decline in demand, due to automation, is already being observed as mining companies invest in remote operations at mining sites.

In addition to this trend, these workers will be impacted by decarbonisation activities (i.e. reduced demand for fossil fuels). Some Drillers, Miners and Shot Firers may transition from coal mining to mineral mining, but some will need to change occupations to other areas of the economy that demand their skills. Reallocating these workers to the areas of the economy that need them most will require employment and training pathways.

3 Matching skills to new work

Queensland workers have, on average, four alternative career pathways they can immediately move into using their current skill set. Harnessing this mobility will be essential in directing skills and workers to where they are needed most as the Queensland economy transforms.

Transferability of skills

Occupations differ from one another based on an underlying set of skills, knowledge and experience typically held by people working in that occupation. The degree to which the skill set profile of one occupation aligns with another determines the ease in which a worker may transfer into that occupation.

For example, where the demand for workers within one occupation might decline in response to a decarbonising economy, the underlying skill profile held by workers in that occupation may be in demand in similarly profiled and equally desirable occupations elsewhere in the economy (e.g. emerging clean economy occupations).

The ability of workers to move jobs in a changing economy is largely dependent on both the availability and transferability of skills – and ultimately the ability of public policy to support this. Assessing how existing skills can be repurposed in the economy is essential in understanding the training needs for a clean industry transformation in Queensland.

How we measure skill transferability between occupations

The underlying skill set of occupations can be defined in many different ways. Deloitte Access Economics defines an occupation's 'skill set profile' as the knowledge, skills and work activity competencies required to undertake the role. These profiles are derived from highly granular data on a large variety of occupation-specific characteristics from the O*NET database. Overarching definitions of skill set characteristics are provided below, with a full list provided in Appendix C.

- **Knowledge –** knowledge attributes are organised sets of principles and facts that apply to a wide range of situations.

- **Skills –** skills are developed capacities that facilitate learning and the performance of activities that occur across jobs.

- **Work Activities –** work activities summarise the kinds of tasks that may be performed across multiple occupations.

These are the characteristics we collectively discuss as 'skills' in the report.

For each occupation, we have developed a skill similarity score based on how closely each occupation aligns to the 109 individual elements (knowledge, skills and work activity) of the others. This is done between ANZSCO occupations, and also between ANZSCO and O*NET occupations. This identifies the skill similarity of ANZSCO occupations and emerging occupations that are not yet detailed in the framework.

The degree to which an occupation's skill set profile aligns with another determines the ability for a worker to move into that occupation. For example, as Queensland reorients itself towards net zero, there will be a greater demand from industries such as clean energy generation. Those industries will demand skills already available in other industries, such as mining and resources, allowing workers with similar skill sets to transfer into a new role.

Education and experience measures

Occupations that exhibit high skill similarity to other occupations indicate that they are likely to be relatively transferable. However, skill similarity scores must also be overlaid with education and experience measures to further inform the skill matching process.

The Job Match Networks presents the qualification and career experience requirements of a worker to facilitate movements into new employment based on skill similarity (see Table 3.1). Essentially, it is important that movements between occupations occur only when they have similar education and experience requirements. For example, if an occupation requires a bachelor qualification to perform in that role (e.g. an accountant), a worker with a high skill similarity, but within the wrong Job Match Network, will not be able to move into that role.[4]

For example, a school principal and a licensed club manager have many similar skills and thus a high similarity score but they have drastically different experience and education requirements. While school principals usually require a university qualification in teaching and extensive teaching experience, licensed club managers don't require any formal qualifications, but vocational training in hospitality is useful. As such, while some occupations may look transferable on the basis of skill similarity only, it is integral that education and experience measures are also taken into account.

Table 3.1 Job Match Networks

Job Match	Experience	Education	Job Training
1	Little or **no previous work-related skill,** knowledge, or experience	Some of these occupations may require a **high school certificate** (or equivalent)	A f**ew days to a few months** of on-the-job training
2	Some previous work-related skill, knowledge, or experience	Most of these occupations require a **high school certificate** (or equivalent)	A **few months to one year** of on-the-job training. A recognised apprenticeship program may be required
3	**Previous work-related skill,** knowledge, or experience	Most of these occupations require a vocational education and training qualification (i.e. **VET certificate/diploma**)	One or two years of on-the-job training A recognised **apprenticeship** program may be required
4	A considerable amount of work-related skill, knowledge, or experience	Most of these occupations require a tertiary qualification (i.e. **bachelor's degree**)	**Several years of work-related experience,** on-the-job training, and/or vocational training
5	**Extensive skill,** knowledge, and experience	Most of these occupations require post-graduate qualification (i.e. **master's, degree,** Ph.D., M.D.)	Employees may need some on-the-job-training, but most of these occupations assume that the person will already have the required skills, knowledge, work-related experience, and/or training.

Source: O*NET, Job Zones

## Transformation lead times and training requirements

The skill similarity scores between occupations is used as a proxy measure to indicate the feasibility of moving between two jobs. This is central to determining future of work pathways as Queensland transforms into a net zero economy and provides new opportunities for workers.

An immediate pathway is where an employee moves into an occupation that involves a similar set of skills and no further training is required to facilitate the move – they could move into this new occupation tomorrow if required.

To qualify for an immediate pathway, the occupation pair must have a similarity score of 75% and must be within the same Job Match Network, or one above or below their current Job Match Network.

Queensland workers have, on average, four alternative occupations they can immediately pursue (no additional formal training required). Whether a worker chooses to pursue these alterative career pathways depends on the desirability of the role.

Figure 3.1 Framework for assessing an immediate pathway for new employment

>75% skills similarity

Within Job Match Network or one below or higher
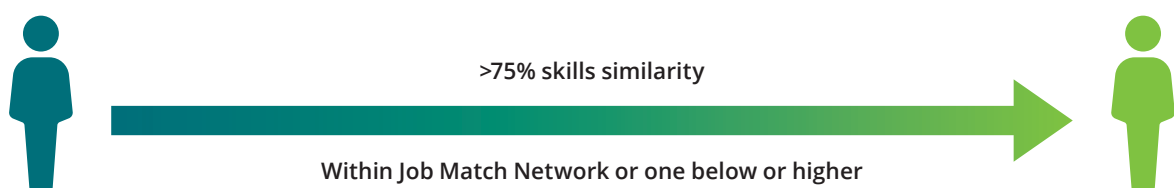
What is a desirable skill pathway for a worker?

There are several barriers that will prevent a worker from moving into a new role. These relate to the suitability of the worker for the role (e.g. transferability of their skill set), but also the preferences of the workers, such as wage and place of work.

These preferences must be considered in workforce planning to ensure that the workers are directed to where they are needed most. Ensuring that workers move into roles that have an equal or higher wage will minimise increases in underemployment, as well as unemployment, during the economic transformation. Equally, it is in the best interest of regions that there is not an abundance of workers moving out of a region to find new job opportunities. As such, when considering the mobility of workers, wage and place of work comparisons between jobs should also be considered – this ensures that *a worker will not be worse off in finding a new skill pathway.*

Examples of immediate pathways for employment based on their Job Match Network and skill similarity score are presented in the regional case studies in the next chapter.

Alternatively, some workers will need additional support, as not all workers will have an immediate pathway available to them. Instead, these workers may have more 'moderate matches' that require upskilling or additional education, constraining their ability to immediately transfer. Potential pathways for moderate skills matches are defined as follows:

- A **short-term skill pathway** is when an occupation pair is in the same Job Match Network (or one above or below) but have a skill similarity score between 60-75%. A short-term pathway requires on-the-job training or a short course to upskill the worker enough for them to successfully perform the tasks required in their new occupation (pathway destination). This new skill pathway could take between 6 months to a year to complete.

- A **medium-term skill pathway** is when an occupation pair has a skill similarity score greater than 50% and the pathway requires the worker to move up two or three Job Match Networks. This means that the worker would need to acquire a relevant qualification from a vocational education institution or university to facilitate a significant jump in Job Match Networks. This new skill pathway could take 2-4 years to complete.

This framework can also be used to identify potential alternative pools of supply to support the rapid expansion of decarbonisation activities and inform targeted upskilling to support the economic transformation.

Figure 3.2 Framework for assessing short-term and medium-term skill pathways

Short-term pathway

Within Job Match Network or -1 / +1

Medium-term pathway

Move 2-3 Job Match Network higher
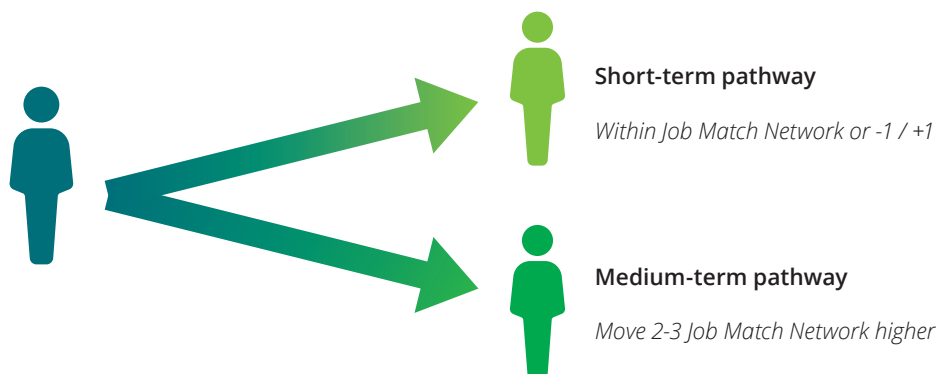
4 A decarbonised Queensland

Under a coordinated net zero transformation, the Queensland economy is 7% larger compared to the baseline at 2050. Over the period to 2050, 1 million jobs will be added to the Queensland labour market.

Net zero is an economic necessity

For Queensland, climate change will economically devastate regional economies, create widespread unemployment, and disrupt the state's traditional economic strengths. Under a future where there is no further significant policy change from today, Deloitte Access Economics estimates an economic and emissions trajectory that produces global average warming of over 3°C by 2070.[5]

In this outlook, Queensland's trend Gross State Product (GSP) growth over the period to 2050 averages just over 2%. Historically, Queensland GSP averaged growth over a similar period from 1990 to 2020 of around 3.8%.[6] This outlook results in (see Appendix A for detailed results):

- **Reduced investment, innovation, and productivity:** For every incremental increase in global average warming, the Queensland economy experiences an incremental loss in economic potential. In such a future, Queensland industries, businesses and governments are not investing in emerging industries or new innovations. Queensland is investing in repairing the past, at the expense of a more productive economic future.

- **Reduced quantity and quality of jobs and economic growth:** A lack of economic growth and significant climate disruption decreases the quantity and quality of jobs and economic growth, resulting in lower standards of living.

This outlook is an economic trajectory worth disrupting and net zero is an economic necessity.

To avoid this outlook businesses, communities and governments across the globe must transform their systems to reach net zero emissions. This global change must occur at an increasing pace and scale to avoid the worst impacts of climate change and generate the greatest economic opportunity for economies and workers.

This pace and scale of change will intensify over the next 10 years as economies invest heavily to bring new low-emissions products to market, transform supply chains and establish new industries – setting them up to compete in a global net zero future. This means that any delay or degree of incoordination in Queensland to respond to this global shift will come at a cost to current competitive advantages and jobs.

To estimate the potential economic benefits Queensland can tap into, Deloitte Access Economics has modelled a future where Queensland undergoes rapid decarbonisation and coordinated structural adjustment.

Under this scenario, Queensland and the world rapidly decarbonises to net zero by 2050. This pathway limits global average warming to well below 2°C. This change transforms production systems, creates new demand for Australian exports (such as base metals and rare earth minerals) and establishes new trading relationships.[7] This emissions trajectory results in (see Appendix A for detailed results):

- **Innovation and new high value adding sectors:** emerging innovations and advancements in productive technologies are successfully adopted and **new energy sectors emerge** such as hydrogen and bioenergy.

- **Sustainable economic growth and diversity:** Queensland's economy grows – **adding over $360 billion to GSP by 2050** (net present value terms) and creating an additional 10,000 jobs, compared to the baseline.[8]

By 2050, Queensland's economy is 7% larger compared to the baseline

The decarbonised Queensland economy in 2050

$780 billion
2.5% annual growth

3.6 million jobs
1.2% annual growth

North Queensland
↑ 2.1% GSP
↑ 1.4% employment

Central Queensland
↑ 2.9% GSP
↑ 1.2% employment

South West Queensland
↑ 1.4% GSP
↑ 1.0% employment

South East Queensland
↑ 2.5% GSP
↑ 1.2% employment

The structural adjustment required for Queensland and the rest of the world to decarbonise results in net gains across all regions

Coal ↓

Oil ↓

Gas ↓

Renewables ↑

Base metals ↑

Services ↑

Figure 4.1: Future growth of the Queensland labour market

2.6 million workers

2021

3.6 million workers

2050

Source: Deloitte Access Economics; ABS, Labour Force, August 2021. Job numbers represent headcount.

The Queensland labour market will continue to grow in the transformative years out to 2050, however the source of this growth will be different as Queensland and the global economy transforms under the rapid decarbonisation activities and broader trends such as automation and digitalisation. Between now and 2050, 1 million additional jobs will be added to the Queensland labour market.

This outcome can only be achieved if government, skilling organisations and businesses coordinate in the early stages of Queensland's adjustment. As such, labour demand from now until 2030 is further explored at the Queensland and regional level, to understand the structural employment shifts that will occur in the short-term. The early push of decarbonisation activities over the next decade will call for the reallocation of workers and shift demand for skilled labour coming out of the education pipeline.

In line with expectations of a net zero transformation, demand for occupations that directly support this transformation will significantly grow – **demand for clean economy jobs is forecasted to grow by 2.5% (CAGR[i]) on average each year between 2021-2030.**

Economic activity will be driven by more than just decarbonisation activities. Queensland's traditional strengths will continue to grow in line with historic drivers and new technology. As such, occupations within the broader economy will also grow (e.g. nurses, teachers etc.). The broader economy occupations that are expected to grow the most significantly are those that provide essential population services and those that are complementary to technological advancements.

75% of the top growing occupations in Queensland out to 2030 are clean economy occupations (Table 4.2). These occupations are labelled as clean economy occupations as they will support the transformation to net zero, but, not all of their growth will be attributable to decarbonisation activities. For example, demand for carpenters and joiners will be driven by other trends as well as decarbonisation.

It must be noted that the forecasted occupations align to current Australian and New Zealand Standard Classification of Occupations (4-digit ANZSCO) and therefore do not include the emerging occupations that have been identified through the O*NET taxonomy.[9] The similarity of skill sets between ANZSCO and emerging occupations are presented in case studies for each region.

i CAGR: Compound Annual Growth Rate.

