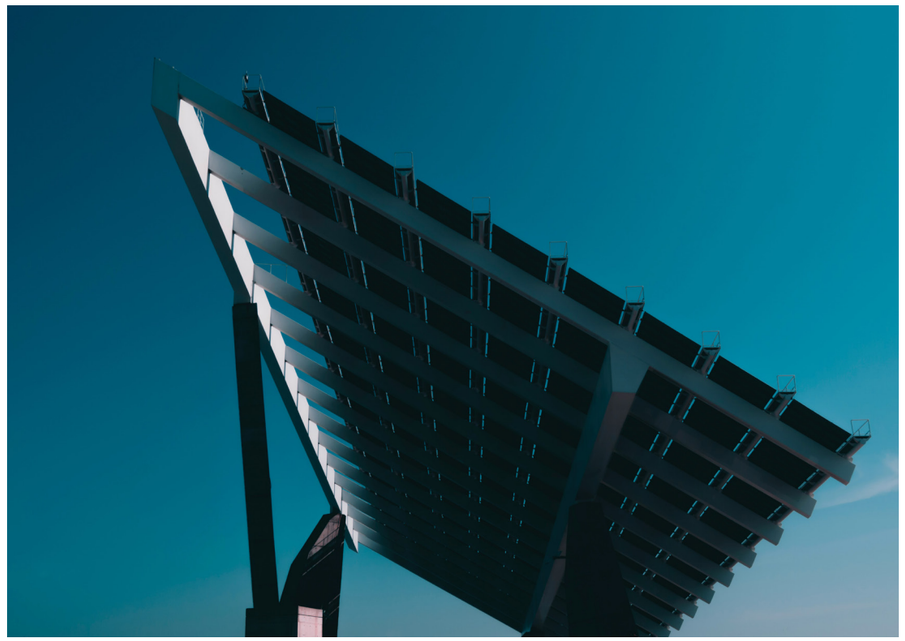
Gippsland Energy Skills Mapping Report 2022

Federation University Australia

“A national clean energy workforce of close to 1.8 million people could be created in Australia by 2025.”

—Beyond Zero Emissions



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Executive Summary

Recent studies have shown the considerable potential for job growth across the renewable energy sector. The Australian Bureau of Statistics (ABS, 2019) concluded that the number of full-time equivalent (FTE) jobs related to renewable energy activity grew by 28 per cent in 2017 and 2018 to a total of 17,740 FTE jobs across Australia. In its 2016 report on renewable energy jobs, the Climate Council argues that moving to a 50 per cent renewable electricity target scenario by 2030 will lead to over 28,000 new jobs, with almost 50 per cent more employment than a business-as-usual scenario. These jobs will be created in the construction, operation, and maintenance of new energy installations and in shifting traditional, fossil-fuel-based power generation to new energy-generating fields.

In its 2020 report, the Clean Energy Council of Australia points to creating 4,000 jobs in Victoria due to major renewable energy projects and investments. A major focus in Victoria is on the Latrobe Valley, which has key infrastructure such as transmission lines, existing and proposed high-voltage direct current (HVDC) links with Tasmania, offshore wind farms, and Energy Australia's repositioning. Moreover, the federal government has identified Latrobe Valley as a hydrogen hub (the Committee for Gippsland initiatives, the NERA cluster for a hydrogen economy, and others).

The renewable energy industry is driving this job growth, underpinned by state government policy targets and support structures. This growth is expected to continue, and the diverse workforce needed to support this industry must be highly skilled. With several large-scale projects coming online across Victoria, specifically Gippsland, there is an urgent need to lay a solid foundation for a Gippsland training base.

The energy sector in Gippsland already has a skilled workforce. Understanding how we can support this workforce to use innovative technologies is the key to increasing the region's economic prosperity. There are gaps in our understanding and reporting procedures of existing skills, required skills, and transferrable skills that are necessary for the future workforce in the energy sector in Gippsland.

The specific aims are as follows:

- Identify current renewable energy projects in Gippsland and their projected development
- Identify the existing skills and future skills required
- Identify the skill gap
- Capture training across education and industry
- Identify gaps and opportunities for training and education
- Determine how to reduce the skill gap

Desktop literature reviews, stakeholder engagements, and online surveys are used as vehicles to achieve these objectives. Technicians and trade workers represent 17.8 per cent of Gippsland's population, which is higher than the state average of 13 per cent. Many of these technicians, trade workers, and labourers are already highly skilled and experienced in the conventional energy sector. Gippsland contains a broad workforce with skills and experience that can be used to design and manufacture new energy technologies.

There is overlap between the fossil fuel and renewable energy sectors in broad occupations: technicians, construction and project managers, engineers, electricians, and others. However, there is no direct occupational match for the core mining workforce, which consists of drillers, miners, shot firers, and mechanical trades. This is particularly relevant to the export industry for metallurgical and thermal coal, where the bulk of coal mining jobs are concentrated.

Up to 80 per cent of renewable energy jobs are in design, manufacturing, construction, and installation. However, by 2030, almost 50 per cent of those jobs could be in operations and maintenance (O&M). In addition to the traditional energy workforce, the digitally enabled workforce has been identified as critical for the future energy sector.

Critical occupations and skills within a digitally enabled workforce include:

- Data analytics
- Cyber-physical system specialists
- Software application and programming skills

Furthermore, there would be new occupations and skills required in the energy sector, which include:

- Smart grid engineers
- Hydrogen production professionals
- Occupational health and safety professionals
- Internet of things (IoT) engineers

There are opportunities for operation and maintenance (O&M) jobs to be created in offshore and onshore wind projects. For example, blade technicians – already an in-demand role – and civil construction workers will be required. In addition to these technical skills, cross-cutting skills are also required. There are potential jobs for construction project managers, senior managers, and accountants in the renewable energy sector in Gippsland. However, according to the stakeholder engagement feedback, the energy industry does not completely understand what is being done to train its workforce.

Seven universities in Australia currently offer renewable energy programs. From these, three universities in Victoria provide undergraduate programs specialising in advanced renewable engineering. The undergraduate programs are mostly at basic and intermediate levels, covering aspects of electrical, sustainable, electronics, and communication fields of study. Despite post-secondary education related to clean energy and industry engagement in developing these programs, skill shortages exist and are expected to worsen.

There are over 250 units available in the vocational education and training (VET) sector, covering electrical engineering and renewable energy specialisations across Victoria. However, there are still some new programs and course development opportunities, especially in hydrogen technology, smart grids and battery development.

A key to addressing skills shortages in the sector and unlocking additional gains is to make the industry more accessible and appealing to diverse groups. Women are significantly underrepresented in the energy industry, but opportunity abounds. People from other diverse backgrounds (e.g., people with a disability, indigenous people) are also underrepresented in the energy sector.

Based on the findings mentioned, the following recommendations are made:

Recommendation One — State-of-the-art infrastructure, equipment, and laboratories are required in Gippsland to deliver new energy training and education:

- Urgently undertake a business case into the establishment of a New Energy Education and Training Centre at the Morwell Education Precinct including costing state-of-the-art hardware and software facilities including power system simulator, hydrogen simulation tools, navigator systems incorporating existing energy management systems, microgrid controllers, human-machine interface communication tools and protection devices.
- Consider in the business case options for a hub and spoke model that would allow for the establishment of a centre in Morwell, but with training nodes across Gippsland including Sale and East Gippsland.

Recommendation Two — New programs need to be developed and offered in Gippsland to meet the requirements of the new energy sector in the next 2-10 years including:

- Certificate III in Renewable Energy-ELV
- Certificate IV in Renewable Energy
- Diploma in Renewable Energy Engineering
- Bachelor of Renewable Energy
- Certificates II, III and IV in hydrogen, storage and fuel cell technologies (with potential to explore undergraduate hydrogen-specific qualifications)
- Most training and education units are currently solar and low-voltage system oriented. Develop modules and units of other renewable energy applications including IoT, smart grid technology and big-data applications in energy systems.
- Other short courses will need to be considered, in close collaboration with the industry including asset management and graduate certificates in power and energy.
- Explore how to best train offshore and onshore wind technicians, with as many local training options as possible.

Recommendation Three — Partner with the industry to ensure education and training programmes meet industry needs:

- Develop a new energy industry advisory group in Gippsland to advise education providers on curriculum development, work placement, research and innovation and other collaborative opportunities.

Recommendation Four — Raise awareness of new energy careers:

- In partnership with primary, and secondary schools, local learning and employment networks, career practitioners, educators, industry and government seek to develop priorities and programmes to promote new energy sector careers for a diverse group of school leave and mature age students.
- Promote clear pathways into new energy-related careers across the secondary school, VET and higher education.

Recommendation Five — Develop clear pathways between secondary, vocational and higher education in clean energy careers:

- Develop clear pathways between certificates, diplomas, advanced diplomas, undergraduate, graduate certificates and postgraduate studies in clean energy.
- Provide multiple exit points based on career preferences.
- Ensure recognition of prior learning.
- Close collaboration between VET and Higher Education required.

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Abbreviations & Definitions

Abbreviation	Description
ABS	Australian Bureau of Statistics
BESS	Battery Energy Storage System
CPD	Continuing Professional Development
DERs	Distributed Energy Resources
DNSP	Distribution Network Service Providers
EV	Electric Vehicle
GW	Gigawatt (a measure of power or load)
GIS	Geographical Information Systems
HE	Higher Education
IoT	Internet of Things
OHS	Occupational Health and Safety
O&M	Operations and Maintenance
PV	Photovoltaic (Solar)
SCADA	Supervisory Control and Data Acquisition
VET	Vocational Education and Training

Term	Description
Accreditation	The action or process of officially recognizing someone as having a particular status or being qualified to perform a particular activity. postsecondary institution or program as meeting the standards established by a nationally recognized accrediting association.
Cross-cutting (transferable) skills*	Skills such as teamwork, critical thinking, and skills related to information and technology enhance the ability to transfer and apply knowledge in a variety of settings. In literature, these skills are referred to as cross-cutting skills. They enhance learning and its application in most disciplines and careers.
Major Course	The primary field of study in a higher education course.
Minor Course	The secondary (or lesser) field of study that complements the major course of study.
Short Course / Micro credentials	A learning programme that provides combined content or specific skills training in a short period of time. Short courses often lean towards the more practical side of things and may have less theory than a technical and further education (TAFE) certificate or higher education degree course; this gives learner a more hands-on experience within the field of interest. Short courses can be accredited or non-accredited. Short courses are often referred to as micro credentials. These are mini qualifications that demonstrate skills, knowledge, and/or experience in a given subject area or capability.

*M. Snow Andrade, 'Cross cutting skills: Strategies for teaching and learning,' Higher Education Pedagogies, vol. 5, 2020.

1—
Context

Of Gippsland's population, 17.8 per cent are technicians and trade workers— higher than the state average of 13 per cent.

1— Context

In the Australian context, there have been several preliminary studies exploring the future energy workforce potential and projected growth. Until recently, very few of these had provided a breakdown of the skills and roles required of the future workforce. For some years, governments, industry bodies, and advocacy groups (e.g., State of Victoria, 2016, 2018; Clean Energy Council, 2020a; Beyond Zero Emissions, 2020) have claimed that the future workforce will be 'green'. These reports generally focus on the opportunities for Australia and the specific opportunities for traditional carbon/fossil fuel regions such as the Latrobe Valley. However, apart from a few particular areas of Australia (e.g., Latrobe Valley, Hunter, Bowen Basin), the overlap between coal mining and power generation locations and renewable energy zones is not significant (Briggs et al., 2020a). There is far greater geographical dispersion in renewable energy than in coal mining and power generation, as illustrated in Figure 1 using Victoria as an example. This pattern is replicated across the eastern seaboard of Australia.

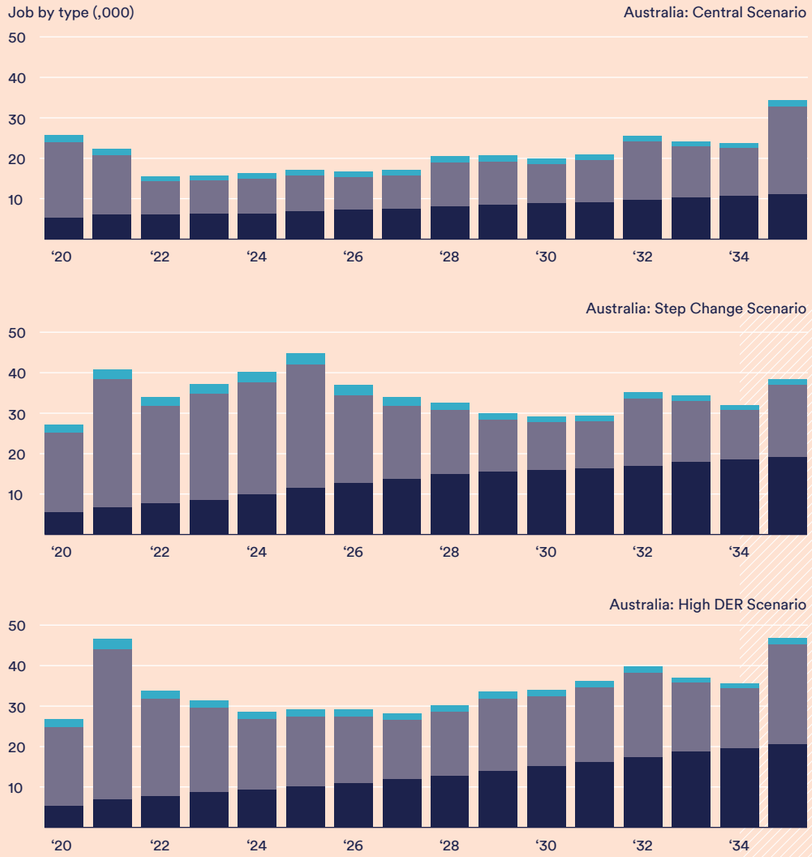


Figure 1. Share of operations and maintenance jobs (Briggs et al., 2020a)

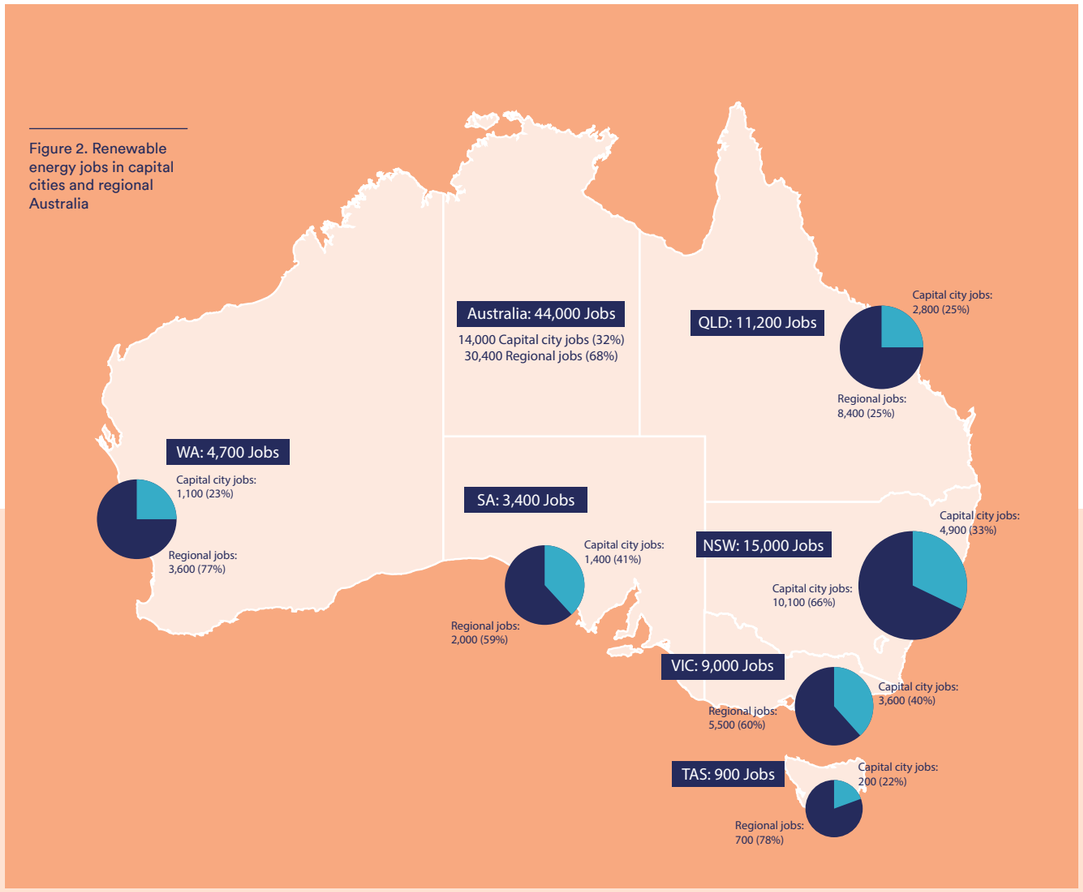


Figure 2. Renewable energy jobs in capital cities and regional Australia

Furthermore, there is some overlap between occupations in the traditional and renewable energy industry (e.g., technicians, construction and project managers, engineers, electricians). There is no direct occupational match for the core mining workforce, which consists of drillers, miners, and shot firers, or for the mechanical trades (Briggs et al., 2020a) – this is particularly the case for the metallurgical and thermal coal export industry, where the bulk of coal mining jobs are concentrated. Census data shows that the domestic coal (thermal mining and power generation) workforce in 2016 was 11,000 people nationally, which pre-dates the closure of the Hazelwood Power Station in the Latrobe Valley (Briggs et al., 2020a).

Among all the occupations identified in Renewable Energy Jobs in Australia (Briggs et al., 2020a), almost one-fifth of the workforce are electricians or electrical trade assistants. The most dominant technology sector – especially for laborers – is rooftop solar, which is predominantly an installation-focussed effort. Given the sustained growth in installations, jobs in this area would be ongoing rather than focussed on short-term construction. Figures 2 and 3 provides a further breakdown of renewable energy jobs across Australia averaged over the years 2020–2025.

