



**Victorian
Skills Authority**

Victorian Skills Plan

Electricity, Gas, Water and Waste Services Industry Insight

October 2022



Education
and Training



Contents

Introduction	3
Report coverage	5
Executive summary.....	6
Industry outlook.....	9
Workforce and skilling implications	16
Education and training pipeline.....	20
Workforce priorities	25
Collaborative response	27
Appendix A – Data methodology	30
Appendix B – Victorian VET pipeline methodology	33
Appendix C – Stakeholder engagement process	34
References.....	35

Introduction

This report on the Electricity, Gas, Water and Waste Services industry is part of the 2022 Victorian Skills Plan. It outlines demand for occupations, identifies education and training needed to meet the demand, and highlights current workforce issues facing the industry.

This report has been prepared by the Victorian Skills Authority (VSA). The VSA was formed in July 2021 in response to the review *Future Skills for Victoria: Driving collaboration and innovation in post-secondary education and training* (known as the Macklin Review). The VSA is charged with preparing an annual Victorian Skills Plan (the Skills Plan) to guide decision-making on skills and training, by the Government, education and training providers, industry and communities.

The Victorian Skills Plan

The annual Skills Plan sets out Victoria's skills needs for 2022 to 2025 by drawing on data, evidence and insights from a range of system-wide and local sources.

The Government in conjunction with industry, communities and education and training partners brings collaborative action through the Skills Plan which:

- **defines skill needs** with clear statements of required skills and capabilities (current and emerging)
- **sets priorities** for post-school education and training in Victoria
- **communicates to the community** the opportunities education and training can provide to offer careers for individuals that also meet the workforce needs of industry
- **aligns action** across industry and government to support improved outcomes for all Victorians.

The Skills Plan consists of:

- a summary report – the Victorian Skills Plan
- the industry needs of the Victorian economy segmented into 13 insight reports, each comprising like industries – of which this report is one
- profiles of industry and occupations in the regional areas of Victoria which outline priorities for skills development – either as snapshots or Regional Skills Demand Profiles
- current employment and forecast demand to 2025 across Victoria – a user-driven dashboard.

About Industry Insight Reports

Each industry insight is based on robust research, qualitative and quantitative data collection and analysis and extensive consultation with the Government's Industry Advisory Groups, partners and stakeholders over a period of six months. Each report sets out to:

- profile the **industry outlook**, taking into account sector trends and key drivers of demand
- detail the **workforce and skilling implications** of the industry based on forecasting
- set **industry priorities** in responding to current and future workforce challenges
- provide initial guidance for an **education and training response** to these challenges.

The industries reflected in each report are defined according to their classification within *1292.0 - Australian and New Zealand Standard Industrial Classification (ANZSIC) 2006*, prepared by the Australian Bureau of Statistics. Occupations within industries have been defined using the *Australian and New Zealand Standard Classification of Occupations (ANZSCO)*.

Each industry insight contributes to the conclusions and recommendations of the Skills Plan, focusing on actions for implementation over a three-year period.

The VSA acknowledges and extends sincere thanks to the individuals and organisations that participated in the consultations and contributed to these materials.

Using this report

This is a point-in-time report on the Electricity, Gas, Water and Waste Services industry in Victoria and the associated skills and workforce issues.

This report, along with the Skills Plan, has been prepared for industry and provider partners as a summary of demand for occupations and workforce issues. In addition to being used by the Victorian Government to consider responses as a public document it is available to industry and education and training partners to form actions and responses.

The report does not represent the full picture of workforce issues in the industry. Opportunities associated with skills and workforce are longstanding. The information in the report provides the basis for ongoing work on skills demand and responses, including by the VSA and through the Industry Advisory Groups.

Feedback

Feedback on this report, and others, is welcome and can be provided to SkillsPlan@education.vic.gov.au. Feedback will contribute to developing insights and actions.

Report coverage

This report focuses on the Electricity, Gas, Water and Waste Services ANZSIC industry and the ANZSCO occupations relevant to it. It covers the provision of electricity, gas through mains systems, water, drainage and sewage services. It also covers the collection, treatment and disposal of waste, as well as recycling services.

Statistics about an industry and its sub-sectors are collated by the Australian Bureau of Statistics (ABS) from the activity of businesses. Each business is classified to an industry based on their primary activities. Where an individual works for multiple businesses, their main job is used.

Industry classifications rarely encompass the full nature of the work (and therefore skills) associated with a given industry. ABS definitions of industries or sectors may not align with the definitions used by an industry association, while the allocation of businesses on primary activity can result in businesses that perform similar services but with a different emphasis being classified across different industries.

Coverage in this report is limited to employment in the industry and sectors as defined by the ABS. Some occupations are almost exclusively associated with an industry, such as a farm hand in agriculture, while others, such as accountants and electricians, are associated with many industries. In the dashboard, occupational demand for Victoria is the total of occupational demand for all industries.

Table 1 sets out activities that may take place within the Electricity, Gas, Water and Waste Services industry but are reported under other industries, and lists the relevant Industry Insight report.