Table 4.1: Top growing occupations in a rapidly decarbonising Queensland, from 2021-2030

	Occupation	Clean job category	Jobs growth	
			% CAGR	No. of jobs
1	Registered Nurses	Broader economy job	0.6%	11,500
2	Contract, Program and Project Administrators	Evolving clean job	3.8%	8,000
3	Construction Managers	Evolving clean job	3.3%	8,500
4	Primary School Teachers	Broader economy job	0.6%	7,000
5	Secondary School Teachers	Broader economy job	0.7%	6,500
6	Child Carers	Broader economy job	0.6%	5,500
7	Carpenters and Joiners	Clean increased demand	2.4%	5,000
8	Civil Engineering Professionals	Evolving clean job	3.7%	4,500
9	Plumbers	Evolving clean job	2.2%	3,500
10	Production Managers	Clean increased demand	3.1%	3,500
11	Earthmoving Plant Operators	Clean increased demand	2.2%	3,000
12	General Managers	Evolving clean job	2.3%	3,000
13	Occupational and Environmental Health Professionals	Clean increased demand	3.1%	2,000
14	Building and Plumbing Labourers	Evolving clean job	2.5%	2,000
15	Generalist Medical Practitioners	Broader economy job	0.6%	2,000
16	Industrial, Mechanical and Production Engineers	Evolving clean job	2.4%	2,000
17	Supply, Distribution and Procurement Managers	Evolving clean job	2.5%	2,000
18	Electrical Engineers	Evolving clean job	3.6%	1,500
19	Concreters	Clean increased demand	2.1%	1,500
20	Engineering Managers	Evolving clean job	2.9%	1,500

Source: Deloitte Access Economics occupation demand forecasts 2021-2030, based on the net zero scenario. Growth rates reflect compound annual average growth (CAGR).

Current skill shortages

The significant growth in these occupations will be driven by investment in climate change adaptation and decarbonisation activities, in addition to broader investments in innovation and technology. If there is insufficient supply of appropriately skilled workers to support these activities, progress towards net zero and the economic transformation will come at a higher cost.

Many of the clean economy occupations that are critical in the initial stages of the net zero transformation (2021-2030) are currently in a national shortage according to the National Skills Commission Skills Priority List (listed at 6-digit ANZSCO). These occupations include those listed in Table 4.2.

There is an important role for government and education and training providers to ensure that the pipeline of graduates entering or re-entering the labour market are skilled in these priority areas to facilitate the net zero transformation.

Table 4.2: High growth 'clean occupations' currently in national shortage

High Growth Clean Occupations (4-digit ANZSCO)	Jobs in National Shortage (6-digit ANZSCO)
Construction Managers	Construction Project Manager Project Builder
Engineering Managers	Engineering Manager
Production Managers	Production Manager (Forestry) Production Manager (Manufacturing) Production Manager (Mining)
Civil Engineering Professionals	Civil Engineer Geotechnical Engineer Quantity Surveyor Structural Engineer Transport Engineer
Electrical Engineers	Electrical Engineer
Industrial, Mechanical and Production Engineers	Mechanical Engineer
Carpenters and Joiners	Carpenter and Joiner Carpenter Joiner
Plumbers	Plumber (General) Airconditioning and Mechanical Services Plumber Drainer (Aus) / Drainlayer (NZ) Gasfitter Roof Plumber
Earthmoving Plant Operators	Earthmoving Plant Operator (General) Backhoe Operator Bulldozer Operator Excavator Operator Grader Operator Loader Operator

Source: Deloitte Access Economics; National Skills Commission. Skills Priority list, July 2021.
Note: The occupations included in the table are mapped to those in Table 4.2. This is not an exhaustive list of 'clean economy' occupations in national shortage.

The skills needed as Queensland decarbonises

Clean economy skills are a vital input to the transformation of products, services and processes as the demands of consumers and businesses change in response to global decarbonisation.

Clean economy occupations have a high competency (above average) in the following job characteristics (see Table 4.3).

To understand the current supply and the future demand for these skills, we have identified occupations that also have a high competency of these job characteristics. The current 'supply' (employed workers with this skill) and future demand (workers demanded with this skill) is illustrated in Chart 4.1.[10]

There are some skills that are more associated with clean occupations and will be in higher demand, such as 'systems analysis', which are prevalent in the current labour market, with demand increasing as the economy moves towards net zero. There are also some knowledge attributes that are growing and in demand, such as physics.

As shown in the chart, most of these high demand 'clean skills' are already in the workforce and can be redistributed as needed, if there are adequate policies in place to support mobility, upskilling and retraining.

Table 4.3: Core 'clean' jobs characteristics

| Knowledge	Skills	Activities
• Transportation	• Mathematical Problem Solving	• Inspecting Equipment, Structures, or Material
• Production and Processing	• Science	• Estimating the Quantifiable Characteristics of Products, Events, or Information
• Engineering and Technology	• Operations Analysis	
• Design	• Technology Design	
• Building and Construction	• Installation	• Analysing Data or Information
• Mechanical	• Operation Monitoring	• Drafting, Laying Out, and Specifying Technical Devices, Parts, and Equipment
• Mathematics	• Operation and Control	
• Physics	• Equipment Maintenance	
• Chemistry	• Troubleshooting	• Repairing and Maintaining Mechanical Equipment
• Geography	• Repairing	
	• Quality Control Analysis	• Repairing and Maintaining Electronic Equipment
	• Systems Analysis	
	• Systems Evaluation	
	• Management of Financial Resources	

Source: Deloitte Access Economics; O*NET

Chart 4.1: The clean skills that employers want in 2030 and the workers who currently have them
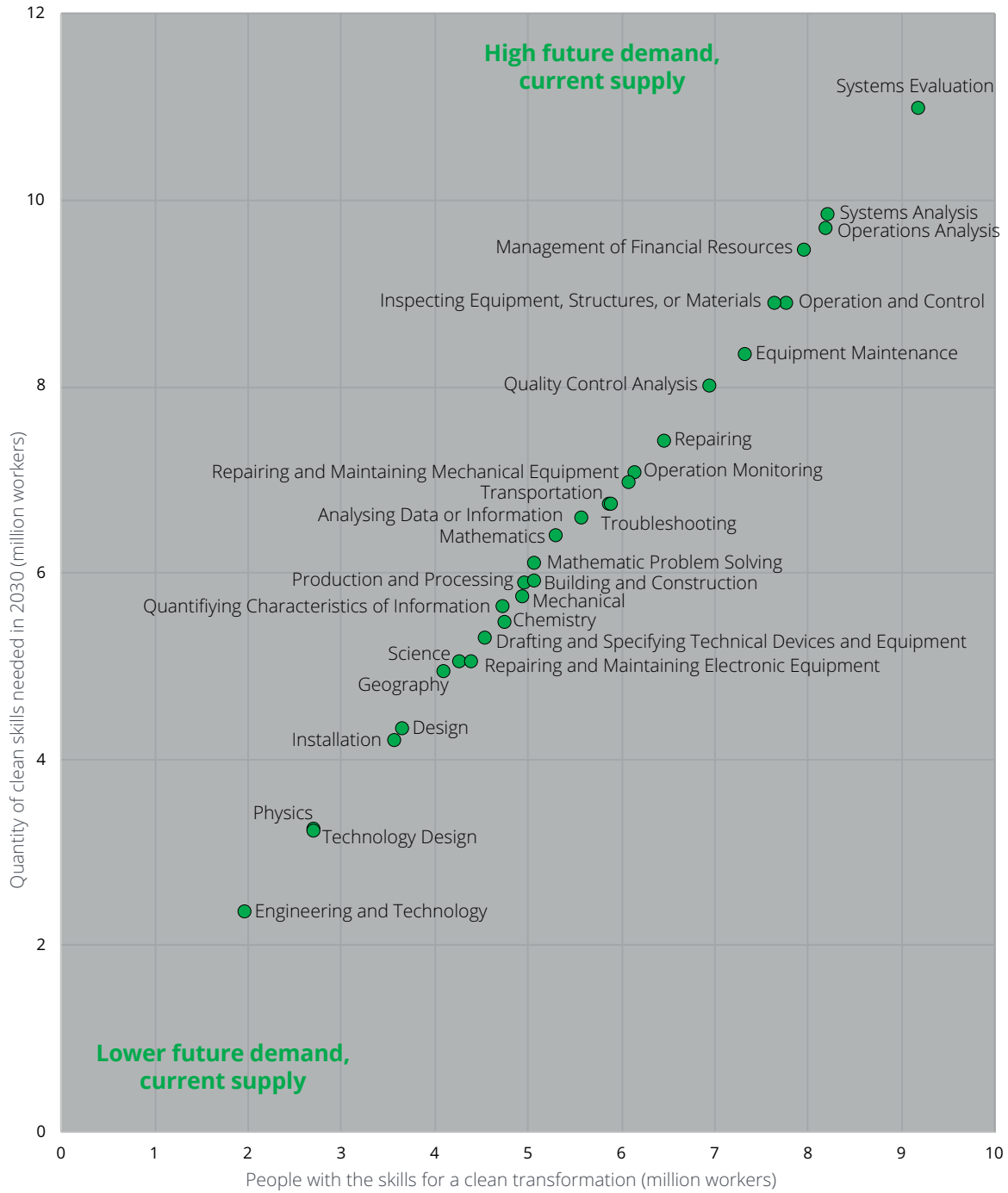
Source: Deloitte Access Economics employment forecasts; O*NET skills, knowledge and work activities data.

REGIONAL CASE STUDIES
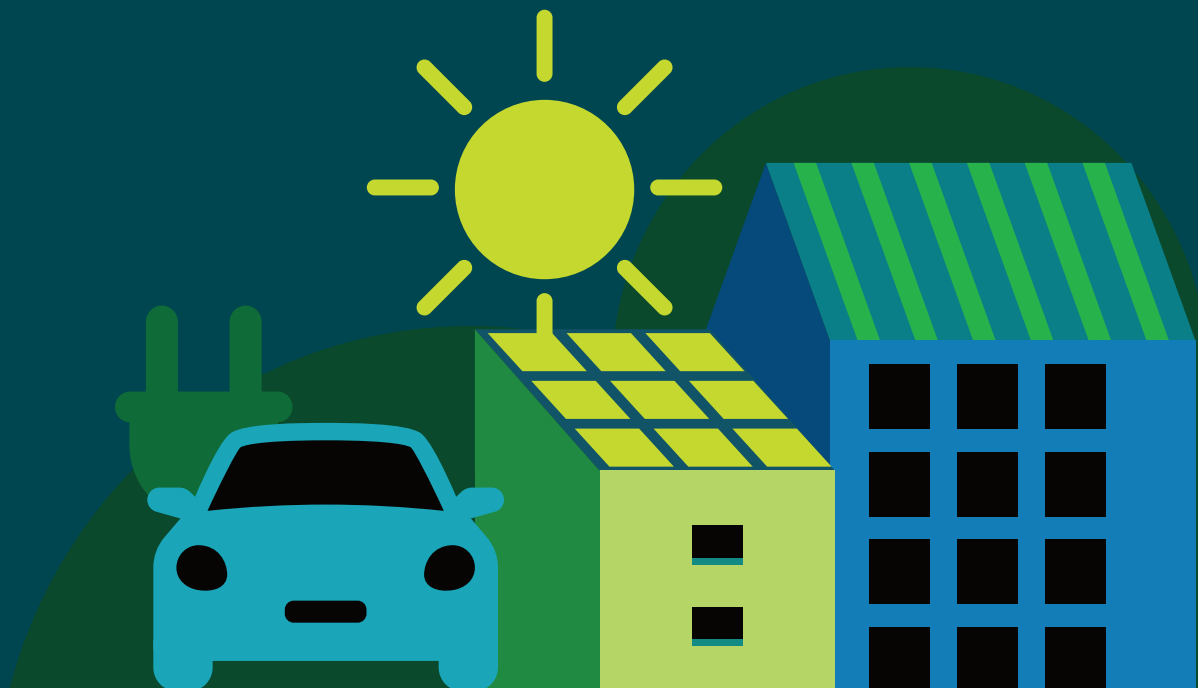
South East Queensland

The traditional strengths of the South East Queensland (SEQ) economy will continue to drive strong economic growth in the years out to 2050, while emerging industries such as hydrogen and bioenergy grow into significant employers for the region.

SEQ extends from the Sunshine Coast in the north, to the Gold Coast in the south, and incorporates Toowoomba to the West. Most of Queensland's population and economic activity is concentrated in this area and as such, it secures the largest share of economic gains from decarbonisation and emerging industry development.

The hydrogen and bioenergy sectors grow rapidly during this period as the region reorients its economy and emissions intensive industries adopt low-emissions technology and expand into new global markets that emerge from global efforts to decarbonise.

Growth and innovation in emerging sectors facilitate broader economic benefits throughout the economy. In SEQ this specifically translates to strengthening the region's core industries:

- **Construction** almost triples in terms of output between 2021 to 2050, from contributing $60 billion in 2021 to $143 billion in 2050. This equates to a CAGR of 3% per year.

- **Private services (includes health and education services)** more than doubles between 2021 to 2050, from contributing $146 billion in 2021 to $315 billion in 2050. This equates to a CAGR of 2.7%.

- **Retail and tourism** more than doubles between 2021 and 2050, from contributing $55 billion in 2021 to $114 billion in 2050. This equates to a CAGR of 2.6%.

Employment

SEQ sees significant employment growth under a net zero transformation. The region benefits from avoided climate damages to its services and construction industries and sees significant boosts to its renewable energy related industries, in comparison to the baseline.

In fact, under a net zero transformation with the new opportunities and investment options it provides, construction is expected to benefit greatly, increasing its industry share for employment from 14% in 2021 to 17.6% in 2050.

Under the net zero scenario, some of the fastest growing industries in terms of employment in SEQ include:

- **Hydrogen** experiences the largest employment growth in SEQ, with employment growing from 20 jobs in 2021 to almost 1,300 in 2050. This is equivalent to a CAGR of 14.9% per year over the same period. The significant growth is a reflection of the emerging industry establishing itself in the region.

- **Bioenergy** jobs are also expected to grow significantly, with employment growing from 70 jobs in 2021 to almost 1,350 in 2050. This is equivalent to a CAGR of 11%.

- **Clean electricity** is expected to experience growth in employment, from 500 jobs in 2021 to 4,900 jobs in 2050. This is equivalent to a CAGR of 8.2%.

In terms of strongest growth, SEQ's historically largest employing industries are expected to experience the largest boosts to employment:

- **Public Services** sees significant employment growth of 150,000 jobs, as available FTE jobs increases from almost 277,000 in 2021 to over 427,000 in 2050.

- **Construction** jobs are strengthened as employment is projected to grow by 136,000 jobs, from 182,000 jobs in 2021 to 318,000 jobs in 2050.

- **Retail and tourism** employment is also projected to grow by 100,000 jobs, from 243,000 jobs in 2021 to 343,000 jobs in 2050.

Current investment in renewables

The Queensland Government has announced that it will develop three Renewable Energy Zones (REZs), located in Northern, Central and Southern Queensland. The Queensland REZs are intended to encourage investment in renewable energy generation and storage projects.

One of the key projects currently in the SEQ region is the $22 million feasibility study for a pumped hydro storage project at Borumba. Getting pumped hydro storage right is crucial to achieving net zero, as it will overtake the current role of coal-fired power stations as our energy network stabiliser.

Employment pathway into a Biofuels Processing Technician vacancy

This employment pathway example demonstrates how current skills in the labour market may be repurposed to support the delivery of biofuels projects.