Beyond Zero Emissions, an independent Australian think tank, suggests that a national clean energy workforce of close to 1.8 million people could be created in Australia by 2025 in their report, The Million Jobs Plan (Beyond Zero Emissions, 2020). This assessment takes a much broader view of the clean energy workforce than other studies, including energy efficiency, zero-emissions transport, clean energy technology manufacturing, land regeneration, and waste management jobs. However, it does indicate the potential size of the new workforce. The Million Jobs Plan also identifies that this workforce could include an additional 10,000 new jobs in training and research activities associated with the transition.

In March 2022, the Victorian Government released its Offshore Wind Policy Directions Paper as the next step towards Victoria establishing an offshore wind industry and meeting the Victoria Renewable Energy Target of supplying 50 per cent of the state's energy needs from renewable sources by 2030. Victoria aims to generate at least 2 gigawatts (GW) of offshore wind power by 2032, 4 GW by 2035, and 9 GW by 2040. The Directions Paper recognises that there is potential for 13 GW to be generated from fixed platforms and significant additional capacity (upwards of 33 GW) to be developed should offshore floating platforms also be employed, as a result of advance in that technology.

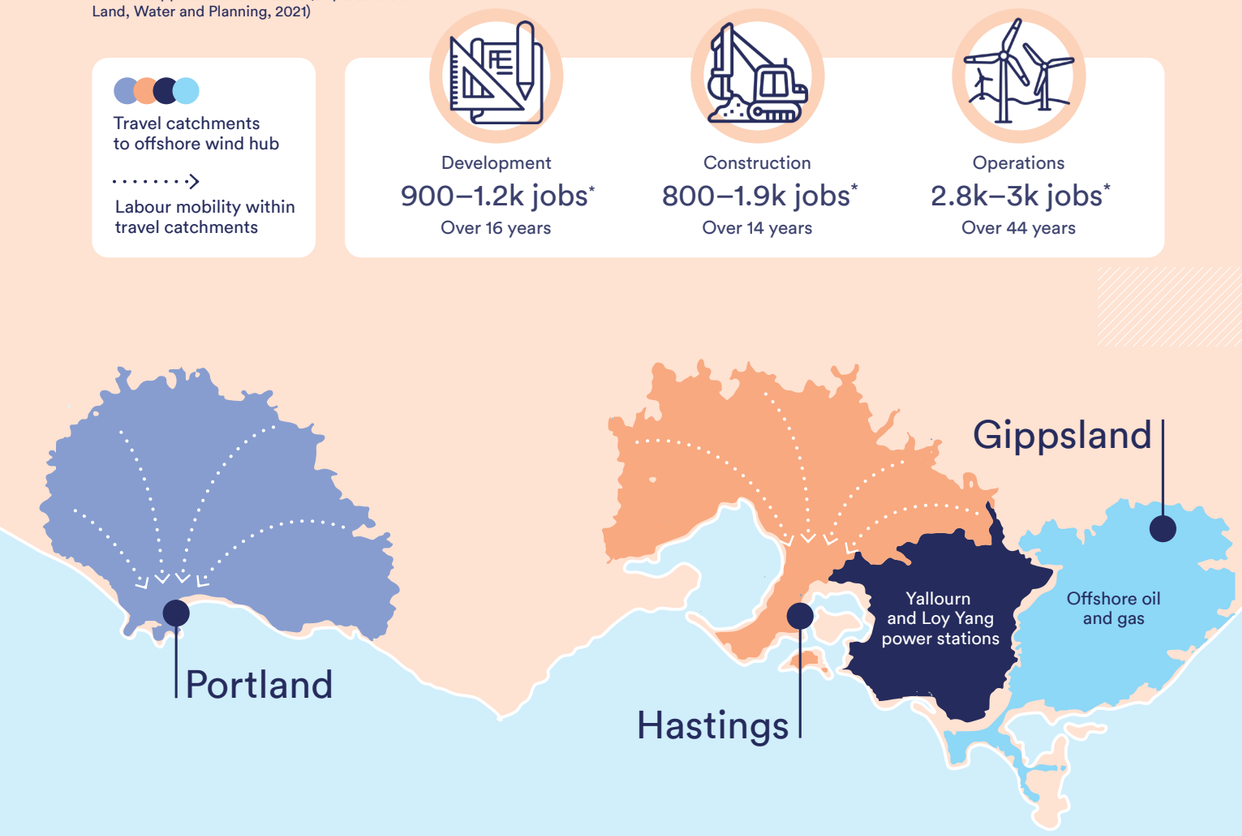
The Directions Paper suggests that with the 13 GW tranche, 3,100 development and construction jobs and 3,000 ongoing operations jobs could be created in Victoria. Of that 13 GW, 10 GW is anticipated to be created in the Gippsland zone, with 3 GW in the Portland West zone, suggesting that most operational jobs should be situated within Gippsland (see Figure 4).

Some local governments (e.g., South Gippsland Shire Council, Wellington Shire Council) have specifically identified growth in utility-scale renewable energy generation and transmission projects as core components of their economic development plans and strategies (South Gippsland Shire Council, 2021, Wellington Shire Council, 2020). However, support for renewable energy infrastructure is not consistent at the local government level, often reflecting specific community concerns (Hepburn Shire Council, 2022, Moorabool Shire Council, 2022). Based on the current state of the energy projects, there could also be significant numbers of jobs in public administration, safety, administration, and support services. An increase in demand has already been observed in the Gippsland region (Figure 5) as per Australian Bureau of Statistics (ABS) data collected in February 2022.

Figure 5 also shows that technical jobs in the energy sector are anticipated to experience steady growth. It is also evident that the manufacturing sector will remain one of the largest sources of employment, behind health, retail, and agriculture. Most jobs advertised in the Gippsland region in the energy and manufacturing sector asked for Certificate IV qualifications (30 per cent), followed by bachelor's degree qualifications or higher (25 per cent) (National Skills Commission, job adverts). Table 1 shows fossil fuel workers in the Gippsland region by local government area. It is evident that there are a significant number of trade and technical workers in the Gippsland region. Furthermore, it has been reported that 80 per cent of the workforce have medium-to-high skills transferability and are well-positioned to work in adjacent energy sectors (which is discussed further in Section 2).

Much of the skills and workforce development agenda, particularly in regional and remote areas, is affected by the lack of assurance

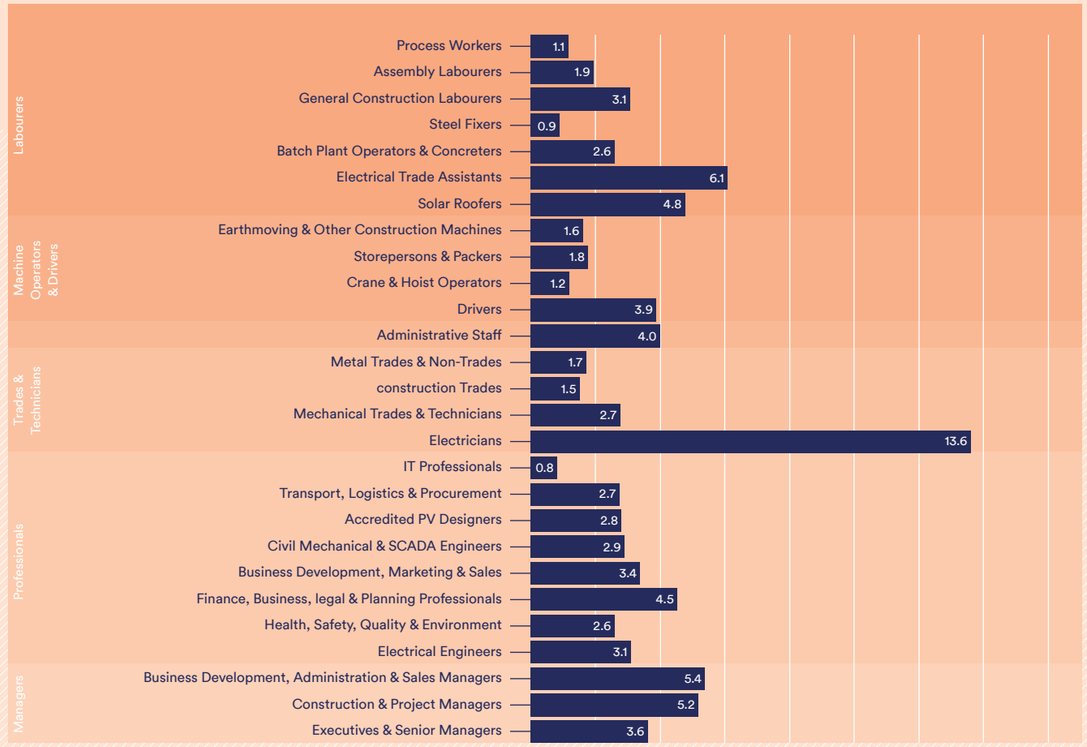
Figure 4. Employment opportunities for offshore wind in Gippsland and Portland (Department of Land, Water and Planning, 2021)



provided during project development phases and the stop–go nature of project infrastructure construction (TEIWAC, 2020). Additionally, operating in regional and remote areas increases competition between projects for local resources and talent. The capacity and capability of local training institutions, ability to source quality trainers, and sustained demand to create new or varied training programs are also challenged by the geographical diversity of projects.

In her discussion on regional employment opportunities presented to the Activating Gippsland's Renewable Energy Workforce Regional Forum hosted by the Australian Renewables Academy, Dr Sue Olney noted two significant value creators in developing a new workforce – local and diverse (Olney, 2021). In looking local, proponents and contractors are able to build a 'social licence' to operate and address skills shortages by creating pipelines into and through education directly linked to jobs, thereby harnessing local knowledge and strengths. By taking a broader look at the potential local workforce, proponents are also able to build diversity into their workforce, tap into less traditional employee pools (especially in a tight job market), and enable them to build creative, resilient, and competitive businesses.

Figure 3. Renewable energy jobs (%) by occupation (Briggs et al., 2020a)



Of Gippsland's population, 17.8 per cent are technicians and trade workers – higher than the state average of 13 per cent. Many of the region's technicians, trade workers, and labourers are highly skilled and experienced in the conventional energy sector. Gippsland contains a broad workforce with skills and experience that can be used to design and manufacture new energy technologies.

Table 1. Fossil fuel workers in Gippsland region (ABS, 2016)

Local Government Area	Managers	Professionals	Technical and Trades	Community and Other Service	Office and Admin	Machinery	Labour	Total
East Gippsland	30	32	73	0	44	63	34	276
Baw Baw	14	8	19	0	9	32	8	90
Bass Coast	27	23	28	0	38	41	15	172
Wellington	34	20	40	0	34	43	34	205
South Gippsland	17	17	48	0	36	38	18	174
Latrobe	215	285	982	21	189	351	199	2,242
Grand Total	337	385	1,190	21	350	568	308	3,159

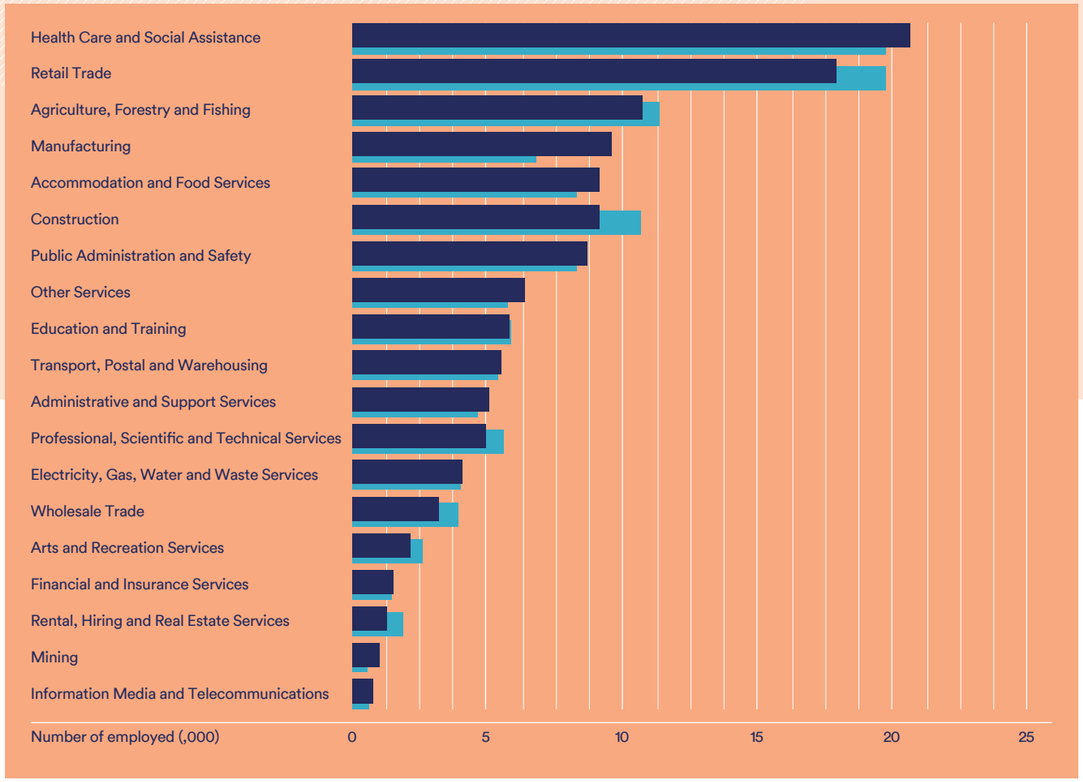


Figure 5. Labour force survey in Gippsland (ABS)

In this context, a review was undertaken to explore the key publicly available information on what is currently known regarding the skills and workforce demands associated with the development of renewable energy infrastructure in Australia and internationally as a precursor and foundation to understanding the current and future skills landscape in Gippsland.

The result of significant investment in renewable energy infrastructure in the region over the next decade is a predicted shortfall in the availability of a skilled, local workforce.

This is overlaid with ongoing dialogue regarding the transition of workers and businesses due to the closure of coal-fired power stations and mines in the Latrobe Valley over the corresponding period.

The energy sector in Gippsland already has a skilled workforce; understanding how we support and progress this workforce into new technologies is key to increasing the region's economic prosperity.

At the moment, there is a lack of understanding and reporting procedures in relation to existing skills, required skills, and transferrable skills that are necessary for the future workforce of the energy sector in Gippsland.

This work addresses this gap and provides organisations with the evidence they require to deliver targeted programs and policies to re-skill and scale up Gippsland's energy workforce.

Significant numbers of the projects are at either the proposal or feasibility study phase. Owners/operators sceptical about the skills that will eventually be required. Therefore, it is difficult to estimate the exact number or types of jobs that will be created in the Gippsland region.

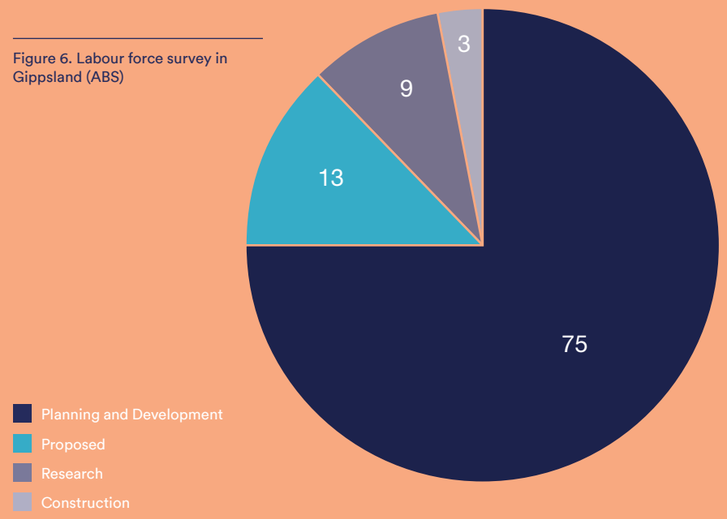


Figure 6. Labour force survey in Gippsland (ABS)

1.1— Renewable Energy Projects in Gippsland

There are over 32 large renewable energy projects currently underway in the Gippsland region. Solar, wind, and battery energy storage systems (BESS) are the dominant technologies. In addition, there are a few projects in biomass and hydrogen technology. Out of these 32 potential projects (see Table 2 for the complete lists), only 3 per cent are under construction, as shown in Figure 6.

Table 3 shows some of the anticipated clean energy projects in the Gippsland region. These projects are mainly at the community consultation and the pre-feasibility phase. Furthermore, Figure 7 shows the wind and energy storage penetrations anticipated in the Gippsland region based on the integrated system planning report published by the Australian Energy Market Operator. The steady growth of wind and energy storage systems is evident from the trends shown in Figure 7.