Table 1 | Scope of related industry activities and insights related industries

Activities	Industry insight
<ul style="list-style-type: none"> Removal of vegetation from on and around powerlines 	Administrative and Support Services
<ul style="list-style-type: none"> Construction of water, gas, sewerage or stormwater drains or mains, electricity or other transmission lines or towers, pipelines and any other civil engineering projects 	Construction
<ul style="list-style-type: none"> Trade services including the installation of electrical wiring, appliances, solar panels or fittings 	Construction
<ul style="list-style-type: none"> Manufacture of new materials and products from refined waste and scrap 	Manufacturing
<ul style="list-style-type: none"> Manufacture of hydrogen gas (as distinct from its usage) 	Manufacturing
<ul style="list-style-type: none"> Consulting services (including in relation to waste and water management) 	Professional, Financial and Information Services
<ul style="list-style-type: none"> Operation of railways and trams, including rail traction 	Transport and Logistics
<ul style="list-style-type: none"> Water and gas freighting 	Transport and Logistics
<ul style="list-style-type: none"> Repair and maintenance of automotives, machinery and equipment (including domestic appliances) 	Services

Executive summary

Industry outlook

The Electricity, Gas, Water and Waste industry provides essential services that allow businesses and households to operate safely and effectively. The industry employs over 49,200 people in Victoria.¹

The past decade has seen a dramatic shift towards renewable energy sources and sustainable water and waste practices. As the industry transitions, the employment outlook remains strong. The key drivers include government investment to reduce greenhouse gas emissions, movement to a circular economy, and public expectations to act on climate change. New technology is creating opportunities to explore new energy sources, materials and maintenance approaches across the industry.

Workforce and skilling implications

On average, across all industries total employment is expected to grow by an additional 211,900 workers to 2025, from 3,538,900 workers in 2022, an annual growth rate of 1.97 per cent^{a,2,3} In comparison between 2017 and 2020 employment grew by 2.68 per cent^b annually.⁴

In the Electricity, Gas, Water and Waste services industry, employment is expected to grow by an additional 2,400 workers to 2025, from 49,200 workers in 2022, an annual growth rate of 2.02 per cent^c which is higher than the overall Victorian average across all industries.^{5,6} In comparison between 2017 and 2020 employment across this industry grew by 1.08 per cent annually^{d,7}

The industry's workforce will need to grow from current levels to meet expected demand. By 2025, an estimated 4,200 new workers are needed.⁸ This includes employment growth of 2,400 additional workers and replacement of 1,900 retirees.^{9,10}

Table 2 identifies the top ten occupations in demand across the industry by 2025.¹¹ Of these, nine occupations (highlighted in table) are expected to experience employment growth at a rate above the overall Victorian average between 2022 and 2025.

Table 2 | Occupations in demand in the Electricity, Gas, Water and Waste industry by 2025^{e,12,13}

Occupation	Current employment	Employment growth (2022–25)		Retirements (2022–25)	New workers needed (2022–25)
		Number	Per cent		
Electrical Engineers	3,050	150	2.6%	100	250
Other Specialist Managers	1,900	150	4.1%	50	200
Truck Drivers	9,200	50	0.3%	150	200
Electricians	2,300	100	2.0%	50	150
Management and Organisation Analysts	900	150	6.7%	50	150
Database and Systems Administrators, and ICT Security Specialists	600	150	7.7%	50	150

^a 3-year compound annual growth rate

^b Computed for 2017 to 2020 employment growth for pre-COVID comparison


^c 3-year compound annual growth rate

^d Computed for 2017 to 2020 employment growth for pre-COVID comparison

^e Due to rounding, some totals may not correspond with the sum of the separate figures

Contract, Program and Project Administrators	850	100	2.6%	50	150
Human Resource Managers	500	100	3.6%	50	150
General Clerks	800	100	3.0%	50	150
Other Information and Organisation Professionals	350	100	5.8%	50	150

Legend

 Above Victorian employment growth average between 2022 and 2025

Advancements in offshore wind, hydrogen, bioenergy and zero-emission vehicles (ZEVs) are driving demand for new types of jobs. These include wind turbine technicians, energy efficiency assessors, electric vehicle network technicians and engineers and plant operators specialising in hydrogen technology.

Industry has also identified changing skill needs. Workers will need to adapt to the emerging renewable energy sector and enhanced sustainability and environment management requirements. Skills in data analytics, electric vehicles, hydrogen, offshore wind, and bioenergy are needed.

Meeting this demand will be challenging. Industry reports three factors that contribute to this challenge: competition with other industries for workers, difficulty retaining existing workers, and a need to upskill and/or reskill a significant portion of the workforce.

Workforce priorities

Three priorities are identified to address workforce and skilling needs for the Electricity, Gas, Water and Waste industries:

1. Strengthening pathways from entry-level to specialist roles and stimulating demand. Improving awareness and delivery of pathway options into higher skilled jobs can help meet demand.
2. Upskilling the existing workforce to remain relevant in a changing industry. Strengthening continuous professional development can support skills development.
3. Increasing supply of specialist water workers in regional areas. Increasing entry level pathway options for critical roles can support workforce sustainability.

Education and training pipeline and workforce response

Pathways to employment in the Electricity, Gas, Water, and Waste industry are split across Higher Education and Vocational Education and Training (VET). Nearly a third of workers (31.8 per cent) hold a degree or above and 39.8 per cent hold a VET qualification as their highest level of education.¹⁴ As an indication of the potential skill pipeline, there were 16,090 enrolments in relevant VET qualifications in 2020 and 16,910 equivalent full-time study load (EFSTL) in higher education in 2019.¹⁵

Key VET entry points to the industry include the Certificate II in Electrotechnology (Career Start), the Certificate II in Electrotechnology Studies (pre-vocational) and Certificate III in Electrotechnology Electrician.¹⁶ While activity is high in some courses, opportunities exist to better respond to demand.