Biofuels Processing Technicians are not currently identified in the ANZSCO framework. However, as significant biofuel projects come online and the biofuel industry expands, it is expected that demand for Biofuels Processing Technicians will increase. Just as the skill similarity scores can be used to determine job pathways for workers whose occupations are disrupted, it can also be used in the **identification of potential alternative pools of immediate supply for the emerging industry and inform targeted upskilling activities to build its future workforce.**

As such, the below examples provide immediate employment and short-term training pathways to support the expansion of biofuels in Queensland. These are examples and are not exhaustive.

Immediate pathways
Immediate pools of labour supply that biofuel companies may be able to leverage in processing refined feedstock are:

Electrical Engineering Draftspersons and Technicians
These two occupations have a **76% skills match,** driven by high competencies in: mechanics; *production and processing; inspecting equipment, structures, or material; experience in controlling machines and processes;* and making decisions and solving problems. As Electrical Engineering Draftspersons and Technicians are one Job Match Network higher, it is expected that the pathway could be facilitated with on-the-job training or a short course.

Other Stationary Plant Operators
These two occupations have an **81% skills match,** driven by high competencies in: *mechanics; monitor processes, materials, or surroundings; making decisions and solving problems; controlling machines and processes; documenting/recording information; and establishing and maintaining interpersonal relationships.* As these occupations are both in Job Match Network 3 and have a skills match over 75%, it is expected that the skills 'distance' between the jobs can be made up with on-the-job-training or a short course.

Drillers, Miners and Shot Firers
These two occupations have a **76% skills match,** driven by high competencies in: *mechanics; operation monitoring; judging the qualities of things, services, or people; inspecting equipment, structures, or material; and estimating the quantifiable characteristics of products, events, or information.* As they are both in the same Job Match Network, it is expected that the skills 'distance' between the jobs can be made up with on-the-job-training or a short course.

Potential training pathways
As Biofuels Processing Technicians are in a low Job Match Network (i.e. 2), the most viable employment pathways are immediate (strong skills match in a Jobs Match Network of 1, 2, or 3).

How to interpret clean job composition changes

Each of the regional case studies provides detailed insights into the structural employment shifts occurring as the region begins to transform (2021-2030). Industries with the largest shifts are presented in the regional infographics (see overleaf).

The changes represent a change in the proportion of industry employment that is attributable to broader economy, evolving clean jobs and increased demand clean jobs. As such, a fall in employment composition of 'broader economy jobs' does not necessarily translate into declining employment, rather employment in these occupations are growing slower than 'clean' jobs, which means that there is a shift in the workforce towards more 'clean' jobs. For example, over the transformation years to 2030, the 'broader economy' share of the mining workforce will fall by around 4% in South East Queensland, with this share of employment shifting to 'clean' occupations.

South East Queensland

Who will need to be upskilled as South East Queensland decarbonises?

Paper and Wood Processing Machine Operators

1,000 regional workers are currently employed as Paper and Wood Processing Machine Operators. It is expected that over the next 9 years, 150 workers will need to transition into a new job. This disruption is more related to technology development over the next 10 years, than directly related to decarbonisation activities.

Repurposing existing skills..
Potential training pathway: Metal Fitters and Machinists

- 73% Skills-match. On-the-job training or VET course required.
- Although routine and manual in nature, jobs growth in this occupation (2,000 new jobs in SEQ) supports the rise of automation as companies require skilled labour in machine maintenance.
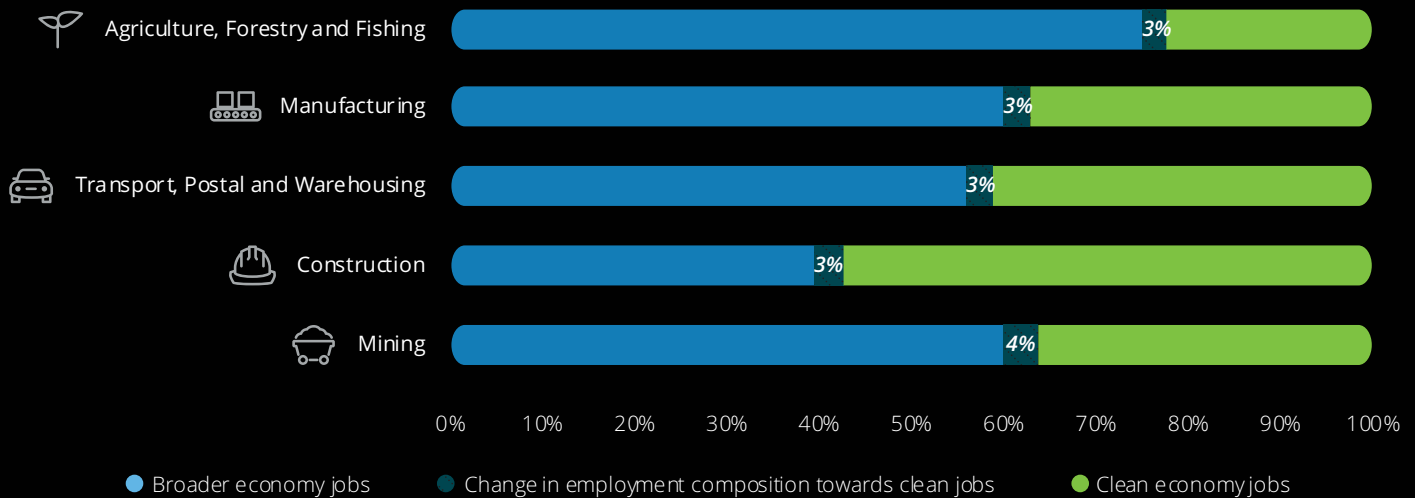
Finding new ones..
Potential economic growth opportunity: Biofuels Processing Technician (new and emerging job)

- 73% Skills-match. On-the-job training or further upskilling may be required.

Regional occupation composition between clean and broader economy jobs, 2021-2030

Agriculture, Forestry and Fishing — 3%
Manufacturing — 3%
Transport, Postal and Warehousing — 3%
Construction — 3%
Mining — 4%

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

● Broader economy jobs   ● Change in employment composition towards clean jobs   ● Clean economy jobs

What does a change in composition in South East Queensland industries mean?

The significant occupation composition change in Agriculture, Manufacturing, Transport, Construction and Mining industries in SEQ towards clean economy jobs, means that demand for clean economy jobs will outpace broader economy jobs in these industries out to 2030. This is expected to occur as labour is directed to activities that support decarbonisation and climate change adaptation in Queensland and the rest of the world. Some of the fasting growing occupations to support this transformation are:

Construction Managers
⬆ 3.3% growth (4,800 jobs)

Production Managers
⬆ 3.0% growth (1,700 jobs)

Industrial, Mechanical and Production Engineers
⬆ 2.3% growth (1,100 jobs)

Electricians
⬆ 1.8% growth (3,900 jobs)

Carpenters and Joiners
⬆ 2.3% growth (3,400 jobs)

Civil Engineering Professionals
⬆ 3.6% growth (2,900 jobs)

North Queensland

North Queensland is expected to experience strong economic growth as its established industries support the transformation to net zero and the growth in renewable sectors. The clean electricity sector is expected to experience the largest growth in employment – growing by 8.6% per year between 2021 and 2050.

North Queensland represents the far north, extending west and north to Charters Towers - Ayr - Ingham. The region is characterised by significant agricultural, retail and tourism industries. This region has a relatively small mining industry but has the largest base metals industry of all Queensland regions, placing the region in a good position to orient its economy to support the development of clean energy.

The region is exposed to the effects of extreme temperatures and weather damaging its agricultural land and tourism assets, as well as reducing labour productivity in its mining and construction industries. As such, North Queensland has more to lose from climate change damages if net zero is not achieved by 2050.

Strong investment in renewables over the forecast period underpins significant gains in the following industries:

- **Clean electricity** experiences the fastest growth in the region, from contributing $59 million in 2021 to $2 billion in 2050. This translates to a CAGR of 13.2% over the same period.

- **Hydrogen** follows with the second highest growth, from contributing $45 million to the region's economy in 2021 to $1 billion in 2050. This is equivalent to a CAGR of 11.8% over the same period.

- **Bioenergy** sees significant growth from its relatively small contribution in 2021 of $2 million to $45 million in 2050 (or a CAGR of 11.4%).

- The largest **Base Metals** sector across Queensland as of 2021, this sector also sees strong growth, from contributing almost $3 million in 2021 to almost $5 million in 2050. This is equivalent to a CAGR of 1.9% over the same period.

Some of the region's strongest growth occurs in sectors that benefit from avoided damages (i.e. climate change damages in the baseline):

- **Private services** almost triples in terms of output between 2021 and 2050, from contributing $26 billion in 2021 to $61 billion in 2050. This is equivalent to a CAGR of 3%.

- **Retail and tourism** more than doubles between 2021 and 2050, from contributing $9.5 billion in 2021 to $21 billion in 2050. This is equivalent to a CAGR of almost 2.9%.

- **Construction** more than doubles between 2021 and 2050, from contributing $7 billion in 2021 to $16 billion in 2050. This is equivalent to a CAGR of over 2.9%.

- **Agriculture** almost doubles between 2021 and 2050, from contributing $8 billion in 2021 to $15 billion in 2050. This is equivalent to a CAGR of 2.3%.

Employment

North Queensland is expected to see one of the highest overall average annual growth rates in employment as new opportunities become available in the region as it decarbonises.

Overall, the structure of North Queensland's workforce does not change much with decarbonisation. The largest shift is that public services increases from the second largest employer to the largest employer under decarbonisation. Given that North Queensland does not have a particularly large mining sector (outside of base metals), decarbonisation does not have as large an effect on its workforce structure as it does other regions.

Current investment in renewables

Kaban Green Power Hub consists of a 157 MW wind farm with approval for a 100 MW battery and a network upgrade, which will ensure the energy can rapidly be exported into the grid.

Located 80 km south-west of Cairns in the Atherton Tablelands, the hub is expected to service a weak part of the grid in Far North Queensland as well as supporting the state to achieve its renewable energy targets.

Some of the largest growing industries arise as a result of the opportunities created by decarbonisation:

- **Clean electricity** is expected to experience the fastest growth in employment, with a compound annual growth rate of 8.6% per year between 2021 and 2050.

- **Hydrogen** is expected to see significant job growth, equivalent to a compound annual growth rate of 8.1% per year between 2021 and 2050.

- **Bioenergy** jobs are also expected to grow significantly, with a compound annual growth rate of 7.4% per year between 2021 and 2050.

This region is also expected to see great opportunities in base metal mining, with gains in employment in this industry vastly outweighing falls in other mining employment. Base metals are expected to gain an additional 1,483 jobs in the region by 2050. Meanwhile, the rest of North Queensland's economy is also expected to strengthen under a net zero transformation pathway:

- **Public services** jobs are strengthened as employment is projected to grow by 38,000 jobs, from 55,000 jobs in 2021 to 93,000 jobs in 2050.

- **Retail and trade** jobs are strengthened as employment is projected to grow by 23,000 jobs, from 42,000 jobs in 2021 to 65,000 jobs in 2050.

Employment pathways for electricians in the mining industry

This employment pathway example demonstrates how electricians currently working in the mining industry might be redeployed to support activity in other sectors.

Although electricians will be needed in the mining industry in the years out to 2050, there will likely be a decrease in fossil fuel related mining in the region. As such, it is important to consider the immediate job pathways these workers can take if their job becomes disrupted.

Immediate pathways

Electricians are perfectly poised to reap the benefits of a decarbonised economy, with growing opportunities in the renewables sector and in other sectors that are decarbonising. As such, an electrician currently working in carbon intensive industries might move to a role supporting decarbonisation activities due to the pull of structural adjustment.

Other than switching industry, electricians also have various immediate pathways into other occupations that they can take. Electricians' skills allow them to move into occupations such as ***Electrical Engineering Draftspersons and Technicians.***

These two occupations have a **76% skills match** and a similar average wage. As they are both in the same Job Match Network, it is expected that the skills 'distance' between the jobs can be made up with on-the-job-training or a short course.

Potential training pathways

Electricians also have short and medium-term pathways available that require additional training.

Short-term pathway: Mechanical Engineering Draftsperson and Technician

Mechanical Engineering Draftspersons and Technicians assist in mechanical engineering research, design, manufacture, construction, operation and maintenance of machines, manufacturing equipment, mechanical installations and facilities.

This short-term pathway has a **60% skills match** and will require upskilling as workers switch both occupation and, likely, industry. Although these occupations are in the same Job Match Network it is expected that the workers will require a VET qualification or short course to transition.

Switching to this occupation would provide workers with a slightly higher wage. This occupation is also expected to experience strong growth into the future with the new technology and machinery that will emerge as a result of investment in renewable energy, carbon capture and other technologies associated with climate change mitigation.

Medium-term pathway: Electrical Engineer

Electrical Engineers design, develop and supervise the manufacture, installation, operation and maintenance of equipment, machines and systems for the generation, distribution, utilisation and control of electric power.

This medium-term pathway has a **67% skills match.** However, this pathway would require a bachelor's degree in engineering. Electrical Engineers have a higher wage and are currently on the Nation Skills Commission's 2021 Skills Priority List (occupations in national shortage, with strong future demand), making it a relatively safe pathway to pursue.[12]

North Queensland

Who will need to move jobs as North Queensland decarbonises?

Electricians

4,100 workers are currently employed as Electricians in the region. Around 400 of these work within the mining industry. As the Queensland and global economy starts to transition, some of these workers may need to move out of mining and will fill demand in the renewable energy sector (due to a change in energy preferences). Not all mining electricians will need to transition.

Repurposing existing skills..

Electricians also have potential training pathways into Electrical Distribution Trades Workers

- 73% Skills-match. On-the-job training or VET course required.
- Although routine and manual in nature, jobs growth in this occupation (45 new jobs in NQ) supports the future changes in electricity distribution technology.
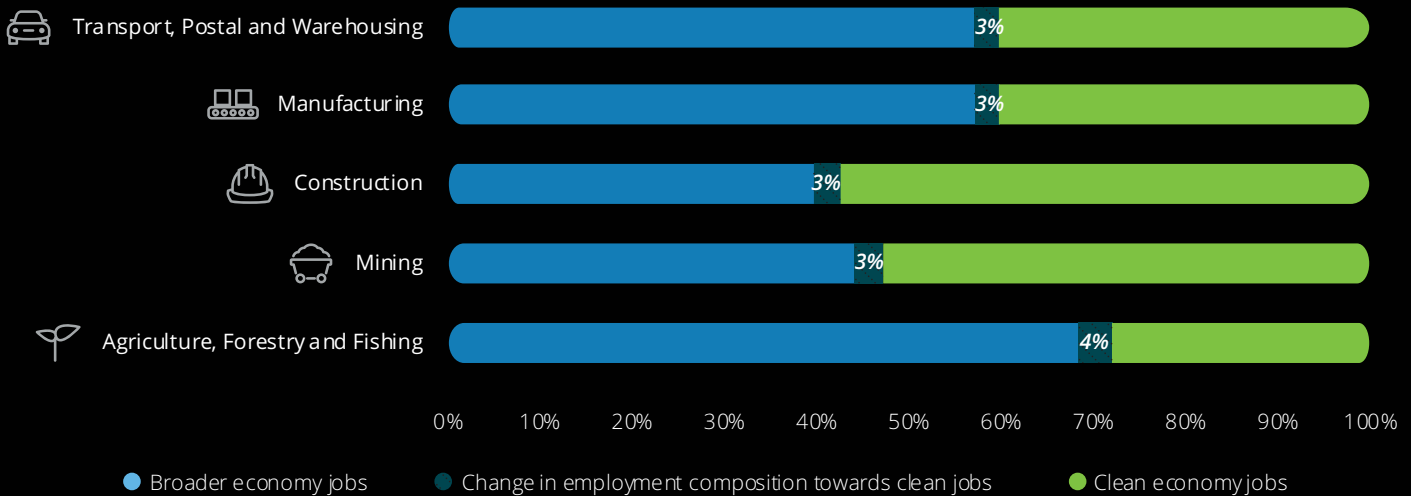
Finding new ones..