Proponent	Project/Technology
RATCH Australia Corporation	Morwell Solar Farm
OSMI Australia	Delburn Wind Farm
Octopus Investments Australia	Perry Bridge Solar Farm
Octopus Investments Australia	Fulham Solar Farm
Solis Gippsland Projects	Gippsland Renewable Energy Park
Copenhagen Investment Partners	Star of the South – Offshore Wind Project
Flotation Energy	Project Sea dragon – Offshore Wind Project
Macquarie / Green Investment Group	Great Southern Offshore Wind Farm
H2X Global	EV Assembly / Manufacturing
Gippsland Circular Economy Precinct	Hydrogen Energy
South Energy	Frasers Solar Farm
Heyfield Community / UTS	Heyfield Town Microgrid
DELWP Community Microgrid and Sustainable Energy Program	Mallacoota Microgrid / Energy Program
DELWP Community Microgrid and Sustainable Energy Program	Omeo Microgrid / Energy Program
Totally Renewable Phillip Island	Phillip Island Microgrid / Sustainable Energy Program
Radial Timber	Yarram Biomass Energy Hub
Energy Australia	Wooreen Energy Storage System
AGL	Loy Yang BESS
DELWP	Gippsland Renewable Energy Zone
Marinus Link	Project Marinus Link
Bluefloat Energy / Energy Estate	Greater Gippsland Offshore Wind Project
Synergy Wind	Gelliondale Wind Farm
Ramahyuck District Aboriginal Corporation	Solar Photovoltaic (PV)
Elecsome	PV Recycling Factory
Port Anthony Renewables	Port Anthony Renewable Energy and Hydrogen Park
Infinite Blue Energy	IBE / PAR Hydrogen Liquefaction and Storage
Pure Hydrogen	Port Anthony Green Hydrogen Project
Patriot Hydrogen	Port Anthony Biomass to Hydrogen Project
Maoneng	Mornington BESS
TILT Renewables	Latrobe Valley BESS
Utilitas Group Bio hub	Bio Energy Project

Table 2. Lists of energy projects in Gippsland

1.2— Scope and Issues in Gippsland

In Victoria, when examining an overlay of renewable energy zones with workforce projections, much of the operations and maintenance (O&M) workforce will be regionally located. Except for the Latrobe Valley, there is very little correlation between existing fossil fuel jobs and the location of new renewable energy jobs (Briggs et al., 2020a, 2020b). In the Gippsland region, there is some proximity between fossil fuel job locations (i.e., coal and power stations) and major renewable energy developments, particularly with the expansion and growth from developments associated with the Gippsland Renewable Energy Zone. Additionally, the fossil fuel job descriptions listed in the summary by Briggs et al. (2020b) focus on coal mining, power generation, and export, and do not appear to take into account offshore oil and gas extraction and processing – a fossil fuel industry also located in and offshore from Gippsland. The oil and gas and offshore wind sectors have been recognised as having many compatible and transferrable skills (International Renewable Energy Agency [IRENA], 2018; GWEC, 2021b), creating the opportunity for a transition program between the two sectors (State of Victoria, 2022). Table 4 shows the potential jobs created by new energy projects during the construction and the operation phases. During the construction phase, 8,153 full-time equivalent (FTE) jobs are expected, and approximately 1,559 FTE ongoing jobs are also anticipated. Figure 8 shows future projections of clean energy jobs in Gippsland between 2025 and 2036. These projections were made based on the theory published by Briggs et al. (2020).

Table 3. List of projected energy projects in Gippsland

Clean Energy Projects	Project/Technology
Solar and battery projects	At least 20+ sites in Ausnet Network
Electric vehicle charging facilities	All shires and major transport route
Hydrogen fuel pumping stations (number determined by the feasibility study)	Major transport route from 2025
Pumped hydro projects (projected number: 3)	In mining site from 2025
Biomass generation plants in timber mills (projected number: 4)	From 2024
Large neighbourhood batteries (the number is yet to be determined)	From 2023
Offshore wind farms peak build phase	From 2026
Hydrogen fuel generation plants and fuel cells	From 2026
Recycling and waste-to-energy plants	From 2023

Table 4. Jobs in new energy projects in Gippsland 2022–2032

Type of Projects	Construction (FTE)	Ongoing (FTE)
Solar Projects	4,101	82
Wind Projects	2,446	551
Batteries	130	06
Hydrogen	486	540
HVDC	250	50
Renewable energy zone transmission upgrade project	740	330
Total	8,153	1,559

(a) Storage

Figure 7. Lists of energy projects in Gippsland (Australian Energy Market Operator, 2021)

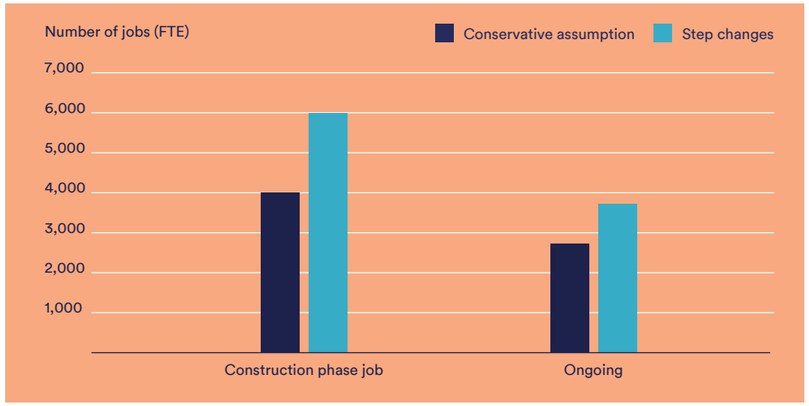
Proponent					
	Suggested Storage for REZ (MW)				
		Depth	Projected		
			2029-30	2034-35	2039-40
Gippsland REZ has a strong 500 kV network connecting coal fired power stations to the Melbourne load centre as well as interconnection to Tasmania via Basslink. Due to the high network capacity. Gippsland REZ is a good candidate for storage. Storage has been projected in this REZ for the Step Change and Slow Change scenario	Central	Shallow	0	0	0
	Step		0	0	0
	Fast		0	0	0
	High DER		0	0	0
	Slow		0	100	100
	Central	Medium	0	0	0
	Step		100	100	550
	Fast		0	0	0
	High DER		0	0	0
	Slow		0	0	150

(b) Wind Energy

Figure 7. Lists of energy projects in Gippsland (Australian Energy Market Operator, 2021)

Variable Renewable Energy outlook									
	Solar PV (MW)				Wind (MW)				
	Existing / Committed	Projected			Existing / Committed	Projected			
		2029-30	2034-35	2039-40		2029-30	2034-35	2039-40
Central	There is no exisiting or comitted solar generation in this REZ. The modelling outcomes, for all scenarios, did not project additional solar generation for this REZ.				119	650	650	650
Step						50	50	1,150
Fast						0	0	0
High DER						200	200	200
Slow						900	900	900

Figure 8. Projected jobs in new energy projects (Briggs et al., 2020)



2—
Skills and Skilled Workers Required for a Successful Energy Transition

Of Gippsland's population, 17.8 per cent are technicians and trade workers— higher than the state average of 13 per cent.

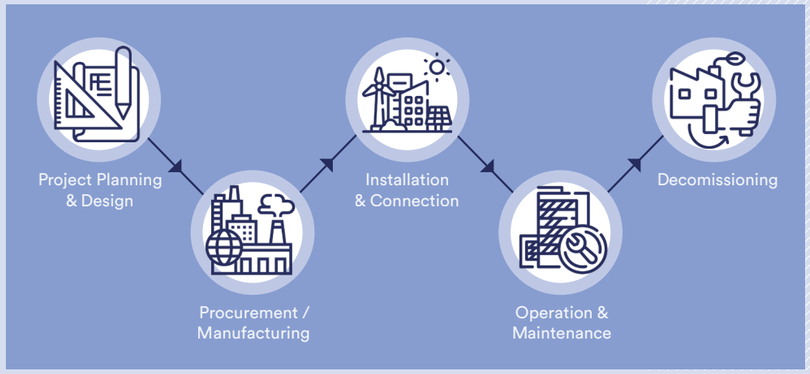


Figure 9. Value chain for different clean energy technologies (IRENA, 2018)

2— Skills and Skilled Workers Required for a Successful Energy Transition

Up to 80 per cent of renewable energy jobs are currently in design, manufacturing, construction, and installation phases. However, by 2030, almost 50 per cent of those jobs could be in O&M (Briggs et al. 2020). When considering the technical skills required for a clean economy, it is necessary to think about skills across the entire value chain. A simplified typology of the value chain – adapted from IRENA (2018) – indicates five phases, as shown in Figure 9. Taking a sectoral approach provides an additional lens for considering the required skills and jobs. The Decarbonisation Futures study by Climate Works Australia (2020) highlights electricity, buildings, transport, industry (including manufacturing, mining, and resources), and agriculture and land as the key sectors that need to fully decarbonise by 2050. Agriculture and land are less relevant from an energy transition perspective as the possible interventions in those sectors are largely non-energy related. Overlaying the value chain with this sectoral approach provides a detailed framework for analysing the required skills. This makes it possible to investigate which skills are required to design net-zero buildings, maintain battery storage systems, procure more energy-efficient equipment, or connect renewable energy systems to the grid. Another useful typology when considering the required skills to enable the energy transition is based on different occupations.

A good example is introduced by Briggs et al. (2020) specifically for renewable energy but is also applicable more generally. They point out that the energy labour force can be broken down into laborers, machine operators, drivers, trades, professional services, and managers. These occupational groups require different types of training and qualifications, although further detail is needed on the specific occupations. One factor that cuts across the value chain and different sectors and occupations is the growing importance of digital skills in the energy sector (i.e., big data analysis, nowcasting of renewable resources, and energy market analysis). An earlier study into the skills required for electricity networks by Energy Skills Queensland (2016) refers to the emergence of a 'digitally enabled workforce' alongside the traditional energy workforce. Critical occupations within a digitally enabled workforce include:

- Data analytics
- Cyber–physical system specialists
- Software application and programming

These occupations are in high demand across the economy. Attracting people who have specialised digital skills and knowledge of the energy sector could be particularly challenging. Most workers in the energy systems of the future will need some level of digital skills (i.e., data analytics, cyber-physical systems, software, and programming), and studies in the water sector have highlighted how challenging it can be to develop or attract these skills (IRENA, 2018).

> "The energy industry doesn't completely understand what the whole industry is doing to train their workforce. At this stage, we are gathering the information."
>
> —Two interview participants

2.1— Current Shortages in Energy Skills in Australia

Research on the current and future Australian renewable and clean energy workforce has found that not enough people are taking up training to meet the current demands of the clean energy sector (Rutovitz et al., 2021), let alone to accommodate the growth in the sector workforce over the next 5–10 years. The authors also emphasise that a detailed mapping of future occupations and skills is required to enable the energy transition and meet demand for energy workers. This has now been recognised by the Australian Government (Department of Industry, Science, Energy and Resources, 2022) in their report Improving understanding of Australia's energy workforce, which addresses the need for good-quality data and workforce projections. This report also forecasts numbers of future jobs and where they will be located.

In its Clean Energy at Work report, the Clean Energy Council (2020a) points out the difficulties in filling construction and O&M roles and recruiting construction managers and wind blade technicians. For wind blade technicians – a role already in high demand and hard to fill – the increasing investment in wind farms, higher O&M requirements, and greater proportion of roles in the future having an O&M focus means there will be a heightened demand for these skills. When asked which roles were the most difficult to fill, respondents in the large-scale solar sector mentioned construction managers and engineers (civil, electrical, grid, supervisory control and data acquisition (SCADA)) most frequently. On the other hand, trades and technicians were said to be relatively easier to recruit. Experience, pay rates, and location were the three most common reasons given for recruitment difficulties.

Reports from Australia and around the world have outlined the immediate and long-term need for increased training system capacity to deal with the significant uptick in demand for a skilled renewable energy workforce (TEIWAC, 2020). The structure and suitability of the training system to meet industry demand need to be reviewed in collaboration with training bodies, unions, regional development agencies, and policymakers; this is a key recommendation of the Clean Energy Council's Clean Energy at Work report (2020a).

Current technical skills shortages highlighted in the literature include:

- Battery manufacturers
- Construction and site managers for large-scale wind, solar, and energy storage projects
- Internet of things (IoT) engineers / software engineers
- Electricians certified to install PV, particularly in remote regional areas
- Energy auditors / energy management system consultants
- Energy data analysts
- Energy managers with an adequate understanding of energy
- Electric vehicle (EV) infrastructure engineers
- EV mechanics for EV repair and service
- Grid engineers
- Fuel cell technology
- Occupational health and safety (OHS) officer
- Power system engineers
- Control engineers / renewable energy engineers
- Specialist truck drivers
- Wind turbine blade and turbine technicians

This is crucial as it impacts the developer's ability to forecast and commit to future skills and training needs, given that responsibility. This responsibility will fall primarily to the contractor rather than the project owner/developer.

Figure 10. Timing for offshore wind farm construction.

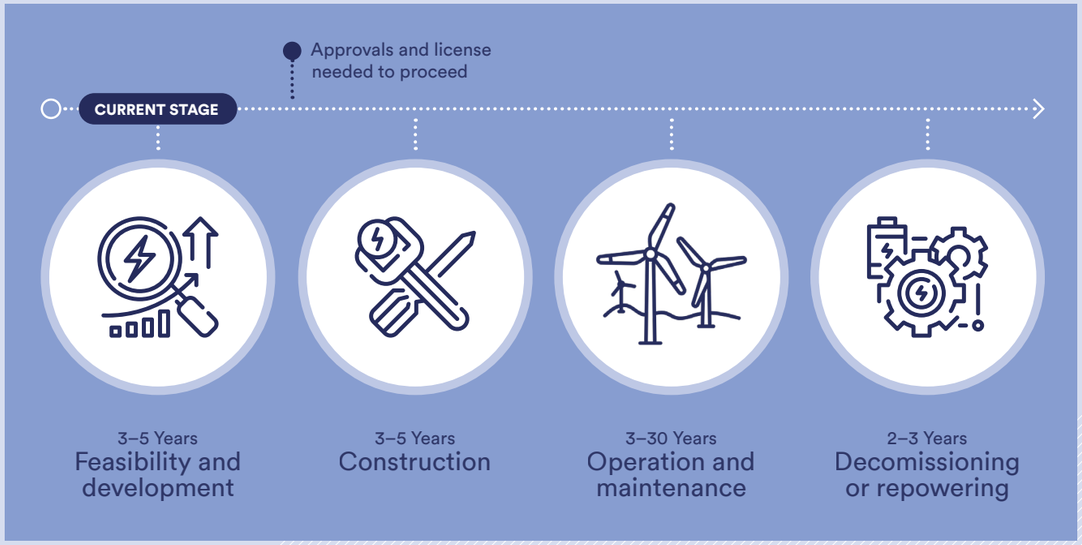


Figure 10 shows the timing for offshore wind farm development. After the developer concludes the feasibility study, significant jobs would be created during the construction phase. Then, following construction, the project would go into operation (sequentially). Consequently, there would be jobs in O&M from year 3 of the development.

There would be a high number of O&M jobs associated with offshore wind technology. The diversity of job types also increases with the project's generation capacity, especially one that incorporates marine and safety operations to work in the offshore environment (estimated at 0.33 FTE per megawatt). Based on the Australian Energy Market Operator's integrated system planning and offshore wind energy projection, there would be 4000–4500 FTE O&M jobs, including wind turbine technicians, electrical and mechanical technicians, SCADA engineers, blade repair technicians, and reliability and asset management specialists. The offshore wind projects showed a relatively even split across qualification types associated with O&M functions, although a complete list of roles was not provided (see Table 5).

Table 5. Wind sector job opportunities based on survey data.

Professional	Trade/Technician
Project engineer	Apprentice hydraulics/mechanical fitter
Quality manager	Apprentice electrician
Grid connection engineer	Mechanical/hydraulics technician
Project manager	Electrical technician
Data analytics (wind yield performance)	Radio operator
Asset integrity manager	Electrical and instrumentation technician
Contract/commercial manager	Wind turbine technician
Procurement manager	Painter/rope access technician
Planner/project control manager	Blade repair technician
Electrical supervisor	Crane operator
Rope access manager	Warehouse storeman – onshore
Quality, health, safety, and environment manager	Crew transfer vessel crew
Supervisory control and data analytics	Control room technician
Permit manager	Heavy lift supervisor
Human resources manager	
Risk manager	
Site manager – onshore	
Marine Geo-Data Specialist	
Environmental Scientist – offshore and onshore (including collection and monitoring of biodiversity data)	
Permitting/Regulatory approvals specialists	
Land access liaison specialist	

Most of the identified roles require OEM-specific training rather than general training. Wind turbine and blade repair technicians are two specifically identified roles that have OEM-specific training requirements.

The O&M manager, together with the project and developer team, makes up the ongoing O&M team for a utility BESS project. The majority of the employees are likely to be degree/tertiary qualified staff, with some corporate/administrative roles. In addition, the BESS designers and installation staff are likely to be OEM-specific.

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The transmission group AusNet has revealed plans for a 10 GW renewable energy zone in Victoria's Gippsland region. Renewable energy zones are now seen as crucial to the massive rollout of wind, solar, and storage required to transition Australia's grid from fossil fuels to renewables over the coming decade or two. Based on a previous interview with AusNet, a list of required future skills is shown in Table 6. Table 7 shows the job skills required for storage and hydrogen. Table 8 shows the skill requirements in the bioenergy and geothermal sectors.

There are some indirect job opportunities associated with clean energy projects. Figure 11 shows the direct and indirect job opportunities related to the clean energy project supply chain.

Table 6. Skills required for the renewable energy zone development.

Skills Required	Stage of Life Cycle
Technical writer	Plan and design
Community stakeholder engagement	Throughout
Transmission line design	Plan and design
Project management	Throughout
Transmission station electricians	Construction
Network authorities	Construction and maintenance
Environmental advisers	Construction and maintenance
Non-network solution engineers	Throughout
Data analytics	Construction and maintenance
Construction work including rigging and traffic control	Construction phase
Vegetation clearance	Throughout
Network authorities	Construction and maintenance
Land valuer	Plan and design
Land surveyor	Plan and design
Statutory Planning	Plan and design
Land liaison officer	Throughout
Stakeholder engagements	Throughout

> "The existing local agreements were in place for future training needs. Traineeships were indicated as potential opportunities for long-term training needs locally."
>
> —Project developer

Table 7. Skills required for storage and hydrogen

Skills required	
Electrical engineer	Control engineer
Software engineer	Data analytics
Gas workers	Stakeholder engagement
Mechanical design	Statutory Planner
Chemical engineer	
Process and supply engineer	
Hydrogen safety officer	
Manufacturing engineer and trades in electrolysers, fuel cell and storage	
Control engineer	
Smart grid engineer	
Plumbers, pipe fitters	
Appliance installation trades	
Civil construction trades	

Table 8. Skills required in the bioenergy and geothermal sectors.