Low awareness and interest among school leavers is a key challenge to meeting demand. Learning experiences and programs should develop students’ understanding of this broad and rapidly changing industry. Collaboration with industry via flexible models of learning will be crucial to supporting this level of exposure. Ensuring these opportunities are available outside Melbourne is important.

Increasing the availability of and participation in post-trade study is necessary to upskill workers into supervisory and specialist roles within industry. Improved linkages between VET and higher education

will allow workers with trade qualifications to transition into roles in emerging or highly technical areas. Specialist teacher capability is needed to support this. Many existing workers will find it useful to upskill in renewable energy and environmental sustainability, while other workers must be supported to transition into other roles.

Strategic workforce planning is needed, including upskilling and reskilling workers to transition into new roles and take other pathways. Industry has a central role in determining the content and format of these upskilling initiatives. The work of the Clean Economy Taskforce will be critical in shaping this response.

Without consideration of the employer value proposition, the industry will continue to face difficulties attracting and retaining workers, especially in regional and rural Victoria. Flexible work arrangements, study leave, and subsidising professional development are potential areas to boost the employer offer.

Table 3 highlights actions that could be adopted by education, industry, and government to meet workforce demand.

Table 3 | Actions for consideration for education, industry, and government

- Expand interest and awareness in Electricity, Gas, Water and Waste Services related career pathways (particularly renewable energy), especially with women and other underrepresented groups in the industry.
- Expand the availability of skill sets and short courses to enable more people to undertake post-trade study in specialist roles, and consider approaches to maintaining niche qualifications vital to the industry in priority areas.
- Consider a blend of skill sets and qualifications to prepare the existing workforce for shifts in the industry toward renewable energy, new technology and environmental sustainability.
- Provide opportunities and practical experience in the industry outside metropolitan Melbourne.
- Ensure that continuing professional development for electrical workers is supported by the education and training response and are based on industry needs.
- Strengthen the appeal of working in the Electricity, Gas, Water and Waste Services industry through, for example, flexible work arrangements and supporting further learning.

Industry outlook

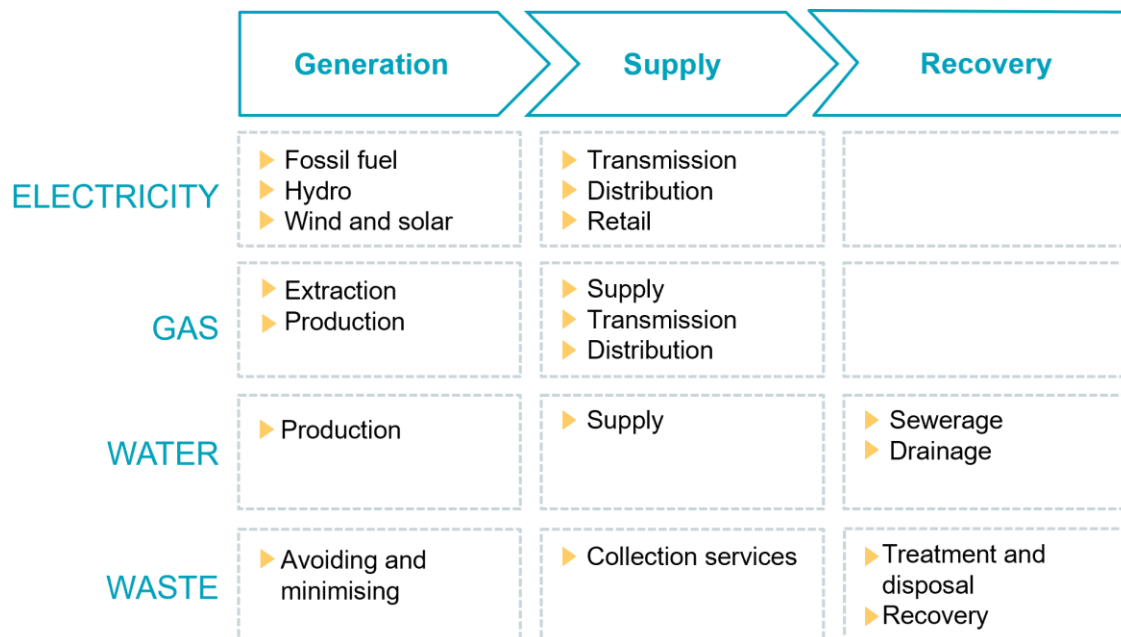
Electricity, Gas, Water and Waste Services will shift in favour of clean energy and greater productivity

The Electricity, Gas, Water and Waste Services industry provides generation, supply and recovery services to business and personal consumers across the Electricity, Gas, Water and Waste sectors. The industry provides vital services to businesses and consumers in Victoria. It is essential to a well-functioning society and the operation of many other industries. Most providers in the industry are large entities who employ workers directly, but specialised tradespeople more commonly operate as sole traders or small businesses.¹⁷ The key sectors within the industry are shown in Figure 1.