Potential economic growth opportunity: Wind Turbine Service Technicians (new and emerging job)

- 68% Skills-match. On-the-job training or formal training may be required.

Regional occupation composition between clean and broader economy jobs, 2021-2030

Industry	
Transport, Postal and Warehousing	3%
Manufacturing	3%
Construction	3%
Mining	3%
Agriculture, Forestry and Fishing	4%

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

- ● Broader economy jobs
- ● Change in employment composition towards clean jobs
- ● Clean economy jobs

What does a change in composition in North Queensland industries mean?

The significant occupation composition change in Agriculture, Manufacturing, Transport, Construction and Mining industries in NQ towards clean economy jobs, means that demand for clean economy jobs will outpace broader economy jobs in these industries out to 2030. This is expected to occur as labour is directed to activities that support decarbonisation and climate change adaptation in Queensland and the rest of the world. Some of the fasting growing occupations (2021-2030) to support this transformation are:

Earthmoving Plant Operators
⬆ 2.3% growth
(300 jobs)

Metal Fitters and Machinists
⬆ 1.9% growth
(500 jobs)

Structural Steel and Welding Trades Workers
⬆ 1.7% growth
(400 jobs)

Electricians
⬆ 2.0% growth
(800 jobs)

Carpenters and Joiners
⬆ 2.5% growth
(500 jobs)

Civil Engineering Professionals
⬆ 3.8% growth
(400 jobs)

Central Queensland

Central Queensland (CQ) will benefit from a clean energy transformation – growing on average by around 3% each year out to 2050. This growth will be supported by the broadening of traditional industries and the establishment of clean energy sectors that will transform the region's value chains.

The Central Queensland region consists of the areas between Bowen Basin – north to Gladstone and Biloela. This region's economy relies heavily on its natural assets. Being both a major access hub to the Great Barrier Reef and having a strong mining and resources sector, the region is especially vulnerable to climate change's impacts on tourism and labour productivity from extreme temperatures and weather.

The largest growth over the next 30 years in CQ occurs in clean energy and industries that support clean energy, as significant switching occurs in this region. With a large mining and resources industry, switching will occur as workers move to hydrogen, bioenergy and the base metals industry, which is already relatively significant in CQ.

- **Hydrogen** is expected to grow by a factor of ten, from contributing $190 million to CQ's economy in 2021, to contributing $2 billion in 2050.

- **Bioenergy** is expected to grow drastically from contributing $8 million to $155 million in 2050.

- **Base metals** is already an emerging sector within the region, currently contributing $1 million, and will experience compound annual growth of over 5.6% between 2021 and 2050. As such, the industry is expected to contribute $6 million to the economy in 2050.

The region will also see overall growth as it avoids further climate damage and reorients its economy:

- **Public services** almost triples between 2021 and 2050, from contributing $43 billion in 2021 to $91 billion in 2050. This equates to a compound annual growth rate of 3.2%.

- **Private services** more than doubles between 2021 and 2050, from contributing $23 billion in 2021 to $58 billion in 2050. This equates to a compound annual growth rate of greater than 2.6%.

- **Retail and tourism** more than doubles between 2021 and 2050, from contributing $17 billion in 2021 to $34 billion in 2050. This equates to a compound annual growth rate of 2.6%.

Employment

Under a net zero scenario, CQ sees the highest average annual growth rate in employment between 2021 and 2050.

The structure of CQ's workforce does not change that much under a decarbonisation pathway. This is because while there are falls in mining employment, this industry only provided 3.3% of total regional employment as of 2021. Services (public and private), retail and tourism are this region's largest sources of employment, and it is these industries that see significant employment growth under a net zero transformation.

Current investment in renewables

Austrom Hydrogen is working to establish the Queensland Solar Hydrogen Facility in Callide, Queensland.

Central Queensland has the ideal conditions to support solar energy production. The facility is expected to generate up to 3,600 MW integrated green solar/battery power, which will then transfer to the hydrogen manufacturing site with minimal energy lost during transmission. From there, modern hydrolysis will be used to minimise water usage. The water will then be split into hydrogen and oxygen using renewable electricity from the solar farm. It is then planned that the new hydrogen transport ships will dock at Gladstone Port where the final product (in the form of compressed hydrogen, ammonia or methylcyclohexane) will be exported to offshore markets.

Austrom Hydrogen estimates that the project will produce enough hydrogen to cover 60% of Japan's hydrogen strategy by 2030. This project is still undertaking regulatory approvals.

Under the assumption that CQ develops hydrogen to support its decarbonisation pathway, this decision is expected to also support labour moving away from mining. While there are falls in mining employment, they do have alternative pathways. Some of the fastest growing industries in terms of employment are:

- **Clean electricity** is expected to experience the fastest growth in employment, with a compound annual growth rate of 7.8% per year between 2021 and 2050.

- **Hydrogen** is expected to see significant job growth, equivalent to a compound annual growth rate of 6.9% per year between 2021 and 2050.

- **Base metal and other mining** jobs will also provide alternative pathways for workers who currently work in coal or gas mining. These industries are expected to experience a compound annual growth rate of 4.9% and 4.0% per year, respectively, between 2021 and 2050.

Central Queensland will also see strong growth in its largest employing industries:

- **Public services** jobs are strengthened with employment is projected to grow by 109,000 jobs, from 134,000 jobs in 2021 to 243,000 jobs in 2050.

- **Retail and trade** jobs are strengthened with employment is projected to grow by 30,000 jobs, from 73,000 jobs in 2021 to 103,000 jobs in 2050.

Employment pathways for Drillers, Miners and Shot Firers

This employment pathway example demonstrates how Drillers, Miners and Shot Firers can be move into alternative occupations to support growth in other sectors.

Demand for Drillers, Miners and Shot Firers is already declining due to technology advancements and the routine nature of the tasks required for the role. This means that as mining companies continue to expand their remote operations, demand for routine and manual jobs will decrease. This decline will be also be impacted by the transformation to a net zero Queensland.

Immediate pathways
The skills of Drillers, Miners and Shot Firers will allow them to immediately move into occupations such as Chemical, Gas, Petroleum and Power Generation Plant Operators. This employment pathway will require an industry shift from mining to hydrogen, bioenergy or other renewable energy industries. Pursuing this employment pathway may also result in a wage increase for workers currently employed as Drillers, Miners and Shot Firers.[13]

Potential training pathways
Drillers, Miners and Shot Firers also have short and medium-term pathways available that require additional training.

Short-term pathway: Electrical Engineering Draftspersons and Technicians
Electrical Engineering Draftspersons and Technicians assist in electrical engineering research, design, manufacture, assembly, construction, operation and maintenance of equipment, facilities and distribution systems.

This short-term pathway has a **68% skills match** and will require upskilling as workers switch both occupation and industry. This pathway would also require a VET qualification in electrical engineering or another related field.

Growth in this field will be driven by both new opportunities and investment in renewable energy as a result of decarbonisation as well as underlying economic activity as the economy grows, fuelling construction and other industry demand for electrical services.

Medium-term pathway: Surveyors and Spatial Scientists
Surveyors and Spatial Scientists plan, direct and conduct survey work to determine and delineate boundaries and features of tracts of land, prepare and revise maps, and analyse, present and maintain geographical information about locations in space and time.

This medium-term pathway has a **54% skills match.** In order for workers employed as Drillers, Miners and Shot firers to pursue this pathway, they will require undertaking further study (i.e. a relevant university qualification), which usually takes around 2-4 years to complete (depending on prerequisites of the individual).

This is occupation has stable future growth as it is needed in a variety of different industries and will support the decarbonisation activities.

Central Queensland

Who will need to move jobs as Central Queensland decarbonises?

Drillers, Miners and Shot Firers

36,600 regional workers are currently employed as Drillers, Miners and Shot Firers. It is expected that over the next 9 years, 650 workers will need to transition into a new job. This disruption is both based on a reduction in international demand for fossil fuels and the impact of automation, which has recently been slowing demand for workers in this occupation.

Repurposing existing skills..

Potential training pathway: Electrical Engineering Draftspersons and Technicians

- 68% Skills-match. On-the-job training or VET course required.
- This job is non-routine and manual in nature, jobs growth in this occupation (170 new jobs in CQ) supports the rise of new technology and machinery that will evolve over time.
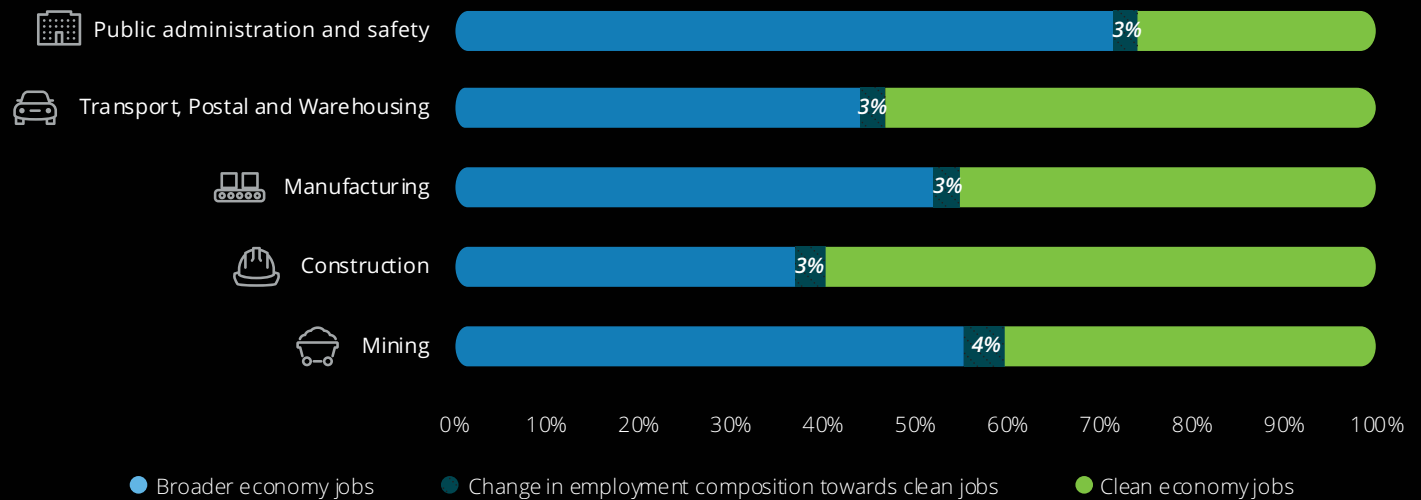
Finding new ones..

Potential economic growth opportunity: Remote Sensing Technician (new and emerging job).

- 60% Skills-match. formal upskilling is required.

Regional occupation composition between clean and broader economy jobs, 2021-2030

Industry	Change
Public administration and safety	3%
Transport, Postal and Warehousing	3%
Manufacturing	3%
Construction	3%
Mining	4%

Scale: 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

- Broader economy jobs
- Change in employment composition towards clean jobs
- Clean economy jobs

What does a change in composition in Central Queensland industries mean?

The significant occupation composition change in Public Administration, Manufacturing, Transport, Construction and Mining industries in CQ towards clean economy jobs, means that demand for clean economy jobs will outpace broader economy jobs in these industries out to 2030. This is expected to occur as labour is directed to activities that support decarbonisation and climate change adaptation in Queensland and the rest of the world. Some of the fasting growing occupations to support this transformation are:

Earthmoving Plant Operators
⬆ 2.3% growth (1,500 jobs)

Production Managers
⬆ 3.2% growth (1,300 jobs)

Contract, Program and Project Administrators
⬆ 3.9% growth (1,700 jobs)

Electricians
⬆ 2.0% growth (3,000 jobs)

Carpenters and Joiners
⬆ 2.5% growth (1,000 jobs)

Plumbers
⬆ 2.3% growth (900 jobs)

South West Queensland

The region's traditional strengths in construction and agriculture continue to support economic and employment growth in the region out to 2050, while an increase in decarbonisation activities supports the emergence of new labour markets.

South West Queensland consists of Outback – South and West Darling Downs – Maranoa. It is highly reliant on agriculture, which contributes 35% of total industry output as of 2021. This industry is vulnerable to climate impacts such as extreme heat and drought. As such, it has much to gain in a scenario where these are mitigated, and the economy can flourish.

Mining is significant in the region, specifically gas extraction, and so South West Queensland is expected to experience change under a net zero pathway as the economy reorients itself to cleaner sources of energy.

The traditional strengths across the region in construction and agriculture will continue to support economic and employment growth out to 2050, while an increase in decarbonisation activities supports the emergence of new labour markets.

- **Construction** more than doubles between 2021 and 2050, from contributing $749 million in 2021 to $1.5 billion in 2050.This equates to a compound annual growth rate of 2.6%.

- **Agriculture** almost doubles between 2021 and 2050, as a result of both switching as well as avoided climate damages. This industry sees the second largest growth in terms of levels, growing from contributing $4 million to the economy in 2021 to $8 million in 2050.

Employment

The industry structure of South West Queensland sees little change under a net zero scenario. The small amount of employment in mining switches to its largest employing industries, such as agriculture, public services and construction. The strengthening of these industries outweighs the small employment falls in mining and heavy manufacturing. In fact, the region is projected to see a net gain of 12,000 jobs by 2050.

As shown in the below case study, the mining industry experiences the greatest change in occupation compositions from those that are highly related to carbon intensive activities to those that support the expansion of base metal mining and the development of renewable energy generation activities. This change is also expected to occur in the electricity, gas, water and waste service sector where the sector shifts from emissions intensive activities (i.e. oil and gas) to renewables.

Current investment in renewables

The Western Downs Green Power Hub is a large solar farm project under construction. Once built, it will be Australia's largest operating solar farm at a size of 460 MW of installed solar panels. The site also holds up to 150MW battery energy storage potential.

Employment pathway for Chemical, Gas, Petroleum and Power Generation Plant Operators

This employment pathway example demonstrates how current skills in the labour market may be repurposed to support the delivery of key renewable energy projects.

There are a number of chemical, gas, petroleum and power generation plant operators employed in fossil fuel industries. However, decarbonisation is expected to change the nature of this occupation as the local and global economy switch from fossil fuels to renewable energy sources.

Immediate pathways

Chemical, Gas, Petroleum and Power Generation Plant Operators have skills that are demanded elsewhere in the economy; however, all identified immediate pathways would likely be undesirable to workers as they would require accepting a reduced wage. As renewable industries expand, workers within this occupation group will have the opportunity to move from one industry that is slowing in growth (e.g. gas) to one that is expanding (e.g. hydrogen) as Queensland decarbonises. These new and emerging industries will experience significant growth in Queensland as investment and technological change accelerates the uptake of renewable energy.