Skills required	
Electrical engineer	Land surveyor
Software engineer	Geologists
Gas workers	Health and safety manager
Mechanical design	Digger
Chemical engineer	Mechanical trade
Process and supply trade	Specialist engineers (e.g., chemical, mechanical, pipeline, drilling, electrical, Instrumentation, and control engineer)
Control engineer	Geo-Data Specialist - Seismic Processing
Smart grid engineer	Permitting/Regulatory approvals specialists Land access liaison specialist
Plumbers, pipe fitters	
Appliance installation trades	
Civil construction trades	
Heavy material movers	
Environmental specialists	
Mining engineering	

TVFH to draft copy for this section of text summarising skills required for renewable energy projects.

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Trade jobs

- Electrical
- Mechanical
- Builder
- Welder
- Metal fabricator
- Fencing contractor
- Carpenter
- Plumber
- Plant operator eg. Excavator driver
- Legal: Construction specialists

Engineering jobs

- Electrical: Power systems and telecommunications
- Civil: Road, foundations, trenching and buildings
- Geotechnical: Siting and construction
- Chemical: Soil analysis
- Hydropower specialists
- Fluvial-geomorphologists
- Mechanical: Machine and equipment design, assembly and operation
- Dam engineers
- Aquatic and terrestrial scientists
- Geologists
- Tunnelling

Other project roles

- Project managers
- Procurement specialists
- Architects
- Land use planners
- Surveyors
- Ecologists
- Accountants
- Mobilisation and industrial relations management
- Safety and environment advisors
- Marine logistics and transport specialists
- Commercial
- Industrial relations specialists
- Detailed design/constructibility
- Community engagement specialists
- HR recruitment specialists
- Lawyers
- Finance and asset managers
- Drafting/document control

Support services

- Accommodation
- Education and training
- Hospitality
- Medical services
- Cleaning
- Food services

Figure 11. Renewable energy project supply chain and associated jobs.

On a state level, there are requirements for licenced tradespeople to meet annual continuing professional development (CPD) requirements, and the relevant licencing authorities are typically involved in approving CPD training. However, the fossil fuel workers would require formal fast-track training in the renewable or clean energy sector (including both gap training and reskilling into a new energy sector).

Tables 9–12 show the transition of fossil fuel workers to the clean energy sector and identify gaps in training and reskilling requirements, mainly in the hydrogen and smart grid domain.

Table 9. Crosswalk between fossil fuel and clean energy sector: laborers, service technicians, plumbers.

Blue text highlights gap training;
+ indicates new development opportunities

Fossil fuel occupation	Fossil fuel skill	Crosswalk occupation	Training skills
Laborers	Construction pathways, concreting	Construction labour in clean energy project	Construction Induction Card, Work Safely at Heights, License to Perform Dogging, License to Perform Rigging – Basic, Intermediate and Advanced
Service technician and mechanics	Certificate II in Technical Support; Certificate III in Engineering Fabrication and Mechanical	Wind turbine repair; monitoring; electric vehicle service technicians; solar roofers	Certificate III in Electrotechnology Electrician; Short course on grid-connected PV Solar Systems; Turbine Technician Courses+; Short course on Electric vehicle repair+; Certificate III in Automotive Electric Vehicle Technology; License class for high voltage installation
Plumbers, pipe fitters, and steamfitters	Post-trade gas fitting and REL; post-trade pumping and trade	Line supervisor; construction trades; electricians; solar roofers; hydrogen energy	Skills Set (possibly both Cert-III & Post Trade) – H2Technology for Gas fitters+; H2 Fuel Cells and Electrolysis; Advanced Hydrogen Technology (Tertiary education)+ Short course on Grid Connected PV Solar System; Certificate III in Electrotechnology Electrician

Table 10. Crosswalk between fossil fuel and clean energy sector: engineers, equipment operators, drivers.

Blue text highlights gap training;
+ indicates new development opportunities

Fossil fuel occupation	Fossil fuel skill	Crosswalk occupation	Training skills
Operating engineer and other construction	Civil, mechanical, and electrical engineering qualifications	Condition monitoring and asset management; data analytics; grid connection; transmission line engineering	Certificate and a short course in asset management and condition monitoring (tertiary education); Graduate Certificate in Power and Energy (Tertiary education); Short course in PSCAD for grid connection engineering+ (Tertiary education)
Equipment operators	HSR training courses; Certificate III in Civil Construction Plant Operations; Certificate III in Civil Construction	Extraction worker; equipment operation in construction sites in clean energy	License to operate cranes on offshore site; License to Perform Dogging, License to Perform Rigging – Basic, Intermediate and Advanced; Construction Induction Card.
Heavy and tractor-trailer drivers	Driving operations; HSR training courses	Crane and hoist operator; drivers	License to Operate a Slewing Mobile Crane; License to Perform Dogging, License to Perform Rigging – Basic, Intermediate and Advanced; Construction Induction Card;

Table 11. Crosswalk between fossil fuel and clean energy sector: service attendants, material movers and hand

Blue text highlights gap training;
+ indicates new development opportunities

Fossil fuel occupation	Fossil fuel skill	Crosswalk occupation	Training skills
Service attendants	Certificate II in Engineering - Trade; Certificate II in Technical Support	Storage person; electrical inspection of the clean energy sector	Work Safely at Heights; Certificate II in Electrical Inspection+; License class for high voltage installation; License class for hazardous areas.
Material movers and hand	Enter and work in a confined space; licence to operate forklift; driving operations	Clean energy construction site; packers, operation, and handling	Construction Induction Card, Work Safely at Heights, License to Operate a Slewing Mobile Crane; License class for hazardous areas.

Table 12. Crosswalk between fossil fuel and clean energy sector: general operation manager, line supervisor, welders, cutters

Blue text highlights gap training;
+ indicates new development opportunities

Fossil fuel occupation	Fossil fuel skill	Crosswalk occupation	Training skills
General operation manager	Building and construction (specialist trades); building and construction (management) – higher education (HE) qualifications	General operation manager in clean energy, manufacturing energy-efficient products, zero-emission building construction, operation, and retrofitting	Certificate IV in Building and Construction Diploma of Building and Construction
First-line supervisor for production and operation	ESI generation (operations); ESI generation; ESI generation maintenance – electrical	Wind energy or hydrogen energy operation manager; electrical inspection of high voltage	Advanced Hydrogen Technology (Tertiary education) +; Skills Set (possibly both Cert-III & Post Trade) – H2Technology for Gas fitters+; H2 Fuel Cells and Electrolysis+; Turbine Technician Courses; Certificate II in – Transmission Structure and Line Assembly+; Certificate III in ESI – Transmission Overhead+
Welders, cutters	Certificate III in Engineering – Fabrication Trade	Electrical power-line installer and fitter; EV repair and assembly	Short Course in Transmission Structure and Line Assembly Power Industry Induction Card Pathway to -Certificate II in – Transmission Structure and Line Assembly+; Certificate III in ESI – Transmission Overhead+; Certificate III Electrotechnology Certificate III Engineering – Mechanical

3—
Training and Professional Development Program

Of Gippsland's population, 17.8 per cent are technicians and trade workers— higher than the state average of 13 per cent.

3.1— Current Vocational and Tertiary Education Training

Post-secondary education considered in this report includes vocational education and training (VET), higher education courses, industry accreditations, and CPD. Rutovitz et al. (2021) identified education and training gaps in the renewable energy sector. It is reported that there is a mismatch between offerings by the education system and industry demand, particularly when considering the quantity of higher education (HE) courses offered against high industry demand for hands-on training.

Table 13 lists the programs available. Universities in the Regional Universities Network (RUN) offer associate and Bachelor of Engineering Technology degrees specialising in power and renewable energy. However, the RUN universities do not offer specialised or advanced courses in renewable energy that are required by the industries. Furthermore, most RUN universities do not have specialised research centres for the new energy transition.

University/State	Program Title	Comment
University of Newcastle, New South Wales	Bachelor of Renewable Energy Engineering	Accredited by Engineers Australia (EA)
Royal Melbourne Institute of Technology (RMIT), Victoria	Bachelor of Engineering (Sustainable System Engineering)	Accredited by EA
Monash University, Victoria	Bachelor of Resource Engineering (Renewable Energy)	Accredited by EA
Edith Cowan University, Western Australia	Bachelor of Engineering (Electrical and Renewable Energy)	Accredited by EA
Murdoch University, Western Australia	Bachelor of Engineering (Renewable Energy Major)	Accredited by EA
University of New South Wales, New South Wales	Bachelor of Engineering (Renewable Energy)	Accredited by EA
Australian National University, Australian Capital Territory	Bachelor of Engineering (Renewable Energy Major)	Accredited by EA

Table 13. Undergraduate programs specialising in renewable energy

Only seven universities in Australia offer renewable energy programs. Out of seven, three universities in Victoria provide undergraduate programs in the different specialisations of advanced renewable engineering.

Figure 12. Undergraduate and postgraduate programs in renewable energy at Victorian universities

University	Undergraduate/Degree Program	Post-graduate/Certificate Program
University of Melbourne	Bachelor of Engineering (Electrical)	Master of Electrical Engineering (3 years)
Monash University	Bachelor of Electrical and Computer Engineering, Bachelor of Resource Engineering (Renewable Energy)	Master of Electrical Engineering Master of Sustainable Energy
RMIT University	Bachelor of Engineering (Electrical) Bachelor of Engineering (Sustainable System Engineering) Associate Degree in Engineering	Master of Engineering (power) Master of Engineering (Renewable Energy)
Swinburne University of Technology	Bachelor of Engineering (Power) Associate Degree in Engineering	Master of Engineering
Deakin University	Bachelor of Engineering (Power)	Master of Engineering Electrical and Renewable Energy Graduate Certificate in Power and Energy
Federation University Australia	Bachelor of Engineering (Electrical & Communication) Bachelor of Technology (Renewable—proposed)	Master of Engineering (Renewable and Power System) Graduate Certificate in Community Energy and Microgrid
Victoria University	Bachelor of Engineering (Electrical)	Master of Engineering (Electrical Power) Graduate Certificate in Power and Energy

The listed undergraduate programs shown in Figure 12 are at basic and intermediate levels and cover different aspects and areas in electrical, sustainable, electronics, and communication fields of study. There are also some advanced-level courses and programs in power engineering with less of a focus on current industry requirements.

The high number of university degrees results from universities having a high degree of freedom to develop and offer new courses. The universities can self-accredit the development of the new courses, but the level of consultation with appropriate industries is quite vague. Federation University in Gippsland offers programs and courses suitable for clean energy technologies, including:

- Bachelor of Engineering in Civil
- Bachelor of Engineering in Electrical and Information Technology
- Graduate Certificate in Community Energy and Microgrid
- Bachelor of Environment and Conservation Science
- Master of Business Administration (MBA)

Courses available in VET, along with a reference to specific keywords in their course descriptions, are shown in Table 14. Course approval in the VET sector is highly centralised, and multiple registered training organisations can offer the approved courses. As a result, all the listed VET qualifications and accredited courses are available from many providers.

Over 85 per cent of VET program enrolments are in training package qualifications. Multiple training packages have been identified as potentially relevant for the skills required for a clean energy transition, including:

- Electricity supply
- Information and communication technology
- Resource and infrastructure
- Sustainability
- Transmission and distribution

The VET sector in Gippsland currently offers the following courses/programs align with clean energy sector

- Certificate II in Electrotechnology (Career start);
- Certificate III in Electrotechnology (Apprenticeship);
- Certificate III in Instrumentation and control;
- Certificate III in Instrumentation and control (Apprenticeship);
- Course in New Energy Technology System;
- Course in Working Safety in Solar Industries.

There are courses/programs also available in the VET sector covering renewable energy such as Certificate III in Renewable Energy - ELV, Certificate IV in Renewable Energy, and Diploma of Renewable Energy Engineering. All qualifications currently exist under training packages available within the vocational education sector, however, would require the development of curriculum and training facilities to support delivery.

UEE32020 Certificate III in Renewable Energy - ELV

This qualification covers competencies to select, install, set up, test, fault find, repair and maintain renewable energy (RE) equipment and systems. It does not include electrical work covered by licensing requirements declared by Electrical Regulatory Advisory council (ERAC) for an 'Electrician's license'.

UEE41611 Certificate IV in Renewable Energy

This qualification provides competencies to select, install, commission, fault find and maintain multiple renewable energy (RE) sources and equipment for control of energy use.

UEE50720 Diploma of Renewable Energy Engineering

This qualification provides competencies to develop, select, commission, maintain and diagnose faults/malfunctions on large-scale renewable energy (RE) equipment and systems.

Furthermore, the existing offering units are solar and low voltage system dominated. Modules and units of other renewables and big data analysis in energy systems need to be developed and integrated.

Tables 15–18 show the skills and qualifications required by renewable energy projects that are covered in the VET sector.

Table 14. Current nationally recognised training in renewable energy

Keyword	VET Qualifications and Accredited Courses
Renewable energy	9 (15 units of competency)
Energy efficiency	5 (6 units of competency)
Sustainable energy	1 (5 units of competency)
Electrical	41 (213 units of competency)
Solar	1 (3 units of competency)

Table 15. Available VET qualifications for managerial roles in renewable energy projects

Role	VET Qualification
Executive and general managers	Graduate Diploma of Strategic Leadership
Human resources, finance, and business administration managers	Business Services Training Package Diploma of Human Resources Management
Construction/project managers	Advanced Diploma of Building and Construction (Management)
Site managers (project builders)	Diploma of Building and Construction (Management)
Operations/asset managers	Diploma of Banking Services Management
Other managers	Advanced Diploma/Diploma of Leadership and Management / Advanced Diploma/Diploma/ Certificate IV in Process Plant Technology

Table 16. Available VET qualifications for professional roles in renewable energy projects

Role	VET Qualification
Legal and planning professionals, policy and planning professionals	Diploma of Government
Human resource professionals	Certificate IV in Human Resources Diploma of Human Resources Management
Sales and marketing professionals	Advanced Diploma / Diploma in Marketing and Communication Certificate IV in Marketing and Communication
Community engagement workers, public relations professionals	Certificate IV in Local Government Diploma of Community Development
Surveyors	Certificate IV in Surveying
Civil engineers	Advanced Diploma of Civil Construction
Electrical engineers	Advanced Diploma of ESI - Power Systems
Grid engineers (industrial engineering)	Certificate III in Engineering – Industrial Electrician
Mechanical engineers	Certificate IV in Engineering (Pathway)
Solar PV designers, engineering professionals	Certificate IV in Electrical – Photovoltaic systems
Environment assessment professionals	Certificate IV in Local Government (Health and Environment) Diploma of Local Government (Health and Environment)
SCADA/telecommunications engineers	Diploma of Telecommunications Engineering
Geographic information system professionals	Advanced Diploma in Surveying
Health and safety professionals	Advanced Diploma in Work Health and Safety Certificate IIV in Work Health and Safety
IT professionals	Certificate IV in Information Technology Diploma of Information Technology
Civil engineering technicians	Diploma of Civil Construction Management
Electrical technician support workers, power plant control room operators	Certificate II ESI Generation (Operations) Certificate IV ESI Generation (Maintenance) Certificate IV ESI Generation (Maintenance) Certificate IV ESI Generation (Fabrication) Certificate IV ESI Generation (Maintenance) – Electrical Electronic
Telecommunications trades	Diploma in Electronics and Communication Engineering
Mechanical trades, mechanical draftspersons	Diploma in Hydraulic Services Design, Diploma in Fire Systems Design
Transport and logistics	Certificate IV or Advanced Diploma in Material Logistics

Tables 13–18 show that both the VET and higher education sectors offer training and knowledge in the new energy sector relevant to managers, engineers, technicians, trade support, and others. However, there is always a moment of transition between the development of new technologies and relevant course offerings. Currently, courses in hydrogen, fuel cell-related technology, advanced asset management, and IoT application in energy systems are not well developed across the higher education and VET sector. Moreover, some of the qualifications related to transmission line model, structure, and development have either ceased or are no longer offered.

Furthermore, the project team has reviewed several jobs adverts in the renewable energy domain (offshore sector) and found the following short courses that are immediately required for new energy jobs. Table 19 shows the short qualifications needed for current renewable energy projects.