The industry employs 1.4 per cent (49,200 workers) of the total Victorian workforce, the second smallest in Victoria.¹⁸ Across the industry, 33.1 per cent of workers are female, significantly lower than the Victorian average of 47.2 per cent, and 30.2 per cent are aged over 50, similar to the Victorian average of 29 per cent.^{19,20}

The above figures do not account for the wider workforce engaged in manufacturing components, transporting materials and constructing new utilities infrastructure. Associated employment in adjacent industries can also be substantial – for example, a new windfarm will support a significant number of jobs in construction required to build the structure, as well as manufacturing jobs needed for assembling turbines and manufacturing associated components.^f

Figure 1 | Key sectors within the Electricity, Gas, Water and Waste Services industry²¹



^f The Clean Economy Skills and Jobs Taskforce is supported by a \$10 million investment in the clean economy workforce. This will help prepare Victoria's clean energy future and achieve net zero emissions by 2050, with a full report from the Taskforce expected in 2022-23.

Electricity

The electricity sector employs around 23,200 Victorian workers.²² Providers generate power from a combination of fossil fuel, hydro, wind, and solar sources. Network providers transmit and distribute electricity to consumers. Retailers purchase electricity from generators in the wholesale market and on-sell it to businesses and households in Victoria (and interstate).²³

The electricity sector is transitioning away from fossil fuels to renewable supply sources including hydro, wind and solar energy to meet the 2030 greenhouse gas emission reduction targets.

The electricity sector is transitioning from fossil fuels to renewable energy to meet the Victorian Government's target to halve greenhouse gas emissions by 2030.²⁴ Regional Victoria plays a key role in the transition, with opportunities around generation, distribution and transmission.

While electricity has traditionally been generated in coal-fired power stations and plants in the Latrobe Valley, supply is shifting to renewable sources such as wind farms, solar farms and storage.²⁵ A key development is the intended closure in 2028 of Yallourn power station, which currently supplies 20 per cent of Victoria's electricity,²⁶ and the announcement of Australia's first four-hour utility scale battery by 2026, which will have the capacity to store excess renewable energy (joining a host of other established batteries).²⁷

In November 2020, the Victorian Government announced a \$1.6 billion clean energy package through the 2020-21 State Budget to invest in renewables, grid infrastructure, energy efficiency and decarbonisation projects, including \$540 million to establish 6 renewable energy zones.²⁸

In March 2022, the Victorian Government announced the intention to build Australia's first offshore wind farm, which is expected to be in operation by 2028.²⁹ It is estimated that up to 20 per cent of Victoria's energy capacity in 2050 could come from offshore wind.³⁰

Since the Solar Homes Program began in 2018, more than 200,000 households have accessed rebates to install rooftop solar panel systems, solar or heat pump hot water systems, or solar batteries.³¹ Small businesses can also access one of 15,000 rebates over the next three years to reduce the costs of installing an approved small-case solar PV.³²

These initiatives highlight that Victoria will require a network upgrade to make the grid function with no coal, extensive rooftop solar and dispersed renewable capacity.

Gas

The gas sector employs approximately 3,600 Victorian workers.³³ The sector extracts and produces natural and other gases for sale to electricity generators, other gas users and energy retailers.^{34,35} It also includes the transmission and distribution network providers that transport and store the gas for domestic and overseas sale and use.

Gas is a major source of fuel in Australia and is extracted from gas fields and transported through privately owned pipelines in Victoria.³⁶ It can be imported and exported to other jurisdictions via interstate connectors depending on demand. Victoria is the largest consumer of gas domestically in Australia, with more than 2 million households and businesses using the fossil fuel for heating, cooking or hot water (representing 60 per cent of gas usage across the state).³⁷ Similarly, many industries, particularly manufacturing, rely on natural gas to conduct their operations; 30 per cent of gas usage is in industrial process heating.³⁸

Historically, natural gas was considered a cheaper and a lower emissions fuel. Rising gas prices and the transition of the electricity grid to renewables mean this is no longer the case. The depletion of gas fields is also leading to a tightening of the gas supply-demand balance.

In line with Victoria's Climate Change Strategy (2021), the Victorian Government is exploring options to reduce emissions from natural gas use. These options include a more efficient use of gas, switching more appliances to electricity, and an increased use of alternative gases such as hydrogen and

biomethane. The Victorian Government is developing a Gas Substitution Roadmap to provide a strategic framework for decarbonising natural gas in Victoria. Natural gas is responsible for approximately 17 per cent of Victoria's emissions and the trajectory of Victoria's clean energy transition indicates a reduced role for natural gas in meeting Victoria's future energy requirements.

Water

The water sector employs around 5,800 Victorians.³⁹ The sector includes the supply of drinking and recycled water, the removal and treatment of sewage and trade waste, water delivery for irrigation, domestic and stock purposes, as well as drainage and salinity mitigation.⁴⁰

Victoria's water sector is state-owned and comprises 18 water corporations who deliver services in designated regions.⁴¹ Water corporations supply urban and rural services including the supply of drinking and recycled water, the removal and treatment of sewage and trade waste, water delivery for irrigation, domestic and stock purposes, as well as drainage and salinity mitigation.⁴²

Victoria is divided into ten catchment and land protection regions. Within each region, Catchment Management Authorities are responsible for the integrated planning and coordination of land, water and biodiversity management.⁴³

Melbourne water storage levels are at a 20-year high, with demand for water in line with stable population growth.