Potential training pathways

Chemical, gas, petroleum and power generation plant operators also have short and medium-term pathways available that require additional training.

Short-term pathway: Nanotechnology Engineering Technician

This short-term pathway has a **78% skills match** and will require upskilling as workers switch both occupation and industry. This pathway would also require a VET qualification.

Medium-term pathway: Electromechanical Engineering Technologist (emerging)

This medium-term pathway has a **70% skills match** and will require upskilling as workers switch both occupation and industry. This pathway would require a university degree to pursue.

This occupation has stable future growth as it is needed to support the new technology and machinery that arises as a result of investment and economic stimulation provided by decarbonisation. Not only will this occupation be demanded by new renewable energy industries, but across the economy as well.

South West Queensland

Who will need to move jobs as South West Queensland decarbonises?

Chemical, Gas, Petroleum and Power Generation Plant Operators

100 local workers are currently employed as a Chemical, Gas, Petroleum and Power Generation Plant Operators. The reduction in economic activity within the gas and petroleum industries will reduce demand for these workers; however, these operators will be demanded in emerging sectors, such as biofuels and hydrogen. This occupation experiences positive annual growth; however, some workers may need to switch industries during the transformation of the energy mix.

Repurposing existing skills..

Chemical, Gas, Petroleum and Power Generation Plant Operators also have potential training pathways into Motor Mechanics

- 77% Skills-match. On-the-job training or VET course required.
- Although routine and manual in nature, jobs growth in this occupation (40 new jobs in South West Queensland) supports the rise of automation and machinery as companies require skilled labour in machine maintenance.
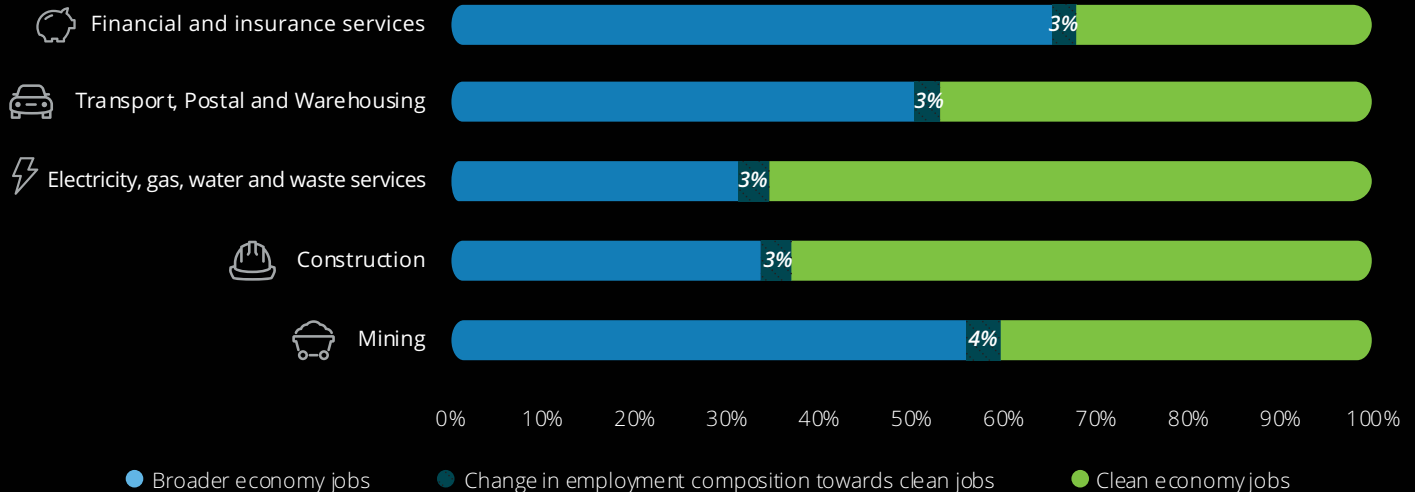
Finding new ones..

Potential economic growth opportunity: Nanotechnology Engineering Technician (new and emerging job).

- 78% Skills-match. On-the-job training or formal training maybe required.

Regional occupation composition between clean and broader economy jobs, 2021-2030

Financial and insurance services — 3%
Transport, Postal and Warehousing — 3%
Electricity, gas, water and waste services — 3%
Construction — 3%
Mining — 4%

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

● Broader economy jobs ● Change in employment composition towards clean jobs ● Clean economy jobs

What does a change in composition in South West Queensland industries mean?

The significant occupation composition change in Finance, Transport, Utilities, Construction and Mining industries in South West Queensland towards clean economy jobs, means that demand for clean economy jobs will outpace broader economy jobs in these industries out to 2030. This is expected to occur as labour is directed to activities that support decarbonisation and climate change adaptation in Queensland and the rest of the world. Some of the fasting growing occupations to support this transformation are:

Construction Managers
↑ 3.4% growth
(100 jobs)

Contract, Program and Project Administrators
↑ 3.9% growth
(100 jobs)

Truck Driver
↑ 2.6% growth
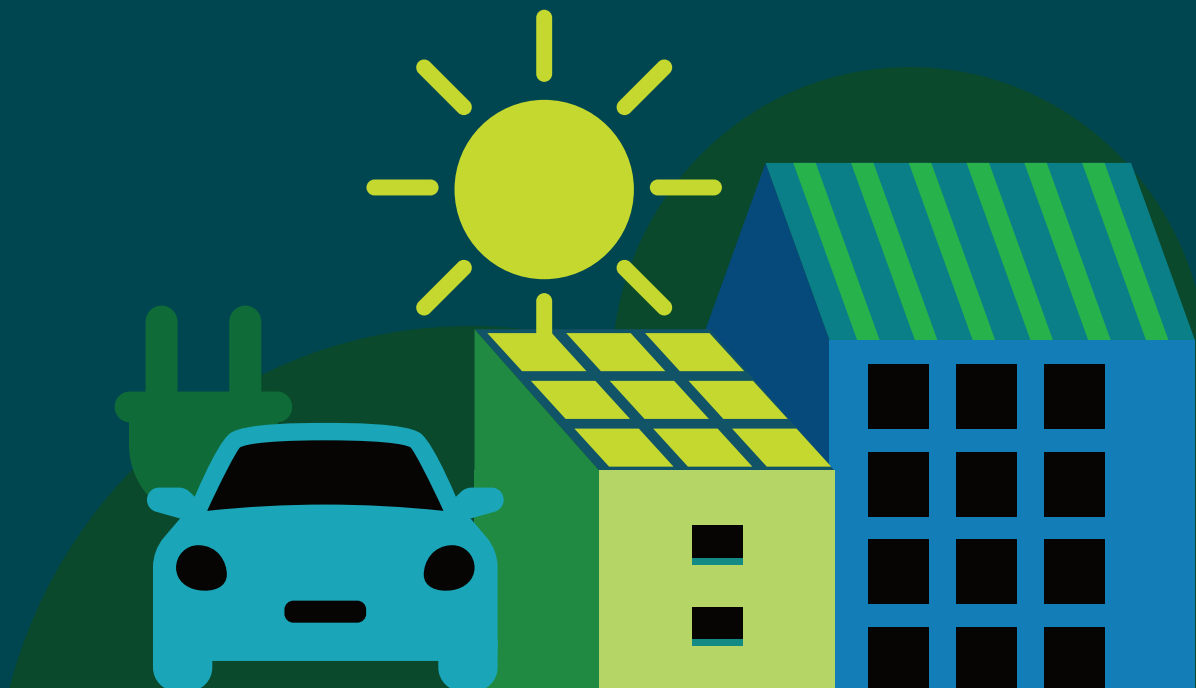(200 jobs)

Electricians
↑ 2.0% growth
(100 jobs)

Metal Fitters and Machinists
↑ 1.8% growth
(100 jobs)

Mixed Crop and Livestock Farmers
↑ 1.8% growth
(100 jobs)

Policy considerations

5 What matters for public policy?

Queensland requires a plan of action that will enable policy makers to respond to identified challenges, minimise worker disruption, and deliver a pipeline of skilled and retrained workers needed in a successful economic transformation to net zero.

The quality of clean jobs

As the Queensland economy structurally adjusts under the forces of Queensland's and the rest of the world's decarbonisation targets, there will be declining demand for labour in parts of the economy (e.g. carbon intensive activities) and increased demand in others. To enable this to happen rapidly, business and industry will need to access alternative pools of supply, as demand for particular occupations rapidly increases over the transformation period.

But is a transformation into a 'clean occupation' from a broader economy occupation a good social outcome?

Using the Australian National University's Australian Socioeconomic Index 2006 against our occupation categories, it was identified that **on average, clean economy jobs are of a higher quality compared to broader economy jobs.**

The Index provides a score for each occupation based on the average level of education required and earnings in that occupation – the higher the score, the higher the 'quality' of the job – a 'good' job that supports a higher standard of living (Appendix B). The scale is a continuous measure which ranges from 0 (lower quality) to 100 (higher quality).[14]

Clean economy jobs have an average score of 68, while broader economy jobs have an average score of 51. By increasing the demand for **clean economy jobs in the economy, Queensland can increase the level of education and wages – and the standard of living – in the economy.**

To guide labour into these clean economy jobs (including new labour market entrants e.g. graduates), there needs to be the right policy settings to enable labour mobility (directing workers to where they can add high-value), upskilling and training.

The supply of clean economy skills

The report has provided evidence that skills are a vital part of the Queensland economy achieving net zero. For these skills to be available when and where they are needed, it is vital that central education and training policy plays a key role in supporting the materialisation of these new transformation pathways.

- **Central policy makers** have an overarching role to influence employment and training outcomes by providing policy direction and incentives that encourage economic growth and labour mobility – creating the demand and directing skills to where they are needed most in the economy – and upskilling in the workplace.

- **Education and training policy makers** have a role in ensuring that the education and training system is responsive to the changing needs of industry. This includes adjustments to what is offered (courses and qualifications) and how it is offered (e.g. online, apprenticeship models, etc.)

Tailored policy mechanisms to move workers to key areas of demand

In times of structural adjustment there is an important role for proactive policy to direct workers and jobseekers to areas of high demand via a job transition or an appropriate training pathway. This is often done through incentives, either to encourage training in priority areas (e.g. Priority Skills List, Skilling Queenslanders for Work) or encourages employers to prioritise hiring jobseekers (e.g. Back-to-Work program). Both policy mechanisms could be used to move skills and labour where and when they are needed in the net zero transformation. Further research is required to identify the priority qualifications to support the transformation and determine whether they will be provided at the required quantity (baseline supply of skills).

Incentives to encourage upskilling while employed

To minimise disruptions to people's employment, businesses need to be encouraged to direct employees towards upskilling/reskilling opportunities. This will enable workers to upskill and adjust their skill set to the changing requirements of a role, or redirect labour from low priority areas into high priority expansionary areas of the business. This provides a direct link between what industry demands and what the education and training system delivers.

A potential policy mechanism to encourage businesses to direct their employees to upskill, could be in the form of training subsidies that can be exclusively accessed by businesses that are adapting new decarbonisation technologies and practices. This will afford small to medium businesses access to the skills required to efficiently decarbonise.

Increase the capacity of education and training sector to provide clean economy skills

The education and training sector has a role in providing a quality pipeline of educated workers to enter or re-enter the workforce that meet the changing demands of businesses. This includes understanding and responding to how the **demand for skills** will shift during transformation– *where are the gaps in the current course offering? How will the priority course list need to change under this transformation?*

New economic structures that will fall out of rapid decarbonisation will require workers to have both qualifications as we know them today, and an ability to obtain incremental skills required to optimise roductivity and their employment pathway potential. This will require the education and training system to be adaptive to how they **supply skills** to Queenslanders – in what form will graduates, workers and jobseekers need to access these courses (e.g. short course skills; online or apprenticeship training models)?

For the education and training system to be operating efficiently, continuous mapping of economic growth with labour (occupations) and skill needs is required – a distinction even more important when navigating structural changes in the economy.

It would be beneficial for the Queensland education and training system to understand the unique skill sets of emerging clean occupations to determine whether they are significantly different from those captured in the ANZSCO framework. This will provide an indication as to whether ANZSCO-associated training products are appropriate in supporting employment pathways into emerging clean economy occupations or whether modifications to courses (e.g. module changes) are required.
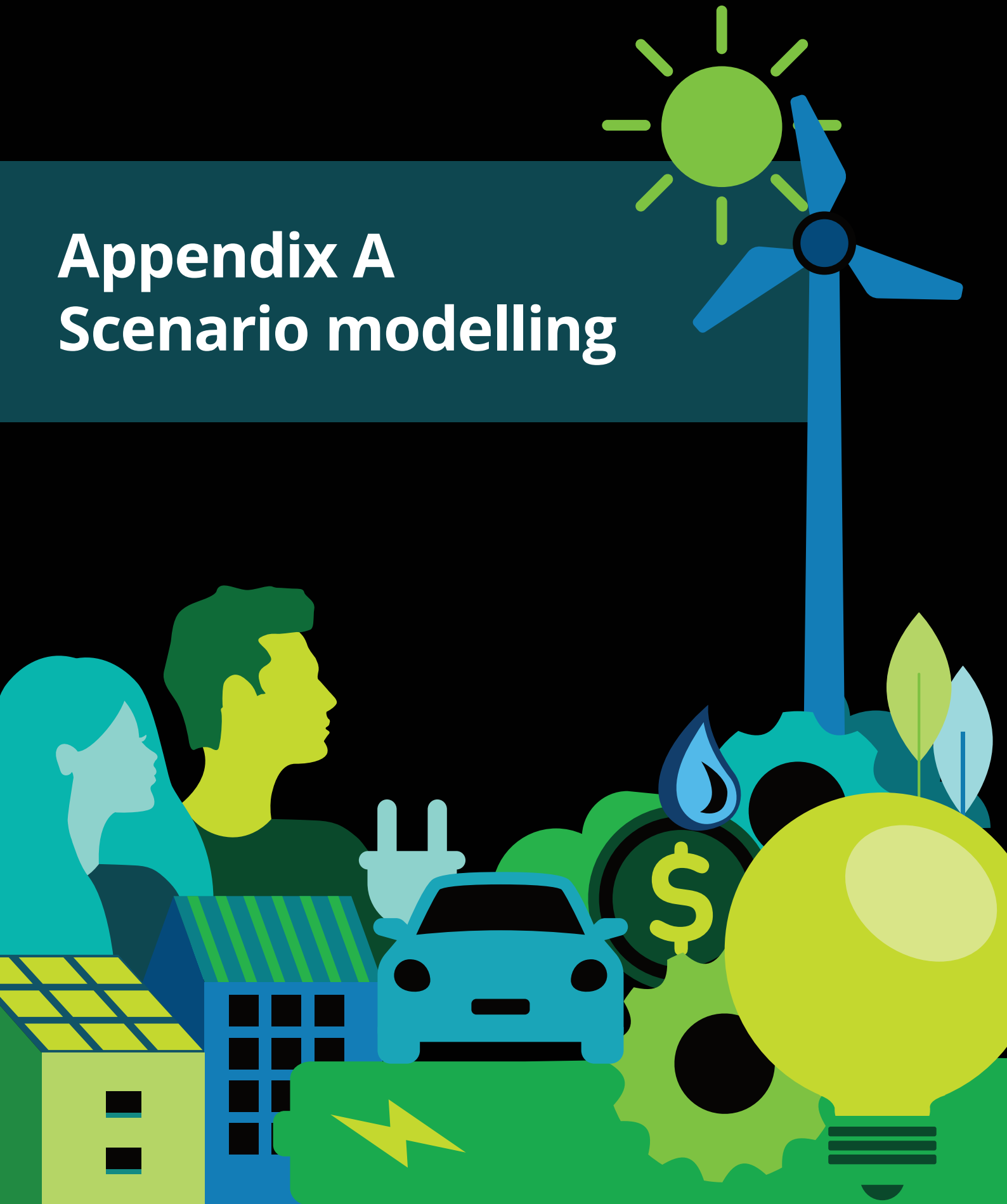
This will allow the sector to incorporate this information into their provision planning and identify potential training capability or provider capacity constraints that might inhibit the sector delivering the future skills Queensland needs to meet net zero.