Table 17. Available VET qualifications for supporting roles in renewable energy projects

Role	VET Qualification
Earthmoving, grader operators	Certificate III in Civil Construction Plant Operations
Truck Drivers (large solar and wind)	Certificate III in Driving Operations
Drivers (distributed solar PV)	Certificate II in Driving Operations
Data entry operator	Certificate III Business Administration
Accounts Clerk	Certificate I in Basic Financial Literacy Diploma of Accounting
Program or Project Administrators	Certificate IV in Project Management Practice
Inspectors and Regulatory Officers	Certificate IV in Local Government (Regulatory Services) Diploma of Local Government (Regulatory Services)

Table 18. Available VET qualifications for labourer roles in renewable energy projects

Role	VET Qualification
Concreters	Certificate III in Concreting
Riggers	Certificate III in Rigging Skills Sets and Short Courses
Dogman	Certificate III in Construction Crane Operations
Electrical trade assistants	Certificate II in Technical Support
Mechanical trade assistants/labourers (mechanics assistant)	Certificate III in Engineering – Mechanical Trade
Civil trade assistants/labourers (Other labourers) (civil technicians)	Certificate II Construction Pathways

Table 19. Immediate training required by fossil fuel workers to work in the offshore wind energy sector

Short courses	RTO delivering this Skill Set	Locations
NDT Certifications (Specific NDT qualifications to be determined at project kick off)	Various course providers including ATTAR AQB, ALS Training Academy, Advanced Infrared Resourced Australia, Kuzer Technical, TAFE	WA, NSW, Queensland, SA and Victoria
GWO Basic Safety Training (BST)	Alitec Australia Pty Ltd, Canberra Institute of Technology, Federation University, Fire and Safety Australia, Skylar Safety, Thomson Bridge Pty Ltd, Vestas Wind Technology Australia, Wright Training,	Melbourne, Canberra, Adelaide, Sydney
Forklift Licence (LF)	Multiple providers in all states and territories, TAFE Gippsland	Multiple providers in all states and territories
Advanced First Aid	Multiple providers in all states and territories TAFE Gippsland	Multiple providers in all states and territories
Welding Inspector Certificate	Multiple providers including Techno weld, Weld Australia, Australian Welding Institute TAFE Gippsland	All states
NACE Coating Inspector Certificate#	AMPP, NACE	Brisbane, Perth, Adelaide, Sydney
Construction Industry White Card	Multiple providers in all states and territories, TAFE Gippsland	Multiple providers in all states and territories
Maritime Security Identification Card (MSIC)	Atlas Professionals, Veritas, Client View	Post office Australia wide or in person at office Perth or Adelaide
Basic Offshore Safety Induction and Emergency Training (BOSIET)	ERGT	Perth, Darwin, Melbourne
Short and Long-Range Radio Operator Certificate	Great Barrier Reef International College, Australian Maritime College, TAFE Newcastle, TAFE Ultimo, South Metro TAFE, TAFE Gippsland	Queensland, Hobart, Perth, Newcastle, Sydney
GWO Blade Repair Training Certificate#	RIGCOM, Vertical Horizons, Skylar Safety	Sydney, Brisbane
IRATA Rope Access Certification	Multiple providers in all states and territories	Multiple providers in all states and territories
Dogging and Rigging Certifications (DG, RB)	Multiple providers in all states and territories TAFE Gippsland	All states
Helicopter Underwater Escape Training (HUET)	ERGT, Life Flight Training Academy, Ace Training Centre	Perth, Darwin, Melbourne, Queensland (various cities), Sydney
E- learning service lift training- dependent on wind turbine manufacturer (i.e. Avanti Service Lift Operator)	Turbine manufacturer will determine, example of Avanti	Melbourne for Avanti - Alimak Group
High Voltage Certifications	High Voltage Training Solutions, Volt Edge, Site Skills Training, Optec, Competency Training, Power Supply Services and Training, Western Energy Training, Australian Maritime College, NECA	Sydney, Melbourne, Perth, Darwin, Tasmania, Canberra, Adelaide
Master 11/2 <3000GT (Unlimited)#	Australian Maritime College, South Metro TAFE, TAFE NSW- Newcastle	Hobart, Perth, Newcastle
ECDIS (Electronic Chart Display and Information System)	AMC, Smart Ship Australia, Perth Sim Centre, TAFE Newcastle, TAFE Sydney, Great Barrier Reef International Marine College	Hobart, Brisbane, Perth, Newcastle, Sydney, Cairns
Dynamic Positioning (DP) Offshore Unlimited Certification	AMC, Perth Sim Centre	Hobart, Perth
ISO 9001, ISO 14001 and ISO 45001 Integrated Management Systems Internal Auditor Training	Many providers including QMS Audits, PWC Training Academy, Bureau Veritas	All cities in Australia and online
Certificate of Safety Training (full course) - STCW Reg IV/1	TAFE Newcastle, TAFE Ultimo, ERGT (Darwin, Perth, Altona), Great Barrier Reef International Marine College, Maritime Career Training, Whitsunday Maritime Training Centre, Australian Maritime Centre, Fremantle Maritime Simulation Centre,	Newcastle, Sydney, Darwin, Cairns, Kulangoor, Airlie Beach, AMC, Altona, Perth, Fremantle
Food Safe Level 1 and 2 (SITXFSA001 Use Hygienic Practices for Food Safety & SITXFSA002 Participate in Safe Food Handling Practices)	CTA Training Specialists (online) TAFE Gippsland	Online
Lifting Equipment General (LEG) Advanced Program	Lifting Equipment Engineering Association	Online e-learning
Risk Management Course	Multiple providers in all states and territories and online	All states and online
Permit to work training	Multiple providers in all states and territories	All states
Working Safely at Heights	Multiple providers in all states and territories TAFE Gippsland	Multiple providers in all states and territories

Table 19. Continued

Short courses	RTO delivering this Skill Set	Locations
PMASUP 305 Operate Offshore Crane	Multiple providers in all states and territories	All states
Manual Handling Cert	Contextual course offered in Multiple TAFE including TAFE Gippsland	All states
LEEA Lifting equipment general (LEG) training	Online training provider	England, India, Australia and NZ. E-learning mainly or instructor-based training on your site
Elevated Platform (EWP) certification	Multiple providers in all states and territories TAFE Gippsland	All states
Dangerous Goods Cert	State Department of Transport and Multiple providers in all states and territories	Online
E-learning training for service lift model i.e., Avanti Service Lift Operator Training	Online training, avanti-online.com	Online
Confined Space entry certificate	Multiple providers in all states and territories TAFE Gippsland	All states
Current High Voltage (HV) certificate	Multiple providers in all states and territories	All states
AMSA Integrated Rating Certificate of Proficiency	Australian Maritime College, South Metro TAFE, TAFE NSW- Newcastle	Hobart, Fremantle, Newcastle
AMSA Chief Integrated Rating Certificate of Proficiency	Australian Maritime College, South Metro TAFE, TAFE NSW- Newcastle	Hobart, Fremantle, Newcastle
ADAS Diver Qualification	ADAS.org	Melbourne, Tasmania, Perth, Albany, Queensland, Sydney, NZ
Risk Management PMI-RMP Certification	online and in class @ sprintzeal.com	All states
Aeronautical Radio Operator Certificate	droneit.com.au or Casa.gov.au	Online
Flag State Medicals and Endorsements	As per flag state of installation and cable lay vessels	Flag state consulate
OGUK Medical	Multiple providers in all states and territories	All states
Chesters Step Test	Any GP can complete this test	All states
AMSA Medical	Multiple providers in all states and territories	All states
AS 2299 Dive Medical	spump.org.au to find doctors or Dive medicals Melbourne/Sydney	Perth, Melbourne, Sydney, Brisbane
GWO Technical training#	APRETC, Federation University TAFE	Mt Helen
Blade Repair Technician Apprenticeships#	APRETC, Federation University TAFE	Mt Helen

Table 20. Additional programs/ courses/training required for higher education graduates

Job Title	Qualification	Additional Qualification and Skill Sought
Renewable Energy Engineer	B.Eng. in Electrical/Renewable	Clean Energy Council Certified Solar Designer Clean Energy Council Certified Battery Storage Designer
Electrical Engineer – Wind	B.Eng. in Electrical/Renewable	WAsP, WindPro, and WindFarmer
Renewable Energy technologist	B.Eng. in Electrical/Renewable/Mechatronics	QA and HSE Audits
Electrical Engineer – Testing	B.Eng. in Electrical	QC testing, product development or manufacturing
Solar Design Engineer	B.Eng. in Electrical/Mechatronics	Ensuring compliance with relevant HSE legislation
Grid Connection Engineer	B.Eng. in Electrical/Renewable	PSAD, PSS/E/DIgSILENT/HOMER

“According to the major job searching website ‘Seek’, there were more than 40 jobs listed in Victoria on 12 June with the job title ‘renewable energy’. ”

The project team has reviewed several jobs adverts in the renewable energy domain which required higher education qualifications. According to the major job searching website ‘Seek’, there were more than 40 jobs listed in Victoria on 12 June with the job title ‘renewable energy’. Table 20 summarises the formal and additional qualifications required for those jobs. Many of the HE courses in Table 13 and Figure 12 do not entirely cover the additional qualifications sought by the industry.

Furthermore, Tables 21-24 summarises the pathway for the current power plant worker to different clean energy sector and training requirements including the gap training and reskilling.

However, this opportunity assessment was limited to an initial stocktake of the current training programs offered at tertiary and vocational levels in Australia. A deeper, course-level investigation may be required for more granular insights.

Furthermore, different peak bodies and industry organisations also offer training programs in the clean energy sector (e.g., Clean Energy Council, Energy Efficiency Council, Green Building Council).

These programs may include:

- Design and installation courses for solar, micro-hydro, small-scale wind, and battery energy
- Legislation training for installers
- Certified course for energy managers
- Measurement and verification professional certificates

These training programs are not equivalent to the formal qualifications offered by the VET and higher education sectors. However, they could be suitable for the fossil fuel-based workforce to transition into clean energy. All these organisations offer CPD training opportunities to maintain relevant industry certifications. Various other professional governing bodies, including EA, also offer CPD programs and require their members to complete a certain amount of professional training every year.

Table 21. Fossil fuel power industry skill mapping to wind

HV cable joiner — Certificate II in Transmission Structure and Line Assembly	Cable installer: Construction Induction Card; Work Safety at Heights	Electrician technician: Certificate III in Electrotechnology Electrician	Apprentice Electrician: Certificate II in Electrotechnology Electrician		
Rope access — Certificate II in Engineering	Rope access technician: Construction Induction Card; Work Safety at Heights	Rope access manager: Construction Induction Card; Work Safety at Heights	Blade/turbine repair technician: Post-trade skill set for turbine and blade technician ▲	Rigger foreman: Construction Induction Card; Work Safety at Heights	
Team leaders	Asset manager	Site manager (onshore)	Permit manager: Postgraduate in Asset Management	Fabrication supervisor: Construction Induction Card; Maritime training	
Engineers — Electrical, Civil and Mechanical	Grid connection manager transmission: Postgraduate in Electrical and Renewable Energy	Commissioning Engineer: Postgraduate in OHS, Project Management	Project engineer: Postgraduate in Electrical and Renewable Energy	Project planner: Postgraduate in Engineering Project Management	
Utility — Basic rigging	Rigger foreman: Construction Induction Card; Work Safety at Heights				
Mechanical fitter trade — Certificate III in Engineering (Mechanical)	Blade or wind turbine technician: Post-trade skill set for turbine and blade technician ▲	Installation technician: Construction Induction Card; Work Safety at Heights; High voltage installation license	Mechanical supervisor: Construction Induction Card; Work Safety at Heights; High voltage installation license	Mechanical fitter: Construction Induction Card; Work Safety at Heights; High voltage installation license	
Electrician and dual trade instrumentation — Certificate III in Electrotechnology or Instrumentation and control	Wind turbine technician: Post-trade skill set for turbine and blade technician ▲	Installation technician: Construction Induction Card; Work Safety at Heights; High voltage installation license	E&I technician: Construction Induction Card; Work Safety at Heights; High voltage installation license	Commissioning engineer: Construction Induction Card; Work Safety at Heights; High voltage installation license	Electrical supervisor: Construction Induction Card; Work Safety at Heights; High voltage installation license	Control room technician: Course on Working Safety in Industries
Boilermaker trades — Certificate III in Engineering (Fabrication or Welding)	Fabrication supervisor: Construction Induction Card; Maritime Training	Welders: Construction Induction Card; Work Safety at Height;	Installation technician: Construction Induction Card; Work Safety at Heights		Cable installation: Construction Induction Card; Work Safety at Heights; High voltage installation license	

Gap Training Reskilling ▲ New development opportunities ● Working Safety at Heights & Health and Safety Representative Training

Table 22. Fossil fuel power plant skill mapping to hydrogen

HV cable joiner — Certificate II in Transmission Structure and Line Assembly	Fuel cell installation and maintenance: H2 Fuel Cells and Electrolysis ▲; Construction Induction Card	Instrument and electrical technician: Certificate III in Electrotechnology Electrician; Certificate III in Instrumentation and Control			
Rope access — Certificate II in Engineering	Fuel cell maintenance: H2 Fuel Cells and Electrolysis ▲	Pipeline technician: H2 Technology for Gas fitters ▲	Gas fitter: Skills Set (possibly both Certificate III & Post Trade); H2 Technology for Gas fitters ▲		
Team leaders	Project manager	Planner			
Engineers — Electrical, Civil and Mechanical	Surveyors: Licence class for hazardous materials; Short course in Hydrogen Technology ▲	System integration engineer: Postgraduate in Power and Energy; Certificate of short course in Advanced Hydro Technology ▲	Industrial designers: Postgraduate in Power and Energy; Certificate of short course in Advanced Hydro Technology ▲		
Utility — Basic rigging	Service station workers	Fuel cell installation and maintenance: H2 Fuel Cells and Electrolysis ▲			
Mechanical fitter trade — Certificate III in Engineering (Mechanical)	Fuel cell maintenance: H2 Fuel Cells and Electrolysis ▲	Pipeline technician: License class for hazardous materials	Gas fitter: Skills Set (possibly both Certificate III & Post Trade); H2 Technology for Gas fitters ▲	Plumber and engineering trade: Skills Set (possibly both Certificate III & Post Trade); H2 Technology for Gas fitters ▲	Mechanical fitter: License class for hazardous materials
Electrician and dual trade instrumentation — Certificate III in Electrotechnology or Instrumentation and control	Hydrogen process operator: Skills Set (possibly both Certificate III & Post Trade); H2 Technology ▲	Instrument and electrical technician: Certificate III in Electrotechnology Electrician	Quality and safety manager: Course on Working Safety in Hydrogen Industry ▲	Electrolyser technician: H2 Fuel Cells and Electrolysis ▲	Power plant operators
Boilermaker trades — Certificate III in Engineering (Fabrication or Welding)	Equipment certifier: Course on Working Safety in industries ●	Pipeline technician: H2 Technology for Gas fitters ▲	Instrument technician: Certificate III in Electrotechnology Electrician	Manufacturing worker: Course on Working Safety in industries ●; Certificate III in Engineering Fabrication	

Gap Training Reskilling ▲ New development opportunities ● Working Safety at Heights & Health and Safety Representative Training

Table 23. Fossil fuel power plant skill mapping to battery, solar, biomass

HV cable joiner — Certificate II in Transmission Structure and Line Assembly	Apprentice electrician: Certificate III Electro-tech	Electrical inspector: Certificate II in Electrical Inspection ▲	Electrician: Course in New Energy Technology System	Gas pipe technician: Licence class for hazardous area/material				
Rope access — Certificate II in Engineering	Pipe line technician for biomass: Course on Working Safety in industries ●	Installation side technician for solar battery: New Energy Technology Course; Certificate III in Renewable Energy						
Team leaders	Commission and engineering manager	Project engineer and risk manager: Graduate certificate in Reliability and Asset Management	Planner					
Engineers — Electrical, Civil and Mechanical	Smart grid engineer: Post graduate in Power and Energy	Control engineer: Post graduate in Power and Energy	Risk manager: Course on Working Safety in industries ●	Energy yield analysis: Graduate certificate in Power and Energy	Data analytics: Graduate certificate on Data Analysis	Geologist: Graduate course in science	Software engineer: Graduate Certificate in IT	Commission and engineering manager: Postgraduate in project management
Utility — Basic rigging	Biomass installation: Construction Induction Card	Construction side worker: Licence class for hazardous area/ material						
Mechanical fitter trade — Certificate III in Engineering (Mechanical)	Electrical technician: Certificate III in Electro-technology Electrician	Electrical inspection: Certificate II in Electrical Inspection ▲	Risk manager: Course on Working Safety in industries	Solar roofer: Course in New Energy Technology System	Solar cleaning technician: Course on Working Safety in industries ●			
Electrician and dual trade instrumentation — Cert III in Electrotechnology or Instrumenta-tion and control	Control engineer	Electrical technician for the solar and battery: Course in New Energy Technology System	Electrical inspection: Certificate II in Electrical Inspection ▲	Solar roofer: Course in New Energy Technology System				
Boilermaker trades — Certificate III in Engineering (Fabrication or Welding)	Installation trade: Construction Induction Card	Electrical technician: Certificate II in Electrical Inspection ▲	Gas worker: Licence class for hazardous area/material	Process and supply trade: Course on working safety in industries ●				

Gap Training Reskilling ▲ New development opportunities ● Working Safety at Heights & Health and Safety Representative Training

Table 24. Fossil fuel plant skill mapping to renewable energy zone

HV cable joiner — Certificate II in Transmission Structure and Line Assembly	Cable installer: Certificate III in ESI Power Systems — Distribution Cable Jointing; Work Safety at Heights	Electrician technician: Certificate III in Electrotechnology Electrician			
Rope access — Certificate II in Engineering	Cable installer: Certificate III in ESI Power Systems — Distribution Cable Jointing; Work Safety at Heights	Electrician technician: Certificate III in Electrotechnology Electrician	Electrical power line installer: Certificate III in ESI Power Systems — Transmission Overhead		
Team leaders	Project manager	Stakeholder engagement: Certificate in Project Management	Planner and project engineer: Certificate in Project Management	Environmental adviser: Postgraduate in Environmental Science	Risk manager: Graduate certificate or short course in Asset Management, condition monitoring
Engineers — Electrical, Civil and Mechanical	Smart grid engineer: Post graduate in Power and Energy	Grid connection engineer: Post graduate in Power and Energy	Transmission line design: Post graduate in Power and Energy	Construction site manager: Short course in Asset Management	Data analytics: Post graduate in IT or Engineering
Utility — Basic rigging	Installer: High voltage installation license; Work Safety at Heights	Construction work and traffic control: Construction Induction Card			
Mechanical fitter trade — Certificate III in Engineering (Mechanical)	Transmission line design: Certificate III in Transmission Structure and Line	Electrical inspection: Certificate II in Electrical Inspection ▲	Technician: New Energy Technology System; Certificate III and IV in Renewable Energy ▲	Surveyors: Diploma in Surveying; Diploma in Spatial Information Surveying	
Electrician and dual trade instrumentation — Certificate III in Electrotechnology or Instrumentation and control	Electrical technician: Course in New Energy Technology Systems	Electrical installation inspection: Certificate II in Electrical Inspection ▲	Installation and commissioning engineer: Course on working safety in industries ●		
Boilermaker trades — Certificate III in Engineering (Fabrication or Welding)	Cable installer: Certificate III in ESI Power Systems — Distribution Cable Jointing;	Electrical technician: New Energy Technology System	Electrical power line installer: Certificate III in ESI Power Systems — Transmission Overhead	Technician: Course in New Energy Technology Systems; Certificate III and IV in Renewable Energy ▲	

Gap Training Reskilling ▲ New development opportunities ● Working Safety at Heights & Health and Safety Representative Training

3.2— Why Skills Shortages Persist Despite Training Programs

Despite a supply of post-secondary education related to clean energy and industry engagement in the development of these programs, skills shortages exist, and the situation is expected to worsen. A persistent enrolment decline is observed in the tertiary education and VET sectors between 2014 and 2019. In Australia, the number of people working as electrical engineers fell from 19,300 in 2014 to 16,600 in 2019 (ABS, 2019). The 2018 enrolments for domestic students in engineering were down to the 2010 level. The graduation numbers are at an all-time high, but less than 12,000 per year (ABS, 2019). VET program completion for 'Certificate III in Electrotechnology Electrician', the essential requirement for a licenced electrician, declined from 6,735 in 2015 to 5,400 in 2019.