Demand for water has remained steady, consistent with population growth over the past three years.⁴⁴ In Melbourne, water storage levels are the highest they have been for more than 20 years, assisted by the desalination plant in Wonthaggi, which has delivered water for public use since 2017.⁴⁵

Over the next 50 years water supply will need to double to meet demand in major cities and towns in southern Victoria, due to population growth and declining water availability.⁴⁶ With river and groundwater resources fully allocated in many areas across Victoria, an increase in manufactured water supplies will be necessary, such as desalinated and recycled water. Investments in new water supplies are expected to increase the demand for skilled workers over the medium to long-term.

Waste

The waste sector employs around 15,500 Victorian workers.⁴⁷ The sector is responsible for waste collection, processing, and disposal, engaging in activities such as kerbside collection, plant processing, landfill and commercial composting.⁴⁸

Local councils and private industry in Victoria are responsible for waste collection, processing and disposal. While councils provide a wide range of waste services to residents and ratepayers, they mainly outsource waste management to a small number of private companies that operate various networks and facilities such as kerbside collection, processing plants, landfill deposits and commercial composting sites.⁴⁹ Private industry also provides a range of specialist waste services directly to businesses and consumers, including hazardous waste disposal, clinical waste treatment and disposal, commercial and industrial waste and recycling services and construction and demolition waste and recycling services.

The waste sector provides valuable input for the recycling and resource recovery sector which processes and manufactures a diverse range of products for domestic and international markets.





























Victoria's *Circular Economy (Waste Reduction and Recycling) Act 2021* underpins Victoria's transition to a circular economy.⁵⁰ It provides for the establishment of Recycling Victoria as a new state-wide regulator that will provide strategic leadership, oversight and regulation of the waste and recycling sector.⁵¹





The Electricity, Gas, Water and Waste Services industry in Victoria is expected to grow slightly over the next five years

The demand for Electricity, Gas, Water and Waste Services workers in Victoria is expected to grow slightly between 2022 and 2025.⁵² This will be driven by greater energy productivity and a shift in demand for renewable energy jobs. Employment in coal-related energy will decline as renewable energy becomes cheaper and old power stations close. This is likely to be accelerated by technological advancement across the industry and the social and political pressures intensifying in favour of sustainability.

The industry outlook is driven by a range of factors, detailed in Table 4.⁵³

Table 4 | Drivers of demand in the Electricity, Gas, Water and Waste Services industry

	Driver	Electricity	Gas	Water	Waste
Policy	Targets across all sectors to drive sustainability (such as greenhouse gas reduction, gas substitution and waste reduction).	 High	 High	 Medium	 Medium
	Government investment and regulation (such as six-star building standards) is increasing for sustainable and renewable programs, infrastructure, and technologies.	 High	 High	 High	 High
Economic	The cost of fossil fuel energy becoming prohibitive faster than expected, despite being offset by productivity improvements.	 High	 Medium	 Low	 Low
	Market confidence affected by the presence/absence of strategy, certainty and an agreed stimulus from the government.	 Medium	 Medium	 Low	 Low
Social	Public expectations for sustainability and action on climate change are increasing, reducing demand for fossil fuels.	 High	 High	 Medium	 Medium
	Consumers desire greater real time data and analytics on their usage and cost, but have inadequate understanding of existing technologies.	 Low	 Low	 Low	 Low
Techno-logical	Advancing technologies create opportunities to explore new energy sources, repurpose materials and modernise metering and maintenance.	 High	 High	 Medium	 High

	Driver	Electricity	Gas	Water	Waste
Environmental	High variability in climate will continue to place pressure on the availability of water and land. Natural resources are being depleted by consumption patterns.	 High	 Medium	 High	 Medium

Drivers are impacting sectors differently across the industry over the next three to five years. Notable sector-specific trends and influences are described below.

Electricity

Reforms are targeting industry growth at clean energy initiatives. This includes a \$1.6 billion Clean Energy Package⁵⁴ and \$540 million to develop six Victorian Renewable Energy Zones.⁵⁵ Three offshore windfarms could deliver 3,100 local jobs during development and construction (over 15 years) and up to an additional 3,000 ongoing jobs during operations.⁵⁶ These investments highlight the increasing prominence that renewable energy has in Victoria’s political landscape, consistent with changing community attitudes and increased risks associated with climate change.

The Victorian Government has also committed over \$450 million in energy efficiency upgrades for Victorian households and businesses. This includes support for Victorian farmers to improve energy management, solar rebates for businesses and funding for climate change community action.⁵⁷ Popularisation of rooftop solar continues, with households and small businesses switching to solar at record levels.⁵⁸ Around \$100 million has been invested to increase the government’s own energy efficiency.⁵⁹

Clean energy reforms, declining renewable costs and political or social pressures will drive demand in the energy sector.

Since 2010-11, there has been a 45 per cent improvement in energy productivity.⁶⁰ The cost of renewable energy also continues to decline (and is now the cheapest option),⁶¹ enabling new-build renewables to become more competitive.⁶² The early closure of Yallourn will also further transition the sector to clean energy. In place of the Yallourn power station, EnergyAustralia is planning to invest in a 350MW utility-scale battery, which is estimated to be delivered by 2026.⁶³ This is in addition to four utility-scale batteries already operational at Ballarat, Gannawarra, Moorabool and Bulgana totalling 375MW.

A high level of consumer engagement is required for wholesale adoption of technologies that provide insights into utility usage, such as the under the Victorian Energy Upgrades initiative. Energy products and services for consumers will continue to emerge, supported by robust energy data and local innovation. They may drive better consumer and environmental outcomes.