Technical appendix
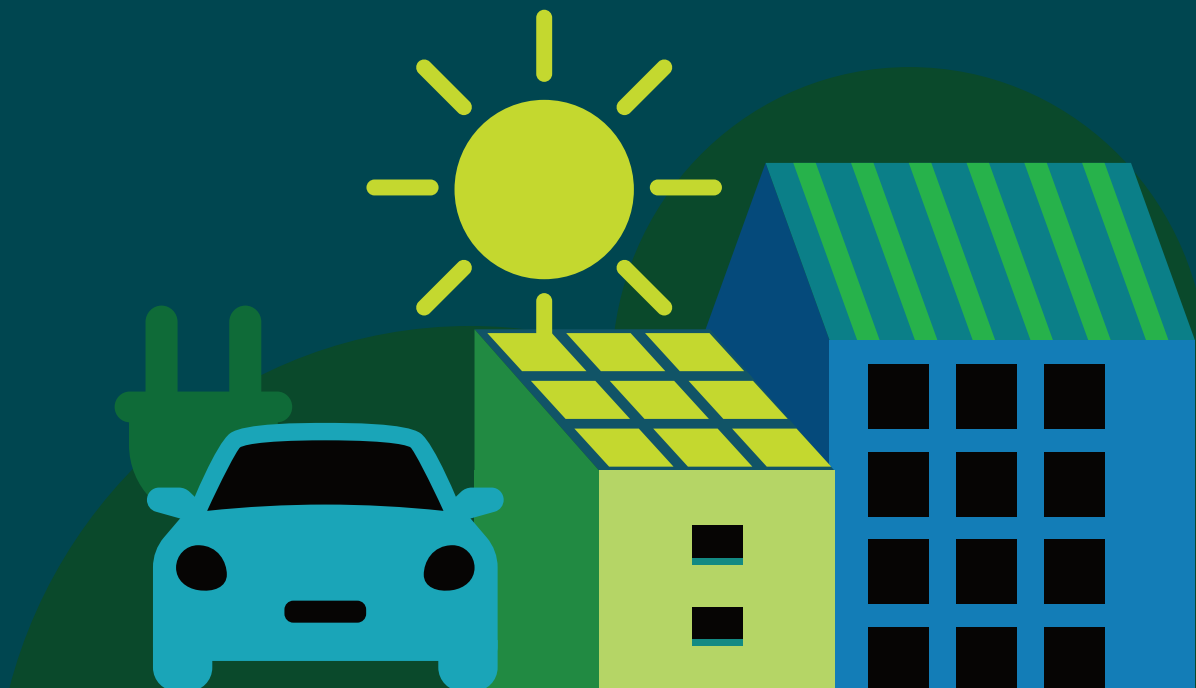
Appendix A
Scenario modelling

A.1. Overview D.CLIMATE modelling framework

D.CLIMATE – which has been tested in Australian state jurisdictions – is a modelling methodology and policy analysis technique that seeks to 'correct' the typical business as usual baseline assumed in most modelling.

This model – that was employed as part of Deloitte Access Economics thought leadership - is built on an economic modelling framework that accounts for the economic impacts of climate change and establishes a reference case that has been modelled to the year 2050. The D.CLIMATE process and logic is as follows:

1. The modelling produces an economic baseline which draws on short-to-medium-term global and regional forecasts in combination with a long run assumption of contraction and convergence.

2. The baseline economic growth path has an associated emissions growth path – derived from the established link between economic flows and emissions – and this corresponds to an evolution in atmospheric greenhouse gas concentration which rise in line with a Representative Concentrative Pathway (RCP).

3. Rising atmospheric concentrations of greenhouse gases causes global warming above pre-industrial levels.

4. Warming causes shifts in global climate patterns and results in damages to the factors of production and their productivities.

5. Damages to factors of production are distributed across the economy, impacting Gross Domestic Product.

6. These feedbacks become inputs back into the model to determine the associated deviation in economic activity associated with a given level of warming (i.e. the damages).

Translating this concept into a modelling process involves three models which are linked through three key outputs. Deloitte Access Economics' approach extends methods adopted by the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), the Intergovernmental Panel on Climate Change (IPCC) and other research organisations. The method is extended by necessity for practical public policy purposes and the modelling is regionalised – allowing results and insights to be produced at the regional level (such as countries or regions or more granular geographies such as statistical or local government areas). The modelling process is summarised below:

1. Deloitte's in-house regional Computable General Equilibrium model (DAE-RGEM) is used to produce a projected path for economic output and emissions that align with a chosen RCP (refer to Figure B.1 overleaf for a stylised representation of this model).

2. For each RCP scenario, the associated climate data (like annual temperature increases and atmospheric concentrations) are sourced from a synthesis of the models available through the Coupled Modelling Intercomparison Project (CMIP6).

3. This climate data becomes inputs into damage functions to inform how shifts in temperature may play out in terms of impacts on the stocks and productivities of factors of production in each sector/region. Unlike most other models, we model a broad range of damages, including capital damages, sea level rise damages to land stock, heat stress damages on labour productivity, human health damages to labour productivity, agricultural damages from changes in crop yields, tourism damages to net inflow of foreign currency and damages to energy demand.

Understanding the net zero scenario parameters

Deloitte Access Economics has modelled a scenario that reflects Queensland, Australia, and the world, achieving net zero emissions by 2050.

- For Australia, net zero by 2050 requires an approximate 80% reduction of greenhouse gas equivalent emissions on 2005 levels, excluding land use change and forestry. Queensland is modelled in terms of its relative share of this abatement.

- Of this, around 100Mt (or around 20%) is expected to be offset or captured via carbon sinks in 2050 in Australia.

In both this scenario and the baseline outlook for the world, Queensland experiences a similar degree of 'locked in' global average warming out to 2050. Beyond 2050, the net zero scenario would result in a significant increase in sector output due to avoided climate change damages, relative to the baseline.

A.2. Scenario modelling

Scenario modelling provides alternative views of the future so that near-term decisions can be considered in a range of future worlds. Specifically, where there is a need to analyse the relationships between technology development and global climate action, and the influence of technology costs and global climate action on Queensland's emissions profile and economic outcomes.

The absence of a common – and robustly quantified – view on the possible range of economic consequences of such relationships in Queensland (and the distribution of those effects across industries, regions and time) will likely weigh on the policy making process. As such, this report leverages modelling from Deloitte Access Economics Thought Leadership on the structural economic impacts in Queensland by region,

industry and over time under two alternative economic futures:

- **Baseline scenario: A future where climate change is unmitigated –** This baseline reflects historical trends in Queensland's resource sector and assumes no further government initiatives to decarbonise. It incorporates climate induced economic damages under an RCP6.0 emissions trajectory.

- **Net zero scenario: A future where Queensland and the world rapidly decarbonises –** Queensland positions itself for growth by decarbonising rapidly and capitalising on new demand from the Indo-Pacific region and emerging innovations for productivity in the resources sector. The modelling imposes a carbon budget to ensure this broadly aligns with RCP2.6.

Queensland regions for modelling purposes and the impacts on the labour market are defined in Figure A.1.

Figure A.1: Scope of Queensland regions modelled

- South West Queensland
- North Queensland
- Central Queensland
- South East Queensland
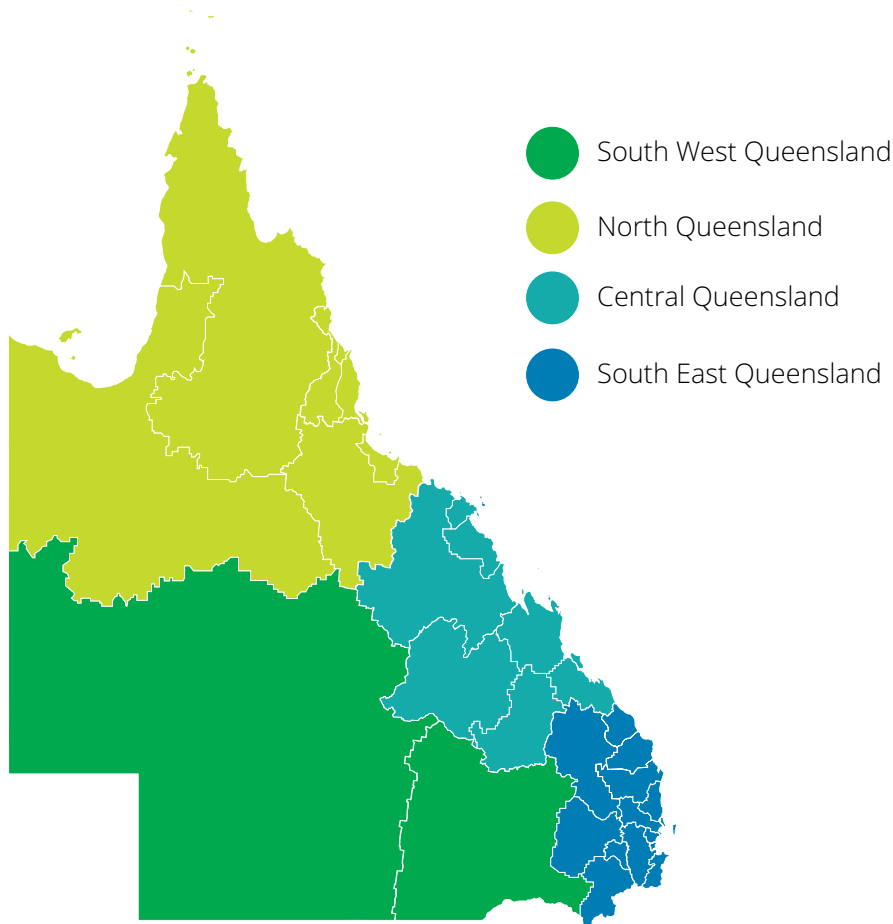
A.2.1. Baseline: A future where climate change is unmitigated

In recognising the human influence that has and continues to warm the atmosphere, ocean and land, it must also be acknowledged that unmitigated climate change will place a heavy burden on the standards of living for Queenslanders.

The baseline for the Queensland economy is designed as a reference case to reflect no further significant policy change or action from today, and therefore includes damages from unmitigated climate change using the parameters of a 6.0 Representative Concentration Pathway (RCP6.0). This is an economic and emissions trajectory that produces global average warming of over 3°C by 2100.

In this baseline view of no further significant action or change from today, not only is there relative economic decline, but the composition and quality of long-term growth is changed.

The analysis in this report differs from scenario analyses that compare alternative future states to a "business as usual" trend that assumes unconstrained economic growth via emissions intensive economic production. Incorporating this baseline view is critical to understanding the longer-term effects of climate change on productivity, output, and economic growth, where future states need to consider the relative impacts of the economy moving to a low-emissions footing.

A.2.2. Rapid Decarbonisation: A future where Queensland and the world rapidly decarbonises

In this scenario, Queensland positions itself for growth by rapidly coordinating domestic decarbonisation and value-chain reorientation to capitalise on shifts in global demand. Both Queensland and the world decarbonises and transforms production systems, develops new markets, and restructures their economies. This rapid decarbonisation puts Queensland and the world on a pathway to successfully decarbonise by 2050, limiting global average warming and mitigating many of the damages associated with unconstrained emissions pathways.

By structurally adjusting, Queensland has the opportunity to capitalise on a new, renewable pathway. This leads to a more resilient and diversified economy, which is well positioned for growth beyond 2050.

In this scenario the forces of structural economic change impact the Queensland economy via:

- Queensland and the world **reducing their emissions** in line with a RCP 2.6 profile.

- Reorienting **markets and production systems,** resulting in new global demand for clean energy and products that support low-emissions economic activity.

- **Capitalising on new sources of demand** across the value-chain, including for emerging areas of clean energy and mineral resources that support these renewables.

- Adopting new emerging innovation and technologies to **drive productivity** throughout the economy.

In both this scenario and the baseline outlook for the world, Queensland experiences a similar degree of 'locked in' global average warming out to 2050. Beyond 2050, the net zero scenario would result in a significant increase in sector output due to avoided climate change damages, relative to the baseline.

Although in this scenario Queensland and the rest of the world rapidly decarbonises, the impacts of 'locked in' damages from current emissions and those that are emitted until net zero is reached are captured in the results.

These costs occur in the medium-term, as a result of unavoidable global average warming caused by current emissions, and the inevitable costs associated with the level of structural adjustment required while moving to net zero by 2050. This 'locked in' warming from today's emissions will still have an impact on regions and industries that are vulnerable to climate change. This will affect growth in the short-term towards 2050 before stabilising in the long run, contingent on emissions being curtailed earlier in the century.

Under a damages baseline where the nation and globe fails to act on climate change, all regions in Queensland experience economic decline as a result of unmitigated damages in a warming world. Alternatively, all regions under a net zero pathways reap economic benefits as further climate damages are avoided and Queensland can capitalises on new markets.

A.3. Detailed rapid decarbonisation results

Queensland's economy has historically been driven by strong mining and tourism sectors, which contributed 11.7% and 3.8% to the Queensland economy in 2019-20, respectively. However, both of these significant sectors are at risk in an emissions intensive pathway without decarbonisation.

The mining sector feels the cost of rising temperature through capital damage and heat stress on labour productivity, but also struggles to reconcile with the decreasing demand for emissions intensive resources as the rest of the world decarbonises. Meanwhile, tourism is impacted through damage to Queensland's natural assets caused by rising temperatures and extreme weather events. These impacts are a direct result of warming that has already been 'locked in' from past emissions.

Queensland cannot change the past but does have bandwidth to impact the future – both in terms of reducing emissions and limiting warming, but also in establishing new competitive advantages that will fall out of a planned and coordinated transformation.

Queensland has an abundance of natural resources that can be directed towards renewable energy and decarbonisation technologies, which will in turn contribute to mitigating global temperature rise and safeguard some of our most prominent industries.

As Queensland and the rest of the world rapidly decarbonises, economies will structurally adjust. This will have implications for Queensland emissions intensive industries, such as coal and gas, as global demand shifts towards renewables, such as hydrogen and base metals.

In this scenario, Queensland reorients its economy to maintain strategic advantages in global trade as global demand shifts under the forces of decarbonisation. As a result of getting this right, this scenario estimates that the emerging renewables sector in Queensland becomes a key economic player.