Across four other diplomas or advanced diplomas related to electrical engineering, completions declined from 425 in 2015 to 255 in 2019. Even general accreditations such as the Certificate IV in Engineering saw a drop from 1,515 in 2015 to 655 in 2019. This figure is even lower for the regional areas. Therefore, attracting enough people to be trained is a significant workforce challenge in Australia, particularly in regional areas like Gippsland (e.g., Federation University has seen a decline in overall engineering enrolment from 23-30 in 2016 to 14 in 2020). Furthermore, the pool of students interested in pursuing engineering from the Gippsland area did not grow significantly in the last five years. Specifically, attracting enough people to engineering studies is an issue for the energy sector.

It is clear that, despite numerous courses on offer, the vocational and tertiary education sectors are not able to attract and graduate enough students to meet the growing industry demand. Table 25 identifies problems related to the persistent skills shortage that exist despite the available training programs.

Table 25. Challenges associated with workforce development and transition

No.	Problems
1	Insufficient numbers of people taking up studies in the relevant technical fields
2	The time commitment and energy investment to complete the programs
3	Training programs not fully meeting skill or workforce needs
4	Evaluating the success of renewable energy education programs
5	Significant lags between identification of industry needs and updates to training packages

> "[There is a] lack of understanding or interest among students in years 10–12 about a career in the new energy sector."
>
> —Survey respondant

4—
How to Close the Skill Gap

As discussed earlier, despite the availability of so many courses and programs, skills shortages exist, and the situation is expected to worsen. The education sector has experienced a persistent decline in technical course availability and enrolment. This work has identified five key issues associated with workforce development and transition in the renewable energy sector. The following measures could be taken to address these issues.

4.1— Suitable Training Programs

Training programs exist, but existing and future energy professionals need professional development pathways with CPD opportunities mapped out for working across the renewable energy sector.

Generally, traditional higher education and VET programs can deliver skilled and qualified workers over the medium to long term (i.e., >5 years), but the required time commitment can be an issue for many mature and young people. Therefore, a new pathway to deliver the program and courses in a shorter time frame is required.

In this case, multiple entry and exit point programs can be developed. For example, Federation University has proposed an opportunity for such a program with technical and further education (TAFE).

The proposed program is designed to include different exit points embedded within the degree. Students will be able to exit with:

1. A Diploma of Applied Technologies (22460VIC) from the TAFE institution at the end of Year 1

2. An Associate Degree in Renewable Energy from the higher education at the end of Year 2

3. A Bachelor of Engineering Practice (Renewable Energy) from the higher education after successful completion of all three years

The program is also designed to facilitate two entry points at the start of Years 1 and 2, subject to an applicant meeting entry requirements. Each of these entry points is aimed at different cohorts (as shown in Figure 13).

Upon completion of the proposed Bachelor of Engineering Practice (Renewable Energy) degree, students will have the opportunity to work as an engineering technologist or continue to the Master of Engineering Technology (Renewable Energy and Electrical Power Systems) with one-semester credit to graduate and work as a professional engineer. A similar program could be developed for construction management and design drafting since most jobs will be in construction during the development of the renewable energy projects. Appendix B shows the detail of such an example program.

Similar to the tertiary education sector, the VET sector can also develop pathway programs with multiple entries and exit points. For example, Federation TAFE has developed a wind turbine technician pathway program, as shown in Figure 14. School leavers, mature people, and people with other skills can enter this program and leave from multiple exit points at Certificate II or Certificate III level or become a wind turbine technician.

Furthermore, engagement with stakeholders has revealed that the private sector could contribute to skills delivery in three important ways:

- Delivering industry-based courses
- Transferring knowledge from industry to training providers
- Offering more work-based learning and apprenticeship opportunities

Furthermore, not all skill acquisition needs formal training. Institutional learning is often impractical for busy employees. From a worker's perspective, incremental upskilling is important because it can be difficult to find the time to undertake full qualifications while in the workforce.

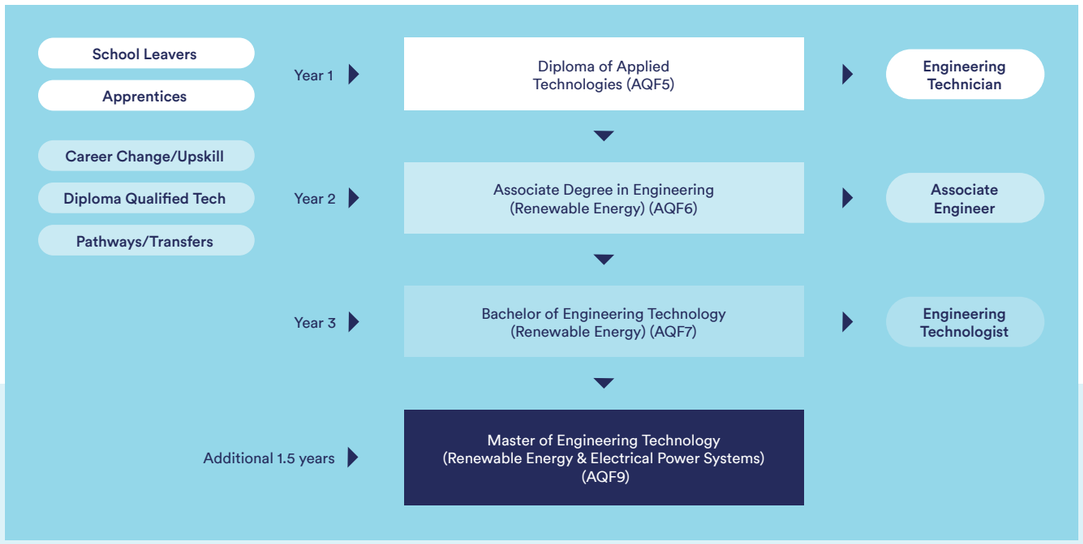


Figure 13. Proposed Bachelor of Engineering Practice (Renewable Energy)

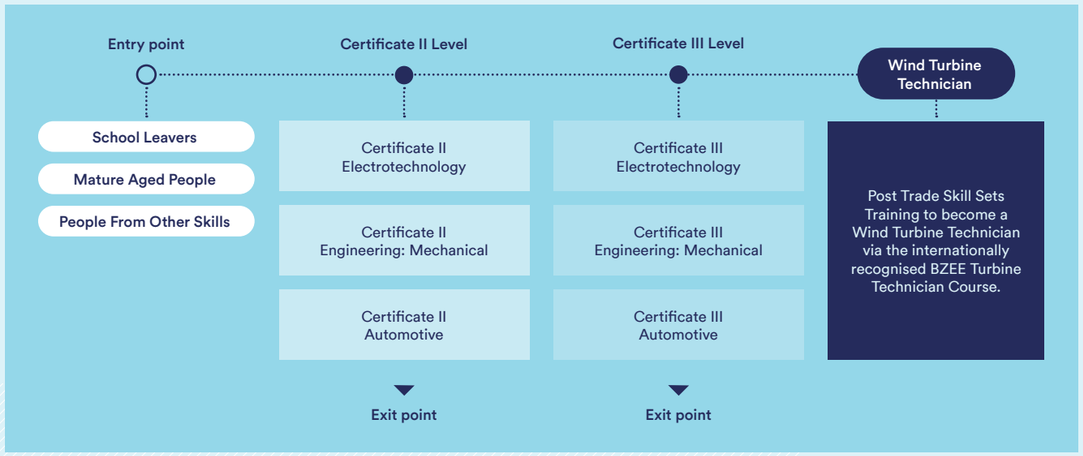


Figure 14. Wind turbine technician education program.

TVFH to write headline summarising below

From an employer perspective, and as Steven Joyce's 2019 review of Australia's vocational education and training system highlighted, 'Employers often didn't need to train workers for full qualifications and preferred to train them for the parts of qualifications relevant at the time'. 'Short courses' is the term often used for this type of training. Recent major reviews in Australia have dedicated significant attention to the better use of micro credentials as an effective method of upskilling existing workers.

4.2— Improving Coordination and Collaboration Among Stakeholders

There is a need for greater coordination and collaboration between various training providers and industries. Each offering from the post-secondary education sector, the VET sector, higher education providers and industry training providers has unique strengths and characteristics, suggesting that the system can be reformed to ensure they are complementary. Training providers should engage with a range of frontier employers, including start-ups and small and medium-sized enterprises with high growth potential, to align innovation in skills development with industry growth and renewal.

4.3— Making Industry More Attractive to Join

This research has shown that an inadequate number of people are taking up training opportunities or joining the energy industry. One barrier for people joining the industry is uncertainty linked to policy developments and the related market conditions. In addition, the boom–bust nature of current renewable developments makes it a less attractive field and may make the retraining of workers challenging.

Moreover, the project-based nature of many constructions and installation jobs has led to limited job security. Projections of workforce requirements in renewable energy industries suggest that demand for skilled workers will continue to increase highlighting the need to incorporate operational workforce planning into energy sector planning (Briggs et al. 2020).

Competition with other industries is another critical barrier for the renewable energy sector. Electricians, for example, are the most likely to be employed among all technicians and trade workers, with high demand for their services in construction, mining, electricity, gas, water, and waste service industries across Australia (no difference in Gippsland).

Career pipeline opportunities effectively introduce and market the clean energy economy to all prospective workers. More energy-related minor courses and non-degree programs for business and humanities students can be designed or offered to allow more people to become engaged in clean energy careers.

Fast-track certificate programs, short courses, or micro credentials can also allow students, skilled tradespeople, and professionals from adjacent sectors to quickly learn the basics of energy science, technology, and adoption.

An initial task would be to identify the appropriate mechanisms to make the industry more attractive and to involve the key stakeholders.

4.4— Diverse Community Inclusiveness in Clean Energy Sector

A key to addressing skills shortages in the sector and unlocking additional gains is to make the industry more accessible and appealing to diverse groups. Women are significantly underrepresented in the energy industry, but opportunity abounds. People from other diverse backgrounds (e.g., people with a disability, indigenous people) are also underrepresented in the energy sector. There are some key reasons behind this under-representation. These include:

- Low familiarity with the sector; most females and people with disabilities don't consider it as a career option
- Poor engagement with STEM subjects; many females are not supported to engage in STEM, and their disconnect can begin in primary school
- The sector being regarded as challenging, male-dominated, and not as impactful or fulfilling as other STEM-related careers
- Little awareness about the impact of a career in the energy sector career, including clean energy
- The energy sector and engineering often being badged in school as 'science' or 'design and technology'.

This gap can be reduced by considering the interplay between key drivers (see Figure 15) and creating targeted interventions to remove barriers as recommended below:

- Foster familiarity with engineering and the clean energy profession through reforms to school curricula that currently lack the 'E' of STEM. For example, include science syllabus requirements, introductory modules, and research on what clean energy discipline involves.
- Raise awareness of clean energy as a viable career option for both men and women from different backgrounds.
- Improve support for females and people from other diverse backgrounds in STEM subjects in junior years.
- Create introductory pathway STEM courses for women, the unemployed, and people with disabilities, and improve support for them.
- Conduct an awareness campaign across society as a whole; ensure that teachers and parents don't actively discourage females from pursuing careers in engineering and clean energy.
- Establish regional scholarships with priority given to aboriginal people, women, and people with disabilities.

4.5— Victorian Senior Secondary School Pathway Reform

Senior secondary education and vocational and applied learning builds critical and creative thinking, communication skills, teamwork and collaboration, and innovation. It provides students with real-world knowledge, workplace awareness, and practical and transferable skills. Victoria's economy is rapidly changing, and the skills and capabilities we provide our students must meet the needs of our dynamic world. Thousands of new jobs relying on VET qualifications in community services, construction, and hospitality will drive our state's economic recovery. Based on John Firth's review into vocational and applied learning pathways in senior secondary schools, reform is proposed from 2023 to improve access to a broader range of high-quality VET courses for all students. The core offering contains 12 VET pathways, including 6 priority pathways and 6 flexible pathways.

The priority pathway programs are:

a) Health

b) Community service and early childhood

c) Building and construction

d) Digital media and technology

e) Civil infrastructure and laboratory skills – engineering

f) Hospitality

Considering the significant workforce required in the clean energy sector in the next 5–15 years, as demonstrated in Sections 2–3, clean energy-related VET programs should be included as a priority pathway in the senior secondary schooling reforms.

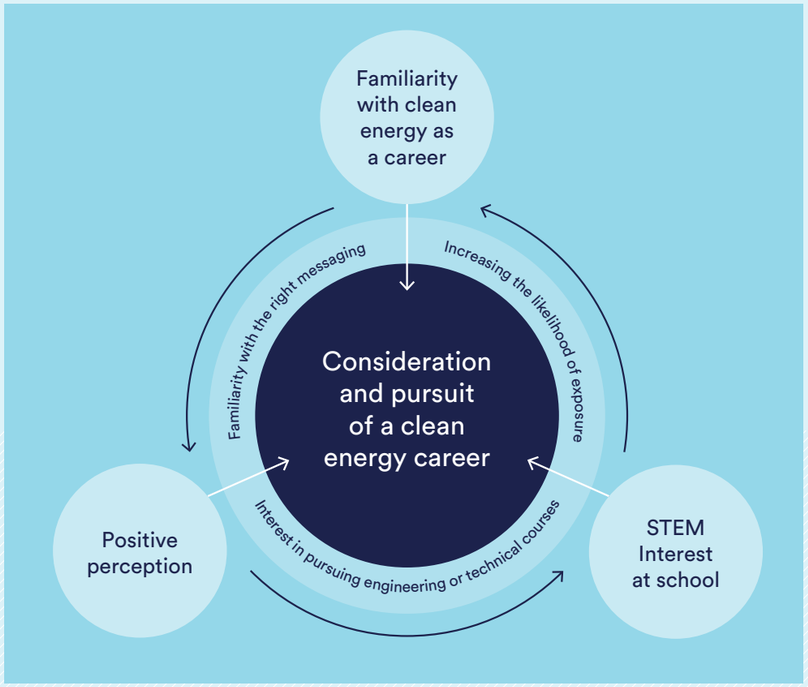


Figure 15. The interplay between key drivers

Summary & Appendices

As discussed earlier, despite the availability of so many courses and programs, skills shortages exist, and the situation is expected to worsen. The education sector has experienced a persistent decline in technical course availability and enrolment. This work has identified five key issues associated with workforce development and transition in the renewable energy sector. The following measures could be taken to address these issues.

Key Summary

- There is overlap between the fossil fuel and renewable energy sectors in many broad occupations (e.g., technicians, construction and project managers, engineers, electricians).
- New and emerging skills and occupations are required in the renewable energy sector – such as data analytics, IoT engineers, and smart grid specialists – which are not required in the fossil fuel sector.
- Further development of training requirements in the battery and hydrogen sectors is required to ensure development of workforce skills are available to meet emerging industry jobs.
- Over 8000 development and construction jobs and 1500 ongoing operations jobs could be created in the Gippsland energy sector based on current projects in the development pipeline.
- There will be a high number of O&M jobs in offshore and onshore wind farms and other renewable energy projects. Blade technicians are already in high demand and hard to recruit in Gippsland, along with construction workers and retail trade workers.
- The most commonly advertised jobs in the energy and manufacturing sectors in the Gippsland region ask for certificate IV qualifications (30 per cent), followed by jobs asking for a bachelor's degree and higher qualifications (25 per cent).
- There are vocational and higher education qualifications covering the renewable energy domain. However, it is difficult to attract enough people to complete the training.
- Women and people from diverse backgrounds are significantly underrepresented in the energy industry.
- Fast-track certificate programs, short courses, or micro credentials would be suitable for students, skilled tradespeople, and professionals from adjacent sectors to upskill the basics of energy, science, technology, and adoption.

References

Australian Bureau of Statistics. (2019). Australian national accounts: input-output tables. www.abs.gov.au/statistics/economy/national-accounts/australian-national-accounts-input-output-tables/latest-release#input-output-multipliers. Accessed 12 June 2022.

Australian Bureau of Statistics. (2016). Australian national accounts: input-output tables. www.abs.gov.au/statistics/economy/national-accounts/australian-national-accounts-input-output-tables/latest-release#input-output-multipliers. Accessed 12 June 2022.

Australian Energy Market Operator. (2021). Integrated System Planning Report. Accessed 10 July 2022.

Beyond Zero Emissions. (2020). The million jobs plan: a unique opportunity to demonstrate the growth and employment potential of investing in a low-carbon economy. https://bze.org.au/wp-content/uploads/2020/11/BZE-The-Million-Jobs-Plan-Full-Report-2020.pdf. Accessed 22 March 2022.

Briggs, C., Rutovitz, J., Dominish, E., & Nagarath, K. (2020a). Renewable energy jobs in Australia – Stage 1. Prepared for the Clean Energy Council by the Institute for Sustainable Futures, University of Technology Sydney. https://assets.cleanenergycouncil.org.au/documents/resources/reports/Clean-Energy-at-Work/renewable-energy-jobs-in-australia.pdf. Accessed 22 March 2022.