To retain a functional grid with the significant increase in dispersed electricity generation, the Australian Energy Market Operator’s (AEMO) Integrated System Plan provides a roadmap for the efficient development of the National Electricity Market over the next 20 years and beyond.⁶⁴

Gas

Increasing pressure to reduce greenhouse gas emissions is transforming the energy sector. Demand for natural gas is likely to decline as households increasingly use renewable electricity and hydrogen gas.⁶⁵ The shift by households toward solar photovoltaic systems is similarly reducing gas usage, with Australia having the highest uptake of household solar in the world.⁶⁶ In terms of hydrogen, the Hydrogen Energy Supply Chain Pilot Project is already underway in the Latrobe Valley,⁶⁷ and a \$10 million hydrogen hub run by Swinburne University of Technology has been created.⁶⁸

The Victorian Government is supporting a broad range of renewable hydrogen initiatives to encourage production and usage across the economy. For example:

- Around \$7.2 million in grants through the Renewable Hydrogen Business Ready Fund and Renewable Hydrogen Commercialisation Pathways Fund to support pilots, trials, demonstrations, business cases and feasibility studies with a total project value of over \$46.5 million.^{69,70}
- Investment of \$37.5 million through the Victorian Higher Education State Investment Fund⁷¹, including to Deakin University's Hycel Technology Hub (Hycel), Swinburne University of Technology's Victorian Hydrogen Hub (VH2) and AIR Hub, and the University of Melbourne's Zero Emissions Energy Lab.
- If fully developed, the Hydrogen Park Murray Valley (HyP Murray Valley) project at Wodonga is expected to enable Victoria's first hydrogen gas blending in the network, creating both decarbonisation opportunities and the need for new skill sets to service the gas industry.⁷²
- Investment of \$20 million (\$10 million each from the Victorian and NSW Governments) to develop a network of renewable hydrogen refuelling stations along the Hume Highway between Melbourne and Sydney and a fleet of approximately 25 hydrogen trucks to utilise the network.⁷³

At full scale, these initiatives will drive workforce demand and provide clean energy that can help meet Victoria's future energy needs. They could also kick-start the emergence of a new, global export hydrogen industry (expected to be worth \$2.5 trillion globally by 2050).⁷⁴

Water

Victoria's water sector is subject to variability in the coming years as it continues to face highly variable rainfall and streamflow, in addition to climate change.⁷⁵ Extreme events such as heatwaves, storms, bushfires, droughts, and floods will impact catchments, water quality and supply as well as water infrastructure, which is a particular challenge for Regional Victoria.⁷⁶ Victoria will need to continue to become more water efficient and look for additional climate-resilient water sources to protect stability of supply for a growing population with increased climate change risks. This includes using all water sources, including recycled water, stormwater and rainwater.

With two rainfall independent water sources in Victoria – desalinated water and recycled water – the sector is in a reasonable position to protect stability of supply for a growing Victorian population.⁷⁷

The sector will also be affected by technological and economic factors. For example, the Murray-Darling Basin Plan has received \$1.54 billion in federal funding and targets water efficiency.⁷⁸ New technologies will modernise the sector including intelligent water metering, remote asset management and inspection, sensors and wearable technology and automated customer interactions.⁷⁹

The Victorian Government, through the 2020-21 State Budget, invested \$11.1 million over four years to continue its Water Efficiency program, which includes programs that support low-income households to install water-efficient products, raising awareness with school students on water efficiency, and campaigns that target reduction in daily average water usage.

Victoria's water corporations are also required under Victoria's water plan, *Water for Victoria* and the *Statement of Obligations (Emission Reduction)*, to reduce their collective greenhouse gas emissions and achieve net-zero.

Waste

The Victorian waste sector is going through a period of transformation and growth. Increasing social and political pressure require improved efficiencies and more sustainable business operations.

The Victorian Government has invested \$515 million to drive sector wide reform. This includes the establishment of a new Circular Economy Act and government business unit called Recycling Victoria to steward Victoria's waste and recycling system, the overhaul of the kerbside recycling system, introduction of a container deposit scheme, a significant expansion of Victoria's network of recycling

infrastructure, and investment in research and innovation to create more products from recyclable materials.^{80,81,82}

The national ban on the export of several streams of waste is further driving the expansion of the waste and recycling industry in Victoria.⁸³

Workforce and skilling implications

An estimated 4,200 new workers are needed by 2025⁸⁴

On average, across all industries total employment is expected to grow by an additional 211,900 workers to 2025, from 3,538,900 workers in 2022, an annual growth rate of 1.97 per cent.^{g,85,86} In comparison between 2017 and 2020 employment grew by 2.68 per cent annually.^{h,87}

In the Electricity, Gas, Water and Waste services industry, employment is expected to grow by an additional 2,400 workers to 2025, from 49,200 workers in 2022, an annual growth rate of 2.02 per cent which is higher than the overall Victorian average across all industries.^{88,89} In comparison between 2017 and 2020 employment across this industry grew by 1.08 per cent annually.^{i,90}

The 4,200 new workers needed between 2022 and 2025⁹¹ comprises 2,400 employment growth and replacement of 1,900 retirees.⁹² The number of retirements does not consider people leaving the industry for other reasons.

Changes are likely to take place in the location and composition of the workforce. Jobs will shift from the Latrobe Valley to regions across Greater Melbourne and Victoria, especially Renewable Energy Zones.