Over the transformation period to 2050, bioenergy is expected to grow annually by 15%, hydrogen by 13% annually and clean electricity (electricity created from wind and solar energy) by 13% annually.* This comes as a result of economic structural adjustment and is supported as industry shifts away from emissions intensive industries.

The Queensland economy strengthens its existing primary sectors in a net zero scenario. The largest growing sector between 2021 and 2050 is private services, which is estimated to grow by almost $254 billion (33% of industry share), to a total contribution of $417 billion in 2050. This is followed by construction and retail and tourism, which will grow by almost $106 and $90 billion, respectively, over the same period. This growth in retail and trade also indicates that by reorienting its economy, Queensland is able to minimise the future impacts of heat stress on labour productivity and damages to our natural tourism assets.

This shows that the Queensland economy as a whole benefits from rapid decarbonation, with further economic gains expected post-2050, once Queensland and the global economy has decarbonised.

Employment

In a net zero scenario, Queensland's workforce structurally adapts to the opportunities presented by decarbonisation. Not only is there significant growth in emerging clean jobs, but Queensland's foundational industries, such as services and construction, also benefit. In fact, it is government services and construction that see a much greater industry share in a net zero future.

This growth in industry share is a result of new opportunities and investments stimulating growth in the construction industry, whilst population services grow to service the growing industry and economic activity. Another component of this growth comes from the fact that Queensland is able to largely avoid climate change induced damage to employment quality and quantity, and also benefits from reorienting its economy to align itself with future global demand and economic opportunities.

*growth rates are CAGR

The fastest growing jobs in a net zero scenario are predictably clean jobs that expand as the economy decarbonises. Bioenergy sees the fastest employment growth, as full-time equivalent (FTE) jobs increase from 80 to 1500 as the industry become established between 2021 and 2050. Hydrogen sees high growth, increasing from 130 to 1,800 FTEs between 2021 and 2050. Clean electricity also sees significant growth with the number of FTE jobs increasing from 550 to 5,700 as renewable energy increases its share of the energy mix between 2021 and 2050.

In addition to these emerging industries, there are also strong growth in traditional sectors that will continue to supply employment opportunity for Queenslanders:

- Government services is expected to grow from 475,000 jobs in 2021 to 776,000 in 2050.

- Construction experiences significant growth of an additional 168,000 FTE jobs by 2050, fuelled by increased construction activity as emerging industries begin to establish themselves.

- Retail and tourism is also expected to experience strong growth, adding an additional 155,000 FTE jobs between 2021 and 2050.

- Base metal mining increases by 8,800 FTE jobs between 2021 and 2050. So, while decarbonisation does necessitate a restructure of the workforce, and therefore some job losses, there are plenty of avenues for workers to follow.
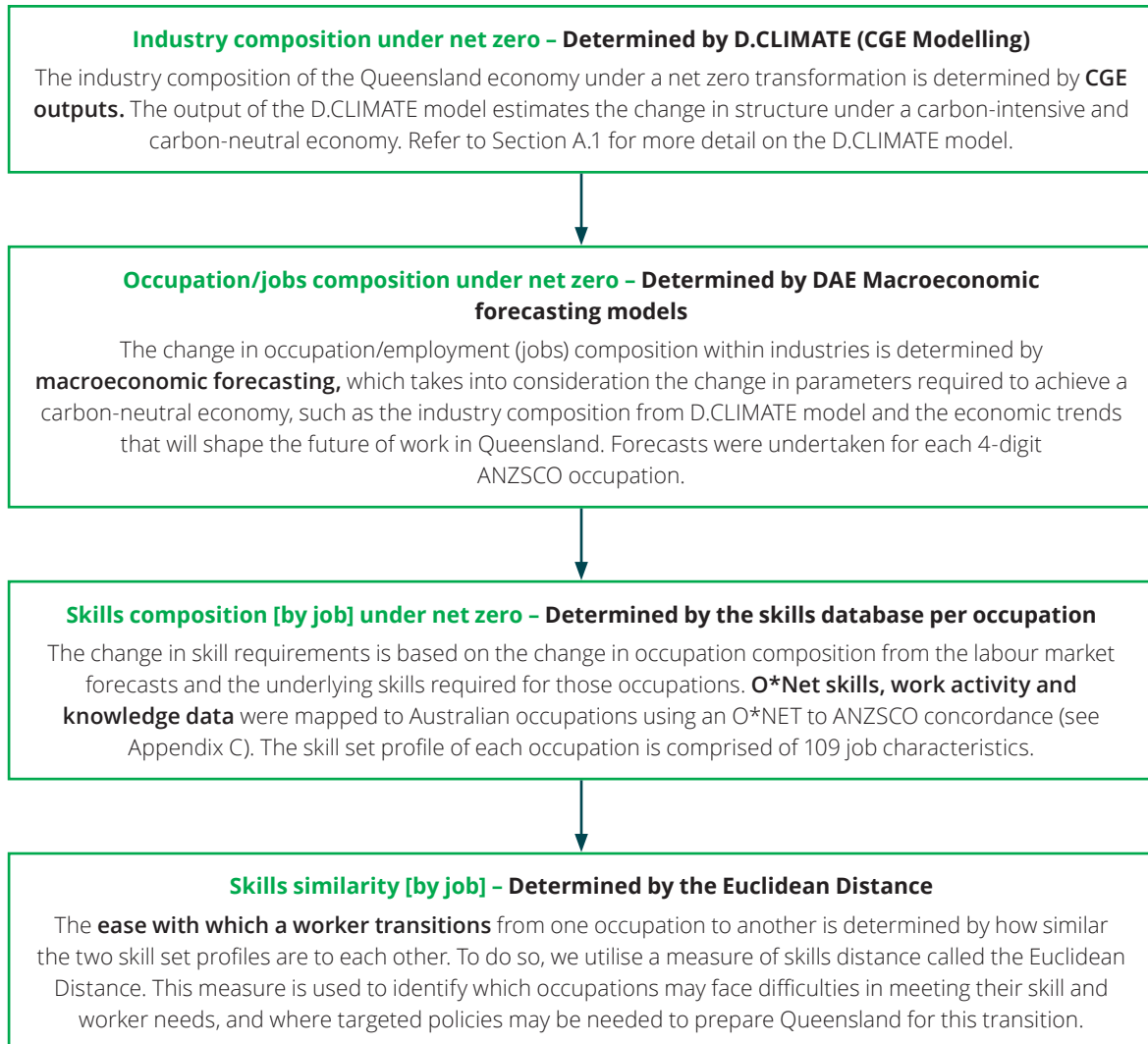
Appendix B
How we measure skill similarity

B.1. Overview of methodology

This project utilised the outputs from four distinct economic modelling and analytical approaches (i.e. CGE forecasting, macroeconomic forecasting, skill similarity measures and linear programming). To ensure consistency and cohesiveness, several global project parameters were utilised across the different workstreams.

Industry composition under net zero – Determined by D.CLIMATE (CGE Modelling)

The industry composition of the Queensland economy under a net zero transformation is determined by **CGE outputs.** The output of the D.CLIMATE model estimates the change in structure under a carbon-intensive and carbon-neutral economy. Refer to Section A.1 for more detail on the D.CLIMATE model.

Occupation/jobs composition under net zero – Determined by DAE Macroeconomic forecasting models

The change in occupation/employment (jobs) composition within industries is determined by **macroeconomic forecasting,** which takes into consideration the change in parameters required to achieve a carbon-neutral economy, such as the industry composition from D.CLIMATE model and the economic trends that will shape the future of work in Queensland. Forecasts were undertaken for each 4-digit ANZSCO occupation.

Skills composition [by job] under net zero – Determined by the skills database per occupation

The change in skill requirements is based on the change in occupation composition from the labour market forecasts and the underlying skills required for those occupations. **O*Net skills, work activity and knowledge data** were mapped to Australian occupations using an O*NET to ANZSCO concordance (see Appendix C). The skill set profile of each occupation is comprised of 109 job characteristics.

Skills similarity [by job] – Determined by the Euclidean Distance

The **ease with which a worker transitions** from one occupation to another is determined by how similar the two skill set profiles are to each other. To do so, we utilise a measure of skills distance called the Euclidean Distance. This measure is used to identify which occupations may face difficulties in meeting their skill and worker needs, and where targeted policies may be needed to prepare Queensland for this transition.

Appendix C
Skills database

Developed in the United States, the Occupational Information Network (O*NET) is a comprehensive system for exploring information about jobs. The O*NET database contains a rich set of variables that describe work and worker characteristics, including skill requirements.

In this paper we use five O*NET data sets: Knowledge, Skills, Work Activities, Job Zones and Green Economy Sector. We utilised the concordance developed by the Australian Government Department of Jobs and Small Business for their Job Outlook initiative to convert these data sets to Australian Occupations.

C.1.1. Knowledge

The Knowledge datasets displays a collection of discrete but related and original facts, information, and principles about a certain domain that is *acquired through education, training, or experience.*

Element ID	Element Name	Description
2.C.1.a	Administration and Management	Knowledge of business and management principles involved in strategic planning, resource allocation, human resources modelling, leadership technique, production methods, and coordination of people and resources.
2.C.1.b	Clerical	Knowledge of administrative and clerical procedures and systems such as word processing, managing files and records, stenography and transcription, designing forms, and other office procedures and terminology.
2.C.1.c	Economics and Accounting	Knowledge of economic and accounting principles and practices, the financial markets, banking and the analysis and reporting of financial data.
2.C.1.d	Sales and Marketing	Knowledge of principles and methods for showing, promoting, and selling products or services. This includes marketing strategy and tactics, product demonstration, sales techniques, and sales control systems.
2.C.1.e	Customer and Personal Service	Knowledge of principles and processes for providing customer and personal services. This includes customer needs assessment, meeting quality standards for services, and evaluation of customer satisfaction.
2.C.1.f	Personnel and Human Resources	Knowledge of principles and procedures for personnel recruitment, selection, training, compensation and benefits, labour relations and negotiation, and personnel information systems.
2.C.2.a	Production and Processing	Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximising the effective manufacture and distribution of goods.
2.C.2.b	Food Production	Knowledge of techniques and equipment for planting, growing, and harvesting food products (both plant and animal) for consumption, including storage/handling techniques.
2.C.3.a	Computers and Electronics	Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming.
2.C.3.b	Engineering and Technology	Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.
2.C.3.c	Design	Knowledge of design techniques, tools, and principals involved in production of precision technical plans, blueprints, drawings, and models.

Element ID	Element Name	Description
2.C.3.d	Building and Construction	Knowledge of materials, methods, and the tools involved in the construction or repair of houses, buildings, or other structures such as highways and roads.
2.C.3.e	Mechanical	Knowledge of machines and tools, including their designs, uses, repair, and maintenance.
2.C.4.a	Mathematics	Knowledge of arithmetic, algebra, geometry, calculus, statistics, and their applications.
2.C.4.b	Physics	Knowledge and prediction of physical principles, laws, their interrelationships, and applications to understanding fluid, material, and atmospheric dynamics, and mechanical, electrical, atomic and subatomic structures and processes.
2.C.4.c	Chemistry	Knowledge of the chemical composition, structure, and properties of substances and of the chemical processes and transformations that they undergo. This includes uses of chemicals and their interactions, danger signs, production techniques, and disposal methods.
2.C.4.d	Biology	Knowledge of plant and animal organisms, their tissues, cells, functions, interdependencies, and interactions with each other and the environment.
2.C.4.e	Psychology	Knowledge of human behaviour and performance; individual differences in ability, personality, and interests; learning and motivation; psychological research methods; and the assessment and treatment of behavioural and affective disorders.
2.C.4.f	Sociology and Anthropology	Knowledge of group behaviour and dynamics, societal trends and influences, human migrations, ethnicity, cultures and their history and origins.
2.C.4.g	Geography	Knowledge of principles and methods for describing the features of land, sea, and air masses, including their physical characteristics, locations, interrelationships, and distribution of plant, animal, and human life.
2.C.5.a	Medicine and Dentistry	Knowledge of the information and techniques needed to diagnose and treat human injuries, diseases, and deformities. This includes symptoms, treatment alternatives, drug properties and interactions, and preventive health-care measures.
2.C.5.b	Therapy and Counselling	Knowledge of principles, methods, and procedures for diagnosis, treatment, and rehabilitation of physical and mental dysfunctions, and for career counselling and guidance.
2.C.6	Education and Training	Knowledge of principles and methods for curriculum and training design, teaching and instruction for individuals and groups, and the measurement of training effects.
2.C.7.a	English Language	Knowledge of the structure and content of the English language including the meaning and spelling of words, rules of composition, and grammar.

Element ID	Element Name	Description
2.C.7.b	Foreign Language	Knowledge of the structure and content of a foreign (non-English) language including the meaning and spelling of words, rules of composition and grammar, and pronunciation.
2.C.7.c	Fine Arts	Knowledge of the theory and techniques required to compose, produce, and perform works of music, dance, visual arts, drama, and sculpture.
2.C.7.d	History and Archaeology	Knowledge of historical events and their causes, indicators, and effects on civilisations and cultures.
2.C.7.e	Philosophy and Theology	Knowledge of different philosophical systems and religions. This includes their basic principles, values, ethics, ways of thinking, customs, practices, and their impact on human culture.
2.C.8.a	Public Safety and Security	Knowledge of relevant equipment, policies, procedures, and strategies to promote effective local, state, or national security operations for the protection of people, data, property, and institutions
2.C.8.b	Law and Government	Knowledge of laws, legal codes, court procedures, precedents, government regulations, executive orders, agency rules, and the democratic political process.
2.C.9.a	Telecommunications	Knowledge of transmission, broadcasting, switching, control, and operation of telecommunications systems.
2.C.9.b	Communications and Media	Knowledge of media production, communication, and dissemination techniques and methods. This includes alternative ways to inform and entertain via written, oral, and visual media.
2.C.10	Transportation	Knowledge of principles and methods for moving people or goods by air, rail, sea, or road, including the relative costs and benefits.

Source: O*NET

C.1.2. Skills

The Skills O*NET dataset reflect capabilities of individuals that are acquired through experience and practice and are used to facilitate knowledge acquisition. The 35 elements below, can be broken down into six skills categories:

- **Basic Skills –** Developed capacities that facilitate learning or the more rapid acquisition of knowledge (e.g. active learning and listening)

- **Complex Problem-Solving Skills –** Developed capacities used to solve novel, ill-defined problems in complex, real-world settings

- **Resource Management Skills –** Developed capacities used to allocate resources efficiently

- **Social Skills –** Developed capacities used to work with people to achieve goals.

- **Systems Skills –** Developed capacities used to understand, monitor, and improve sociotechnical systems.