Briggs, C., Rutovitz, J., Dominish, E., & Nagarath, K. (2020b). Renewable energy jobs in Australia – Victoria summary. Prepared for the Clean Energy Council by the Institute for Sustainable Futures, University of Technology Sydney. https://www.uts.edu.au/sites/default/files/2020-06/RE%20Jobs%20VIC%20profile%5B1%5D.pdf. Accessed 22 March 2022.

Department of Industry, Science, Energy and Resources. (2022). Improving understanding of Australia's energy workforce. Australian Government. https://www.energy.gov.au/news-media/news/improving-understanding-australias-energy-workforce. Accessed 28 March 2022.

Department of Land, Water and Planning. (2021). Community engagement and benefit sharing in renewable energy development in Victoria. A guide for renewable energy developers. State of Victoria.

Clean Energy Council. (2020a). Clean energy at work. https://assets.cleanenergycouncil.org.au/documents/resources/reports/Clean-Energy-at-Work/Clean-Energy-at-Work-The-Clean-Energy-Council.pdf. Accessed 22 March 2022.

Clean Energy Council. (2020b). Clean energy at work in Queensland. https://assets.cleanenergycouncil.org.au/documents/resources/reports/Clean-Energy-at-Work/Clean-Energy-at-Work-in-Queensland-July-2020.pdf. Accessed 22 March 2022.

Ernst & Young Australia. (2019). The economic contribution of Marinus Link and supporting transmission. Prepared for TasNetworks.

Hepburn Shire Council. (2022). Western Victoria transmission network project. https://www.hepburn.vic.gov.au/western-transmission-lines-project/. Accessed 29 March 2022.

International Renewable Energy Agency. (2018). Renewable energy benefits: Leveraging local capacity for offshore wind. International Renewable Energy Agency, Abu Dhabi. https://www.irena.org/publications.

Keyser, D., & Tegen, S. (2019). The wind energy workforce in the United States: Training, hiring and future needs. NREL/TP-6A20-73908. National Renewable Energy Laboratory, Golden, CO. https://www.nrel.gov/docs/fy19osti/73908.pdf

Moorabool Shire Council. (2022). Western Victoria transmission network project. https://www.moorabool.vic.gov.au/About-Council/Large-Projects-Impacting-Moorabool/Western-Victoria-Transmission-Network-Project. Accessed 29 March 2022.

Olney, S. (2021, 9 December). Building a regional workforce [presentation]. Activating Gippsland's Renewable Energy Workforce Regional Forum, Sale, Australia.

Rutovitz, J., Briggs, C., Dominish, E., & Nagrath, K. (2020). Renewable energy employment in Australia: Methodology. Prepared for the Clean Energy Council by the Institute for Sustainable Futures, University of Technology Sydney.

South Gippsland Shire Council. (2021). South Gippsland Shire Council economic development strategy 2021–2031.

Wellington Shire Council. (2020). Sustainability Strategy Report, 2020-2024.

Appendix A: Survey Questions

The survey focussed on operational/ongoing roles in the region.

Survey Questions:

1. What is the project and main technology?

2. Will you own and operate the facility (for generation facilities), or do you expect to appoint an O&M contractor?

3. How many O&M or long-term/ongoing roles do you anticipate?

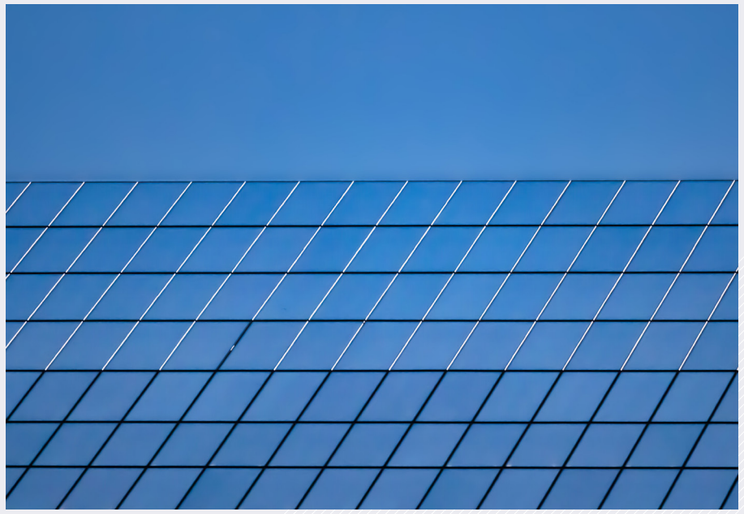
4. What jobs/roles/skillsets do you anticipate being required?

5. What is the split between general labour, skilled trade, professional (tertiary qualified), and corporate/administrative positions? (in %)

6. To what extent do you anticipate OEM-specific training vs general training to be required? What roles will be OEM specific?

7. What partnerships/relationships have you already initiated to cater to your local workforce training/skills requirements?

8. Do you have, or are you likely to have specific long-term employment commitments (e.g. apprenticeships, traineeships, cadetships)?



Appendix B: Program Structure – Bachelor of Engineering Practice in Renewable Energy (Example)

The new courses proposed at Federation University will be heavily skills-based, drawing upon the expertise of TAFE partners in vocational education teaching and training. Thus, on-campus skills development and assessment will be central to the successful delivery of the degree program. Students enrolled in flexible mode will be required to attend the campus in blocks, alongside on-campus students, to complete the skills training and assessment.

It is proposed that the new degree will initially be offered at both Mt Helen and Gippsland campuses. Both campuses are located within the energy hub of Victoria and have existing relationships with local industries. This decision also considers the available space at the Mt Helen and Gippsland campuses to house the required laboratory facilities for the program.

Year 1: Engineering Foundation and Diploma (AQF 5)

Year 1 of the program is comprised of two semesters in which students will undertake a mix of purely HE courses and HE courses with integrated TAFE units. The topics covered will primarily include introductory concepts relating to the electrical and renewable energy engineering discipline. The proposed structure of the first part of the program is shown in Figure B1.

The tentative courses in the first year are shown in Table B1. The program will introduce seven new HE courses (NC1, NC2, NC3, NC4, NC5, NC6, and NC7). Six of these will comprise a combination of TAFE units that cover skills development and training in the renewable energy engineering field (NC1, NC2, NC3, NC4, NC5, and NC6). The delivery of the course and assessment of the TAFE component will be performed by TAFE staff. The seventh course (NC7) will integrate content from both TAFE and HE to provide students with the foundation of HE mathematics necessary to undertake an engineering degree.

Year 2: Associate Degree (AQF 6)

In the second year of the program, students will build on their first-year introductory knowledge and hands-on skills to develop intermediate knowledge and skills in different areas of renewable energy engineering. The proposed structure is presented in Figure B2. The structure includes six existing HE courses covering topics on mathematics (MATHS2016 and MATHS3001), electronic systems (ENGIN2105), electrical machines (ENGIN2404), and principles of renewable energy sources (ENGIN2103) that cover mainly wind and solar energy. One elective course will be taken from the Bachelor of Engineering Practice in Advanced Manufacturing and Automation Engineering. Furthermore, a new course on hydrogen and new energy technologies needs to be developed for this program to focus on the growing hydrogen industry for clean, flexible, storable, and safe fuels. After successful completion of Year 2, a student can exit the program with an Associate Degree in Manufacturing and Automation Engineering at AQF level 6 from Federation University.

Table B1. Proposed tentative mapping of the HE courses with the Bachelor of Engineering Practice in Renewable Energy program with TAFE units, mostly from Diploma of Applied Technology (22460VIC)

HE Courses	TAFE Units
Introduction to Renewable Energy Engineering (NC1)	Write specifications for renewable energy engineering projects Carry out basic repairs to renewable energy apparatus Develop strategies to address environmental and sustainability issues in the energy sector
Introduction to Electrical and Circuit Systems (NC2)	MEM30025A Analyse a simple electrical system circuit MEM23111A Select electrical equipment and components for engineering applications MEM30007A Select common engineering materials
Introduction to Electrical Management (NC3)	MEM234028A Produce and manage technical documentation BSBPMG417 Apply project life cycle management processes Apply principles of occupational health and safety in the work environment
Introduction to ICT in Energy Systems (NC4)	VU22311 Commission a cyber–physical system VU22317 Analyse and manage big data in cloud-based systems
Introduction to Electronics and Digital Control (NC5)	VU22314 Troubleshoot digital control systems VU22313 Implement and problem solve a program logic controller (PLC)-based industrial control system VU22315 Use SCADA system to monitor and control an industrial process
Introduction to Electrical Maintenance (NC6)	ICTTEN202 Use hand and power tools VU21106 Plan, implement, and apply preventative maintenance procedures VU22310 Work in Industry 4.0
Foundation to Technical Mathematics (NC7)	MEM12024A Perform computations MEM23004A Apply technical mathematics

Figure B1. Proposed structure of Year 1 of the new Bachelor of Engineering Practice (Renewable Energy) program, demonstrating the integration of TAFE units into the degree program

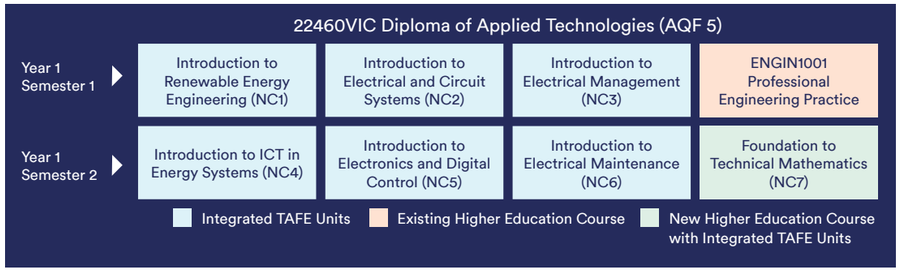


Figure B2. Proposed second-year structure of the new Bachelor of Engineering Practice (Renewable Energy) program

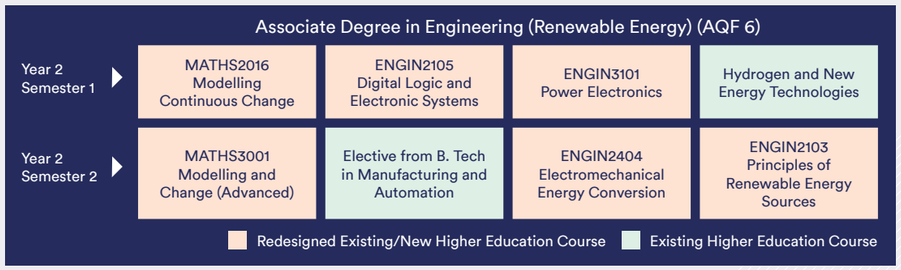
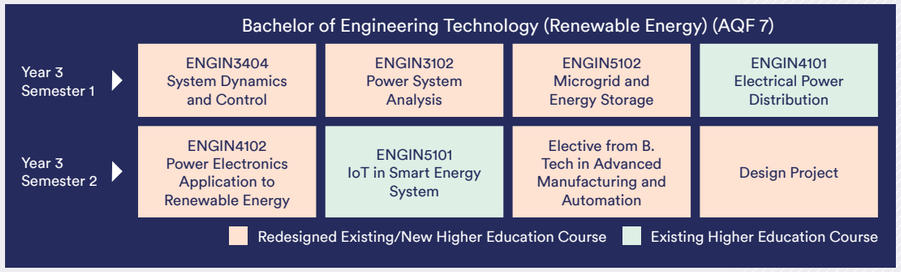


Figure B3. Proposed third-year structure of the new Bachelor of Engineering Practice (Renewable Energy) program



Year 3: Bachelor of Engineering Practice (AQF 7)

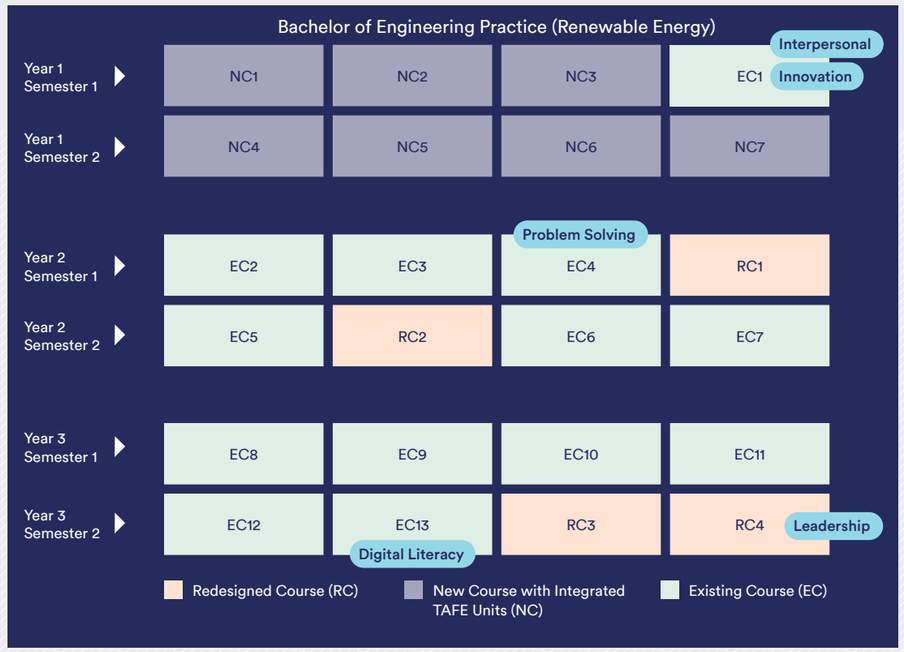
In the final year of the program, students will build on their second-year intermediate knowledge and skills to develop advanced knowledge and skills in different areas of renewable energy engineering. The proposed structure is presented in Figure B3.

The structure includes six existing HE courses covering control engineering, power electronics, power distribution system, microgrids, storage, IoT application in smart energy systems, and basic power system analysis. Two elective courses will be considered from the Bachelor of Engineering Practice in Advanced Manufacturing and Automation Engineering.

There will be one project design course based on the relevant topic of renewable energy. Existing HE courses in design need to be modified. Following successful completion of Year 3, students will receive a Bachelor of Engineering Practice (Renewable Energy) at AQF level 7 from Federation University.

The proposed Bachelor of Engineering Practice (Renewable Energy) program will embed cross-cutting skills using Model 1, as shown in Figure B4.

Figure B4. Embedded cross-cutting skills withing the proposed Bachelor of Engineering Practice (Renewable Energy) program.



Appendix C: Program Structure – Associate Degree in Design and Construction Management (Example)

Figure C1 represents the proposed qualification development and pathways for the Associate Degree in Design Drafting and Construction Management program.

The proposed program is designed to include 2 different entry points and 2 different exit points. Students can enter the program at the beginning of Year 1 and Year 2, subject to meeting entry requirements. Each of these entry points are aimed to target different cohorts, as shown in Figure 1. Students will be able to exit with a Diploma of Building and Construction (Building) from Federation TAFE at the end of Year 1 or finish this program and graduate with an Associate Degree in Design Drafting and Construction Management from Federation University after the successful completion of two years of the program (Figure C1).

On completion of the proposed Associate Degree in Design Drafting and Construction Management, students will have the opportunity to work as an Associate Engineer or continue their studies at Federation University's Bachelor of Engineering (Civil) – Honours with three semesters credit and eventually graduate and work as a professional engineer.

Each academic year of the program is described separately below and illustrated in Figures C2 and C3. Note: The course names, content, and TAFE-HE mappings are tentative and may change as the institute engages our TAFE partners in deeper discussion on the design and delivery of the program.

Year 1: Engineering Foundation and Diploma (AQF 5)

Year 1 of the program is comprised of 2 semesters in which students will undertake a mixture of purely HE courses and HE courses with integrated TAFE units from the Diploma of Building and Construction (Building). The topics covered will primarily be the introductory concepts of construction design and management. The proposed structure of the first year of the program is shown in Figure C2.

After successful completion of Year 1, a student may exit the program with a Diploma of Building and Construction (Building) (CPC50220) at AQF level 5 from Federation TAFE. To facilitate this, students will be jointly enrolled in the Diploma of Building and Construction (Building) (CPC50220) and will be awarded a result in the TAFE qualification at the same time as being awarded a result in the HE courses. The units of competencies in the TAFE Diploma will be packaged into HE courses. The TAFE courses are equivalent to six HE courses (approximately 900 hours with 150 hours for each HE courses). There will also be two existing HE courses included in the first year. The draft mapping of the integrated TAFE and HE courses is presented in Table C1. The total hours of each integrated HE-TAFE course will be confirmed in future conversations with TAFE partners.

Year 2: Associate Degree (AQF 6)

In the second and final year of the program, students will build on their first-year introductory knowledge and hands-on skills to develop intermediate knowledge and skills in different areas of construction, management, and building technology. The proposed structure is presented in Figure C3. The structure includes four existing HE courses and covers topics on concrete technology and civil construction, engineering surveying, engineering mechanics, project management, and sustainability design. One HE course (infrastructure management) that used to be part of the Bachelor of Civil Engineering program until 2018 will be re-designed and offered in the second year of the Associate Degree program (RC1). This course covers important aspects of infrastructure management that are highly suited to the proposed Associate Degree.

Two new courses are proposed to be developed in the HE context: Digital and Automated Construction (NCHE1) and Building Information Management (NCHE2). It is also proposed that the new laboratory facilities of the Bachelor of Engineering Technology (Advanced Manufacturing and Automation Engineering) be used as part of the new Digital and Automated Construction course. These two additional courses can also be added to the current Bachelor of Engineering (Civil) (Honours) program as specialisation electives. The Foundation to Technical Mathematics course is not part of the Diploma of Building & Construction but will be partly delivered by TAFE.