The clean energy transition may create up to 24,000 new jobs by 2030 across all industries.⁹³ Some of these jobs are needed in the Electricity, Gas, Water and Waste industry, such as electricians, line workers and turbine technicians.⁹⁴ Many of these jobs sit within other industries, such as engineers (professional services) and plumbers (construction).⁹⁵

Specialist maintenance tasks performed overseas or by international workers can increasingly take place in Victoria.⁹⁶ For example, Federation University's Asia Pacific Renewable Energy Training Centre in Ballarat will build workforce capability in servicing wind farms.⁹⁷ Consultation highlighted an opportunity for a gearbox test bed to be developed in Victoria, which would negate the need to export maintenance tasks to Europe and China.⁹⁸

There will be a reduction in jobs within the coal-fired power sector. Yallourn power station will close by mid-2028, resulting in the loss of 500 jobs (both permanent employees and contractors).⁹⁹ Other coal stations may close in the years to follow. The transition to renewable energy also means that fewer shutdowns will be required, resulting in a reduction in the demand for scaffolders, specialist technicians, maintenance workers and operations workers within the industry. One third of coal workers, such as drillers and machine operators, may require significant support to transition into new jobs.¹⁰⁰

The gas sector workforce is also likely to change with decarbonisation, the growth of hydrogen and biomethane, the expansion of electrification, and households shifting to PV systems for energy production and usage.

Consultation highlighted that the Gippsland Energy Skills Mapping projects are attempting to identify transition pathways for coal workers, and that gas industry workers can be retrained to work in the hydrogen sector.

Demand for electricity transmission and distribution workers is likely to increase, while increased demand for rooftop solar and batteries will disperse the electricity generation network. Similarly, the transmission and distribution subsectors will benefit from reorienting workforces to accommodate emerging centres for energy generation across Victoria. For example, the AEMO's 2020 Integrated

^g 3-year compound annual growth rate

^h Computed for 2017 to 2020 employment growth for pre-COVID comparison

ⁱ 3-year compound annual growth rate

^j Computed for 2017 to 2020 employment growth for pre-COVID comparison

System Plan includes projects to augment the transmission grid such as the Western Victoria Transmission Network Project, Victoria-New South Wales Interconnector (VNI) Minor and VNI West which are scheduled to be completed before 2030.¹⁰¹

The water and waste sectors will have relatively steady workforce requirements over the next five years. They will require additional capability in recycling and processing activities as well as digital water meter and logger installations. Consultation highlighted the ongoing challenges industry are facing in filling a range of skilled jobs, such as waste collection drivers, landfill and specialist waste facility operators and regulated, trained asbestos removalists.


Across the industry electricians^k and electrical distributions tradespeople will remain in strong demand. Their skills profile will shift as new technologies emerge: their role will become significantly more important as the use of technology and networking increases and the responsibility for infrastructure maintenance falls on a relatively small workforce that is also required to adapt to and upskill in renewable energy.¹⁰²

Table 5 identifies the top ten occupations in demand based on employment growth and replacing retirees by 2025.¹⁰³ Of these, nine occupations (highlighted in table) are expected to experience employment growth at a rate above the overall Victorian average between 2022 and 2025. These figures are estimates that do not account for existing vacancies or take account of changes in the rate of workers leaving the industry.

Table 5 | Occupations in demand for the Electricity, Gas, Water and Waste Services industry^{l,104,105}

Occupation	Current employment	Employment growth (2022–25)		Retirements (2022–25)	New workers needed (2022–25)
		Number	Per cent		
Electrical Engineers	3,050	150	2.6%	100	250
Other Specialist Managers	1,900	150	4.1%	50	200
Truck Drivers	9,200	50	0.3%	150	200
Electricians	2,300	100	2.0%	50	150
Management and Organisation Analysts	900	150	6.7%	50	150
Database and Systems Administrators, and ICT Security Specialists	600	150	7.7%	50	150
Contract, Program and Project Administrators	850	100	2.6%	50	150
Human Resource Managers	500	100	3.6%	50	150
General Clerks	800	100	3.0%	50	150
Other Information and Organisation Professionals	350	100	5.8%	50	150

Legend

 Above Victorian employment growth average between 2022 and 2025

^k Electricians are also covered in the construction industry insight report.

^l Due to rounding, some totals may not correspond with the sum of the separate figures

Estimates of demand prepared by the Department of Environment, Land, Water and Planning (DELWP) suggest demand may be higher for some occupations across the industry. DELWP estimates are being used as an input in the Victorian Government's Clean Energy Taskforce, which will be available in the second half of 2022. The VSA is working closely with DELWP and Department of Education and Training (DET) via the Clean Economy Workforce Development Strategy to explore differences in modelling approaches to inform future planning.

Emerging technologies such as offshore wind, hydrogen, bioenergy, waste and recycling technologies, and ZEVs will require a significant increase in skilled technology workers as detailed in Table 6. Emerging occupations are defined as new, frequently advertised jobs which are substantially different to occupations defined in ANZSCO.¹⁰⁶

Table 6 | Emerging occupations in the Electricity, Gas, Water and Waste industry¹⁰⁷

Emerging occupations	
• Data analysts	• Data architects
• Digital marketing specialists	• Electric vehicle network technicians
• Energy efficiency assessors	• Engineers and plant operators specialising in hydrogen technology
• Hazardous materials labourers	• Solar designers and installers
• Wind turbine technicians	

Occupational shortages will need to be addressed with a focus on environmental sustainability and technological shifts

The Electricity, Gas, Water and Waste Services industry needs to fill occupational shortages to meet future growth.^m This is particularly important in renewable energy and water management (with an emphasis on infrastructure) to ensure the workforce meets the increasing demand for skills in clean energy and technology. The industry will also need to manage the increasing number of older workers that will soon retire and ensure that their valuable skills and knowledge are not lost.