- **Technical Skills –** Developed capacities used to design, set-up, operate, and correct malfunctions involving application of machines or technological systems

Element ID	Element Name	Description
Basic skills		
2.A.1.a	Reading Comprehension	Understanding written sentences and paragraphs in work related documents.
2.A.1.b	Active Listening	Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times
2.A.1.c	Writing	Communicating effectively in writing as appropriate for the needs of the audience.
2.A.1.d	Speaking	Talking to others to convey information effectively.
2.A.1.e	Mathematics	Using mathematics to solve problems.
2.A.1.f	Science	Using scientific rules and methods to solve problems.
2.A.2.a	Critical Thinking	Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.
2.A.2.b	Active Learning	Understanding the implications of new information for both current and future problem-solving and decision-making.
2.A.2.c	Learning Strategies	Selecting and using training/instructional methods and procedures appropriate for the situation when learning or teaching new things.
2.A.2.d	Monitoring	Monitoring/Assessing performance of yourself, other individuals, or organisations to make improvements or take corrective action.
Social skills		
2.B.1.a	Social Perceptiveness	Being aware of others' reactions and understanding why they react as they do.
2.B.1.b	Coordination	Adjusting actions in relation to others' actions.
2.B.1.c	Persuasion	Persuading others to change their minds or behaviour.
2.B.1.d	Negotiation	Bringing others together and trying to reconcile differences.
2.B.1.e	Instructing	Teaching others how to do something.
2.B.1.f	Service Orientation	Actively looking for ways to help people.

Element ID	Element Name	Description
Complex problem-solving skills		
2.B.2.i	Complex Problem Solving	Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.
Technical skills		
2.B.3.a	Operations Analysis	Analysing needs and product requirements to create a design.
2.B.3.b	Technology Design	Generating or adapting equipment and technology to serve user needs.
2.B.3.c	Equipment Selection	Determining the kind of tools and equipment needed to do a job.
2.B.3.d	Installation	Installing equipment, machines, wiring, or programs to meet specifications.
2.B.3.e	Programming	Writing computer programs for various purposes.
2.B.3.g	Operation Monitoring	Watching gauges, dials, or other indicators to make sure a machine is working properly.
2.B.3.h	Operation and Control	Controlling operations of equipment or systems.
2.B.3.j	Equipment Maintenance	Performing routine maintenance on equipment and determining when and what kind of maintenance is needed.
2.B.3.k	Troubleshooting	Determining causes of operating errors and deciding what to do about it.
2.B.3.l	Repairing	Repairing machines or systems using the needed tools.
2.B.3.m	Quality Control Analysis	Conducting tests and inspections of products, services, or processes to evaluate quality or performance.
System skills		
2.B.4.e	Judgment and Decision Making	Considering the relative costs and benefits of potential actions to choose the most appropriate one.
2.B.4.g	Systems Analysis	Determining how a system should work and how changes in conditions, operations, and the environment will affect outcomes.
2.B.4.h	Systems Evaluation	Identifying measures or indicators of system performance and the actions needed to improve or correct performance, relative to the goals of the system.
Resource management skills		
2.B.5.a	Time Management	Managing one's own time and the time of others.
2.B.5.b	Management of Financial Resources	Determining how money will be spent to get the work done, and accounting for these expenditures.
2.B.5.c	Management of Material Resources	Obtaining and seeing to the appropriate use of equipment, facilities, and materials needed to do certain work.
2.B.5.d	Management of Personnel Resources	Motivating, developing, and directing people as they work, identifying the best people for the job.

Source: O*NET

C.1.3. Work activities

The Work Activities datasets is an aggregation of similar job activities/behaviours that underlie the accomplishment of major work functions". This dataset has 41 elements subsumed under four categories:

- **Information input –** Where and how are the information and data gained that are needed to perform this job?

- **Interacting with others –** What interactions with other persons or supervisory activities occur while performing this job?

- **Mental Processes –** What processing, planning, problem-solving, decision-making, and innovating activities are performed with job-relevant information?

- **Work Output –** What physical activities are performed, what equipment and vehicles are operated/controlled, and what complex/technical activities are accomplished as job outputs?

Element ID	Element Name	Description
Information input		
4.A.1.a.1	Getting Information	Observing, receiving, and otherwise obtaining information from all relevant sources.
4.A.1.a.2	Monitor Processes, Materials, or Surroundings	Monitoring and reviewing information from materials, events, or the environment, to detect or assess problems.
4.A.1.b.1	Identifying Objects, Actions, and Events	Identifying information by categorizing, estimating, recognising differences or similarities, and detecting changes in circumstances or events.
4.A.1.b.2	Inspecting Equipment, Structures, or Material	Inspecting equipment, structures, or materials to identify the cause of errors or other problems or defects.
4.A.1.b.3	Estimating the Quantifiable Characteristics of Products, Events, or Information	Estimating sizes, distances, and quantities; or determining time, costs, resources, or materials needed to perform a work activity.
Mental processes		
4.A.2.a.1	Judging the Qualities of Things, Services, or People	Assessing the value, importance, or quality of things or people.
4.A.2.a.2	Processing Information	Compiling, coding, categorising, calculating, tabulating, auditing, or verifying information or data.
4.A.2.a.3	Evaluating Information to Determine Compliance with Standards	Using relevant information and individual judgment to determine whether events or processes comply with laws, regulations, or standards.
4.A.2.a.4	Analysing Data or Information	Identifying the underlying principles, reasons, or facts of information by breaking down information or data into separate parts.
4.A.2.b.1	Making Decisions and Solving Problems	Analysing information and evaluating results to choose the best solution and solve problems.
4.A.2.b.2	Thinking Creatively	Developing, designing, or creating new applications, ideas, relationships, systems, or products, including artistic contributions.
4.A.2.b.3	Updating and Using Relevant Knowledge	Keeping up-to-date technically and applying new knowledge to your job.
4.A.2.b.4	Developing Objectives and Strategies	Establishing long-range objectives and specifying the strategies and actions to achieve them.

Element ID	Element Name	Description
4.A.2.b.5	Scheduling Work and Activities	Scheduling events, programs, and activities, as well as the work of others.
4.A.2.b.6	Organising, Planning, and Prioritising Work	Developing specific goals and plans to prioritize, organise, and accomplish your work.
Work output		
4.A.3.a.1	Performing General Physical Activities	Performing physical activities that require considerable use of your arms and legs and moving your whole body, such as climbing, lifting, balancing, walking, stooping, and handling of materials.
4.A.3.a.2	Handling and Moving Objects	Using hands and arms in handling, installing, positioning, and moving materials, and manipulating things.
4.A.3.a.3	Controlling Machines and Processes	Using either control mechanisms or direct physical activity to operate machines or processes (not including computers or vehicles).
4.A.3.a.4	Operating Vehicles, Mechanised Devices, or Equipment	Running, manoeuvring, navigating, or driving vehicles or mechanised equipment, such as forklifts, passenger vehicles, aircraft, or watercraft.
4.A.3.b.1	Interacting with Computers	Using computers and computer systems (including hardware and software) to program, write software, set up functions, enter data, or process information.
4.A.3.b.2	Drafting, Laying Out, and Specifying Technical Devices, Parts, and Equipment	Providing documentation, detailed instructions, drawings, or specifications to tell others about how devices, parts, equipment, or structures are to be fabricated, constructed, assembled, modified, maintained, or used.
4.A.3.b.4	Repairing and Maintaining Mechanical Equipment	Servicing, repairing, adjusting, and testing machines, devices, moving parts, and equipment that operate primarily on the basis of mechanical (not electronic) principles.
4.A.3.b.5	Repairing and Maintaining Electronic Equipment	Servicing, repairing, calibrating, regulating, fine-tuning, or testing machines, devices, and equipment that operate primarily on the basis of electrical or electronic (not mechanical) principles.
4.A.3.b.6	Documenting/Recording Information	Entering, transcribing, recording, storing, or maintaining information in written or electronic/magnetic form.
Interacting with others		
4.A.4.a.1	Interpreting the Meaning of Information for Others	Translating or explaining what information means and how it can be used.
4.A.4.a.2	Communicating with Supervisors, Peers, or Subordinates	Providing information to supervisors, co-workers, and subordinates by telephone, in written form, e-mail, or in person.
4.A.4.a.3	Communicating with Persons Outside Organisation	Communicating with people outside the organisation, representing the organisation to customers, the public, government, and other external sources. This information can be exchanged in person, in writing, or by telephone or e-mail.
4.A.4.a.4	Establishing and Maintaining Interpersonal Relationships	Developing constructive and cooperative working relationships with others and maintaining them over time.

Element ID	Element Name	Description
4.A.4.a.5	Assisting and Caring for Others	Providing personal assistance, medical attention, emotional support, or other personal care to others such as co-workers, customers, or patients.
4.A.4.a.6	Selling or Influencing Others	Convincing others to buy merchandise/goods or to otherwise change their minds or actions.
4.A.4.a.7	Resolving Conflicts and Negotiating with Others	Handling complaints, settling disputes, and resolving grievances and conflicts, or otherwise negotiating with others.
4.A.4.a.8	Performing for or Working Directly with the Public	Performing for people or dealing directly with the public. This includes serving customers in restaurants and stores and receiving clients or guests.
4.A.4.b.1	Coordinating the Work and Activities of Others	Getting members of a group to work together to accomplish tasks.
4.A.4.b.2	Developing and Building Teams	Encouraging and building mutual trust, respect, and cooperation among team members.
4.A.4.b.3	Training and Teaching Others	Identifying the educational needs of others, developing formal educational or training programs or classes, and teaching or instructing others.
4.A.4.b.4	Guiding, Directing, and Motivating Subordinates	Providing guidance and direction to subordinates, including setting performance standards and monitoring performance.
4.A.4.b.5	Coaching and Developing Others	Identifying the developmental needs of others and coaching, mentoring, or otherwise helping others to improve their knowledge or skills.
4.A.4.b.6	Provide Consultation and Advice to Others	Providing guidance and expert advice to management or other groups on technical, systems-, or process-related topics.
4.A.4.c.1	Performing Administrative Activities	Performing day-to-day administrative tasks such as maintaining information files and processing paperwork
4.A.4.c.2	Staffing Organisational Units	Recruiting, interviewing, selecting, hiring, and promoting employees in an organisation.
4.A.4.c.3	Monitoring and Controlling Resources	Monitoring and controlling resources and overseeing the spending of money.

Source: O*NET

C.1.4.   Job zones

The Job Zone classification is designed to broadly represent an occupation's level of education, training and work experience. The classification is a five-level system, where 1 is the lowest (i.e. little or no preparation needed to transition into this occupation) and 5 is the highest (i.e. extensive preparation needed to transition into this occupation. Table C.1 defines the educational and work experience of each of the zones.

Job Zone	Name	Experience	Education	Job Training
1	Little or No Preparation Needed	**Little or no previous work-related skill, knowledge, or experience** is needed for these occupations. For example, a person can become a waiter or waitress even if he/she has never worked before.	Some of these occupations may require a **high school certificate** (or equivalent).	Employees in these occupations need anywhere from a **few days to a few months of on-the-job-training.** Usually, an experienced worker could show you how to do the job.
2	Some Preparation Needed	**Some previous work-related skill, knowledge, or experience** is usually needed. For example, a cashier would benefit from experience working directly with the public.	These occupations usually require a high school diploma.	Employees in these occupations need anywhere from a **few months to one year of working with experienced employees.** A recognized **apprenticeship** program may be associated with these occupations.
3	Medium Preparation Needed	**Previous work-related skill, knowledge, or experience** is required for these occupations. For example, an electrician must have completed three or four years of apprenticeship or several years of vocational training, and often must have passed a licensing exam, in order to perform the job.	Most occupations in this zone **require training in vocational schools,** related on-the-job experience, or an associate degree.	Employees in these occupations usually need **one or two years of training involving both on-the-job experience and informal training with experienced workers.** A recognized apprenticeship program may be associated with these occupations.
4	Considerable Preparation Needed	**A considerable amount of work-related skill, knowledge, or experience** is needed for these occupations. For example, an accountant must complete a university degree and work for several years in accounting to be considered qualified.	Most of these occupations require a **bachelor's degree,** but some do not.	Employees in these occupations usually need **several years of work-related experience,** on-the-job training, and/or vocational training.
5	Extensive Preparation Needed	**Extensive skill, knowledge, and experience are needed for these occupations.** Many require more than five years of experience. For example, surgeons must complete four years of college and an additional five to seven years of specialized medical training to be able to do their job.	Most of these occupations require graduate school. For example, they may require a **master's degree, a**nd some require a Ph.D., M.D., or J.D. (law degree).	Employees may need some on-the-job training, but most of these occupations **assume that the person will already have the required skills, knowledge, work-related experience, and/or training.**

Source: O*NET

C.1.5. Scale

Importance and Level descriptors in O*NET are associated with a scale, with both descriptors having different minimum and maximum values (e.g., Importance: 1- 5; Level: 0- 7). To make sense of the different rankings, you need to understand the significance of the scale, namely the difference between Importance and Level. As an example, consider skills. While the same skill can be important for a variety of occupations, the amount or level of the skill needed in those occupations can differ dramatically. For example, the skill "speaking" is important for both lawyers and paralegals. However, lawyers (who frequently argue cases before judges and juries) are required to have a higher Level of speaking skill, while paralegals only need an average Level of this skill.

Element ID	Description
Importance	This rating indicates the degree of importance a particular descriptor is to the occupation. The possible ratings range from "Not Important" (1) to "Extremely Important" (5).
Level	This rating indicates the degree, or point along a continuum, to which a particular descriptor is required or needed to perform the occupation.

Source: O*NET

Limitation
of our work

General use restriction

This report is prepared solely for the internal use of the Climate Council. This report is not intended to and should not be used or relied upon by anyone else and we accept no duty of care to any other person or entity. The report has been prepared for the purpose of providing an analysis of the skills and training needed as Queensland transitions to net zero. You should not refer to or use our name or the advice for any other purpose.

Endnotes

1. AFR (2021), Global climate action will reshape Australia's trade, accessed: https://www.afr.com/policy/energy-and-climate/globalclimate-action-will-reshape-australia-s-trade-20210208-p570n2

2. Martinez-Fernandez, C., Ranieri, A. and Sharpe, S. (2013), "Greener Skills and Jobs for a Low-Carbon Future", OECD Green Growth Papers, 2013-10, OECD Publishing, Paris.

3. These categories are based on the Occupational Information Network (O*NET) 'green categories'. After mapping these categories to Australian occupations, Deloitte Access Economics refined the related occupations based on academic literature.

4. There are many different qualifications that can sit within a job match network; however, from our testing as part of the analysis. Having a high skill similarity score (i.e. over 75%) typically means that the 'similar' occupations hold the same or a related qualification.

5. Baseline parameters align to a Representative Concentration Pathway 6.0 (RCP 6.0) range. See (Deloitte 2020) and (Deloitte 2021) for further discussion.

6. QGSO (2020). Queensland State accounts.

7. Rapid decarbonisation to net zero by 2050 aligns to an RCP2.6 pathway range. See (Deloitte 2020) and (Deloitte 2021) for discussion.

8. This represents the present value of the annual change in GSP relative to the baseline over the period 2021-50 (using real discount rate of 2%).

9. Forecasting emerging occupations (those outside of the ANZSCO framework) was out of scope for this piece of work.

10. Forecasting future occupation supply was out of scope for this report.

11. Occupations that were categorised outside of the ANZSCO framework were not forecast as part of this project.

12. National Skills Commission (2021). Skills Priority List. https://www.nationalskillscommission.gov.au/sites/default/files/2021-6/Skills%20Priority%20List%20Occupation%20List_0.pdf

13. Based on Average Weekly Earnings between occupations.

14. An example of a lower quality job (in terms of skills required and wages) is a crop farm worker, with a score of 4.9. An example of a higher quality job is a Generalist Medical Practitioner (GP), which requires extensive education and training and has a high wage. GPs have a score of 100.

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