The program will introduce a total of seven new HE courses integrated with TAFE units (NC1, NC2, NC3, NC4, NC5, NC6, and NC7). Six of these will comprise a combination of TAFE units that cover the skills development and training required in the building and construction field (NC1, NC2, NC3, NC4, NC5, and NC6).

Table C1. Proposed tentative mapping of the HE courses with Associate Degree in Design Drafting and Construction Management program with TAFE Units in Diploma of Building and Construction (Building) (CPC50220)

HE Courses	TAFE Units
Introduction to building plans and principles (NC1)	CPCCBC4012 Read and interpret plans CPCCBC4014 Prepare simple building sketches and drawings CPCCBC4010 Apply structural principles to residential and commercial buildings CPCCBC5018 Apply structural principles to the construction of buildings up to 3 stories
Introduction to legal requirements and contracts (NC2)	CPCCBC4009 Apply legal requirements to building and construction projects CPCCBC5007 Administer the legal obligations of a building and construction contractor CPCCBC5013 Manage professional technical and legal reports on building and construction projects CPCCBC4003 Prepare and administer a construction contract
Building codes and standards in construction (NC3)	CPCCBC4008 Supervise site communication and administration processes for building and construction projects CPCCBC4001 Apply building codes and standards to the construction process for class 1 and 10 buildings CPCCBC5001 Apply building codes and standards to the construction process for type B buildings CPCCBC4053 Apply building codes and standards to the construction process for class 2 to 9 buildings
Introduction to construction project management (NC4)	BSBWHS513 Lead WHS risk management BSBOPS504 Manage risk CPCCBC5011 Manage environmental management practices and processes in building and construction projects CPCCBC5010 Manage construction work
Tender documentation, costs, and finances (NC5)	CPCCBC5019 Manage building and construction business finances CPCCBC4004 Identify and produce estimated costs for building and construction processes CPCCBC4013 Prepare and evaluate tender documentation CPCCBC5002 Monitor costing systems on complex building and construction projects
Management of building construction projects (NC6)	CPCCBC4005 Produce labour and materials schedules for ordering CPCCBC4018 Apply site surveys and set-out procedures to building and construction projects CPCCBC5003 Supervise the planning of onsite building and construction work CPCCBC5005 Supervise and manage building and construction contractors
Foundation to Technical Mathematics (NC7)	MEM12024A Perform computations MEM23004A Apply technical mathematics

Figure C1. Proposed qualification development and pathway for the new Associate Degree in Design Drafting and Construction Management program

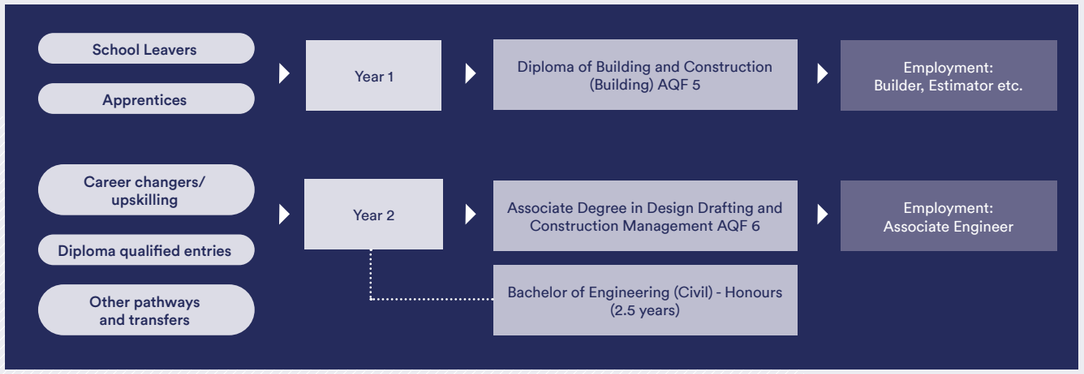


Figure C2. Proposed structure of Year 1 of the new Associate Degree in Design Drafting and Construction Management program, demonstrating integration of TAFE Diploma of Building and Construction (Building) (CPC50220) into the degree program

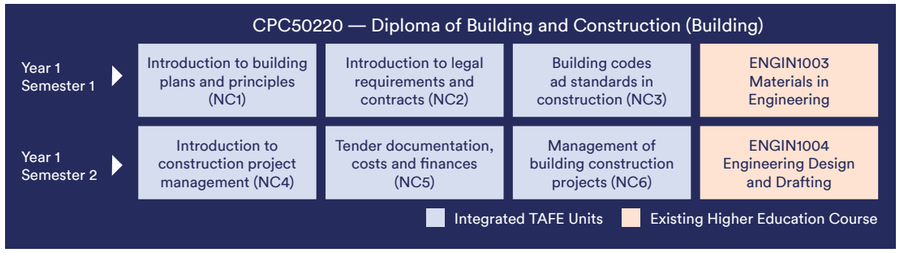
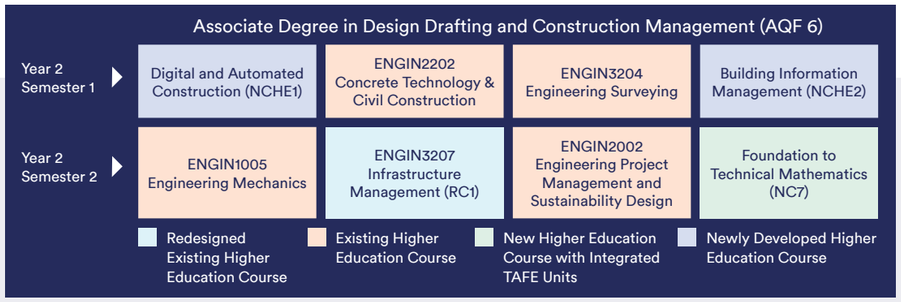


Figure C3. Proposed structure of Year 2 of the new Associate Degree in Design Drafting and Construction Management program



Appendix D: Wind Turbine Technician Vocational Pathway

A modern wind turbine manufactured in the 2020's is typically made up of a number of key components (see Figure D1) including mechanical, electrical, hydraulic and meteorological systems. With the number of independent and dependant systems intersecting with both the electrical and mechanical trades no single apprenticeship exist to serve the needs of the industry. Rather the industry has historically employed electricians, mechanical fitters or automotive technicians and assumed the responsibility to train employees internally to undertake the role as wind turbine technician.

With the industry reluctant to employ an apprentice given the nature of the interdepenent mechanical, electrical and hydraulic systems and the lack of formal vocational pathway existing, Federation University has undertaken to deliver post trade training utilizing the globally recognised BZEE Wind Turbine Technican Training Course, under exclusive license (https://www.bzee-network.com).

Integral to working as a wind turbine technician is the employees capacity to work at heights, in confined spaces, with a buddy at all times, being cognsant of the need for safe working proceedures, use of fire extinguishers and first aide at high level. All these skills are gained through globally recognised Global Wind Organisation Training (https://www.globalwindsafety.org/trainingstandards/trainingstandards) a mandatory requirement prior to commencing employment or undertaking any work on a wind turbine.

The pathway to becoming a Wind Turbine Technician under development by Federation University can be seen in the Figure D2.

It should be noted that there is a current Certificate IV of Large Scale Wind Generation – Electrical (UEP40622), however this qualification and its predecessor have not been delivered since industry doesn't recognise the qualification as the pathway to becoming a wind turbine technician due to it's limited scope 0f delivery being electrically focused.

The BZEE qualification delivered as a skill set over 6 months inclusive of a single month of internship on a working wind farm, will cover electrical, hydraulic, mechancial, operational, health and safety and wind energy technology skills. The qualification will be developed by Federation University in 2022/23 following the completion of teacher training in the USA in the 3rd and 4th quarters of 2022. Table 1. Below lists the skills sets from the BZEE qualification that have been mapped to Australian Units of Competency, which will be delivered as skill sets for the duration of the BZEE Wind Turbine Technician Training.

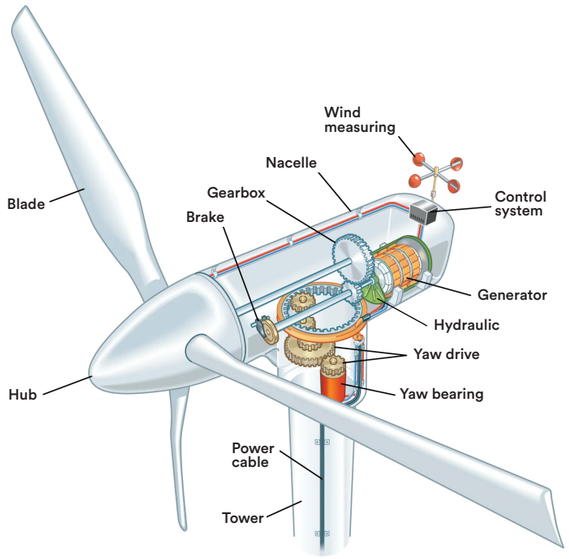


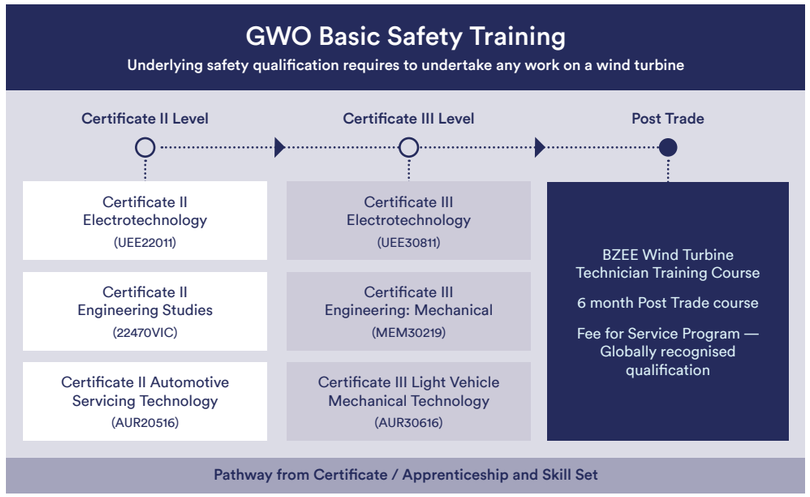
Figure D1. Inside of a wind turbine

Appendix D: Wind Turbine Technician Vocational Pathway (Cont.)

Code	Module	Duration (Hrs)
HSE	Health & Safety	
BZEE-HSE-01	Health and Safety regulations	4
BZEE-HSE-02	Emergency first aid for working at height	16
BZEE-HSE-05	Working at heights and rescue training, basics	16
BZEE-HSE-15	Lifting and attachment of loads	16
BZEE-HSE-16	Fire awareness and fire-fighting, basic training	4
BZEE-HSE-17	Fire awareness and fire-fighting on wind turbines	4
BZEE-HSE-18	Handling of hazardous materials	8
BZEE-HSE-25	CSE – Confined Space Entry	24
	Total	92
ELT	WT Electrics	
BZEE-ELT-01	Principles of electrical engineering	40
BZEE-ELT-08	Cable finishing	8
BZEE-ELT-09	Generators and electric motors	24
BZEE-ELT-10	Transformers	8
BZEE-ELT-11	Inverter maintenance and trouble- shooting	4
BZEE-ELT-12	Electrical measurement techniques	8
BZEE-ELT-13	Sensor installations in wind turbines	24
BZEE-ELT-14	Wind turbine electronics	40
BZEE-ELT-15	Wind farm networks, data transmission, optical fiber technology	16
BZEE-ELT-16	Lightning protection maintenance	8
	Total	180
MEC		
BZEE-MEC-01	Materials engineering	16
BZEE-MEC-02	Mechanical systems and components - basics	40
BZEE-MEC-03	Inspection of bearings, shafts, gears	16
BZEE-MEC-04	Brake systems maintenance	4
BZEE-MEC-05	Lubricants functions and deployment	8
BZEE-MEC-06	Power drive sockets (hydraulic, electric, mechanical)	8
BZEE-MEC-07	Function and maintenance of yaw systems	8
BZEE-MEC-08	Coating systems and corrosion protection	8
	Total	108

Table D1. BZEE Wind Turbine Technician Training Skills Sets

Table D1. BZEE Wind Turbine Technician Training Skills Sets



Appendix E: Wind Turbine Blade Repair Technician Vocational Pathway

Context

The repair and maintenance of wind turbine blades is a distinct skill requiring the technician to be able to work with composite materials, whilst potentially either working in a confined space or supported via a rope from the hub of a Nacelle. The blades are extremely large measuring up to 100mtres in length (See Figure E1).

Currently the repair of blades is undertaken by skilled professionals who have either come from a background in working with composites or alternatively come from the factories making the blades. Largely the workforce employed in Australia currently is made up of a mix of locally skilled professionals or imported workers from overseas. Increasingly since the pandemic access to skilled overseas workers has been significantly constrained.

No current vocational pathways exist for a wind turbine blade repair technician other than the skill sets training offered via the Global Wind Organisation which is a two week training course delivered by a few private registered training organisations. Federation University however is in the process of developing the first Australian apprenticeship for wind turbine blade technicians based on the Certificate III Engineering – Composites (MEM31119).

Federation University has received industry and state government funding to establish the new apprenticeship and anticipates delivery to commence in the 4th quarter of 2022, following the completion of refurbishments to an existing building at their Mt Helen Campus.

The apprenticeship will be contextualised to the role of a wind turbine blade technician role but will have applicability across the automotive and marine industries at a very minimum. The units being developed and the delivery plan can be seen in Table E1.

Integral to working as a wind turbine blade technician is the employees capacity to work at heights, in confined spaces, with a buddy at all times, being cognsant of the need for safe working proceedures, use of fire extinguishers and first aide at high level. All these skills are gained through globally recognised Global Wind Organisation Training (https://www.globalwindsafety.org/trainingstandards/trainingstandards) a mandatory requirement prior to commencing employment or undertaking any work on a wind turbine.

Figure E1. Wind turbine blade being manufactured

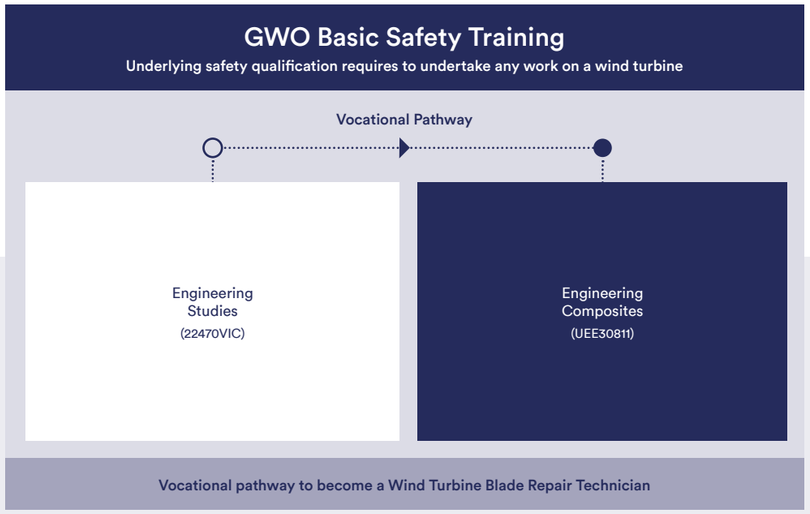
Federation TAFE | APRETEC |
Cert III in Composites for wind.

Table E1. Certificate III Engineering – Composites (MEM31119)

Turbine blade repair technician apprenticeship		Delivery Sequence	Unit Code	Unit Title	Points
1st Year on the Job as a blade repair apprentice.	Cluster 1: Induction Orientation and Inspection.	1	MEM13015	Work safely and effectively in manufacturing and engineering	2
		2	MEM16006	Organise and communicate information	2
		3	MEM16008	Interact with computing technology	2
		4	MEM11011	Undertake manual handling	2
		5	MEM15004	Perform inspection	2
		6	MEM18001	Use hand tools	2
		7	MEM18002	Use power tools/hand held operations	2
	Cluster 2: Blade fundamentals and basic techniques used in industry.	8	MEM13003	Work safely with industrial chemicals and materials	2
		9	MEM26010	Store and handle composite materials	2
		10	MEM26020	Identify and interpret required standards for composites	2
		11	MEM26017	Prepare composite or other substrate surfaces	4
		12	MEM26006	Mark and cut out sheets for composite use	4
		13	MEM26001	Layup composites using open moulding techniques	6
		14	MEM26019	Finish a composite product	4
2nd Year on the Job as a blade repair apprentice.	Cluster 3: Blade repair intermediate	15	MEM13002	Undertake work health and safety activities in the workplace	3
		16	MEM09002	Interpret technical drawing	4
		17	MEM12023	Perform engineering measurements	5
		18	MEM12024	Perform computations	3
		19	MEM26002	Layup composites using vacuum closed moulding techniques	6
		20	MEM26007	Select and use reinforcing appropriate for product	4
		21	MEM26008	Select and use resin systems appropriate for product	4
		22	MEM26009	Select and use cores and fillers appropriate for product	2
3rd Year on the Job as a blade repair apprentice.	Cluster 4: Blade repair advanced	23	MEM14006	Plan work activities	4
		24	MEM26015	Select and apply repair techniques	6
		25	MEM26011	Determine materials and techniques for a composite component or product	6
		26	MEM26013	Select and use composite processes or systems appropriate for product	4
		27	MEM26016	Select and use joining techniques	6
	Cluster 5: Composite manufacturing, Mentorship and Environmental stewardship	28	MSMENV272	Participate in environmentally sustainable work practices	3
		29	MEM26003	Layup composites using pressure closed moulding techniques	6
		30	MEM17003	Assist in the provision of on-the-job training	2

The vocational pathway for a person to become a wind turbine blade technician can be seen in Figure E2 below.

Figure E2. The vocational pathway to become a wind turbine blade technician

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LATROBE VALLEY AUTHORITY

VICTORIA State Government

Federation University Australia