Occupational shortages need to be addressed across the industry to realise growth in renewable energy.

A 2021 survey of industry and transmission network businesses identified a risk of local skills shortages for transmission projects across key occupations such as grid engineers, transmission line workers and construction managers.¹⁰⁸ Engineering Procurement Construction (EPC) contractors in particular report that they are experiencing considerable difficulty filling vacancies for certain occupations at current levels of remuneration and conditions of employment, and in reasonably accessible locations. In regional areas there are significant shortages of statutory planners in local councils.

These shortages exist largely because of a lag of supply in response to government investment that has been made or committed in recent years. In the case of water, consultation emphasised that qualifications were of a highly specialised nature and were only offered at one registered training organisation in Victoria.¹⁰⁹

^m A shortage exists when employers are unable to fill or have considerable difficulty filling vacancies for an occupation at current levels of remuneration and conditions of employment, and in reasonably accessible locations. Where an occupation specialisation is in shortage, the occupation will be treated as in shortage.

VSA consultations indicate several other occupations currently or soon to be in shortage across Victoria. A list of specific occupational shortages is shown in Table 7.

Table 7 | List of occupational shortages facing the Electricity, Gas, Water and Waste Services industry^{110,111,112}

Occupational shortages	
<ul style="list-style-type: none"> Electricians and electrical inspectors in renewable energy 	<ul style="list-style-type: none"> Microbiologists in the waste sector to discover new product and recycling opportunities
<ul style="list-style-type: none"> Planners to deliver the state agenda for renewable energy, especially those with 5-10 years' experience. This is particularly acute in regional areas (note that most of these occupations fall within the public administration and safety industry) 	<ul style="list-style-type: none"> Trucking and waste vehicle drivers¹¹³
<ul style="list-style-type: none"> Skilled trades and labour for the construction and maintenance of renewable energy infrastructure – note that most of these occupations fall within the construction industry 	<ul style="list-style-type: none"> Specialist waste and resource recovery roles¹¹⁴
<ul style="list-style-type: none"> Water management roles relevant to water networks, source management, hydrography, irrigation, and trade waste 	<ul style="list-style-type: none"> Independent water quality technical specialists for providing industry with expert advice on the management of water, wastewater and for water quality sampling

Electricity, Gas, Water and Waste workers need to upskill in data and technology to meet industry trends

Workers in the Electricity, Gas, Water and Waste Services industry will need to build general technological skills to adapt to the emerging renewable energy sector, combined with a greater understanding of sustainability and environmental management in response to shifting social attitudes. Specific technical skills will be required to exploit, deliver and evaluate new sources of energy in a growing clean economy.

As Victoria moves towards a more circular economy there will be an increasing need for skills to avoid waste or reuse it in innovative ways. Such skills include design, product repair, as well as materials efficiency and new businesses models that optimise how we use materials.

A list of specific skills shortages is shown in Table 8.

Table 8 | Skills shortages facing the Electricity, Gas, Water and Waste Services industry^{115,116}

Skills shortages	
<ul style="list-style-type: none"> Data analytics 	<ul style="list-style-type: none"> Digital capability
<ul style="list-style-type: none"> Electrical technologies (including electric vehicles) 	<ul style="list-style-type: none"> Environmental and sustainability management
<ul style="list-style-type: none"> Hydrogen, offshore wind and bioenergy technology capability 	<ul style="list-style-type: none"> Resource recovery technologies (new and emerging)¹¹⁷
<ul style="list-style-type: none"> Skills associated with waste collections (driving waste collection vehicles)¹¹⁸ 	<ul style="list-style-type: none"> Soft skills such as flexibility and agility
<ul style="list-style-type: none"> Waste operations¹¹⁹ 	

Education and training pipeline

There were around 16,090 enrolments in Electricity, Gas, Water and Waste related Vocational Education and Training (VET) qualifications in Victoria in 2020 and around 16,910 relevant enrolments in Higher Education. This should translate to more than 10,830 graduating studentsⁿ entering the workforce each year with relevant qualifications, presenting a significant opportunity to meet projected demand. Some will seek employment in other industries, (e.g. electricians in the construction industry) reducing the potential pipeline. For further detail, see the collaborative response toward the end of this report.

VET remains a significant pathway into the Electricity, Gas, Water and Waste Services industry

VET will likely continue to be a significant channel of education supply to the Electricity, Gas, Water and Waste Services workforce, with 39.8 per cent of the current workforce holding a VET level qualification as their highest level of education.¹²⁰ A VET level qualification is required for many top employing occupations in the industry, including electrical distribution and trades workers, electricians, and gas plant operators. There are also key occupations that are not as readily serviced by VET, such as cable jointing, rail traction and linework. VET is also important for workers in specialist water roles, though only one RTO offers qualifications dedicated to water industry operations.

Employment opportunities in the industry are available at all skill and experience levels. The industry relies significantly on specialised tradespeople and professionals including electrical engineers. It is anticipated that up to 3,000 projected jobs in solar and wind will be created within operation and maintenance by 2035. By contrast, there will be fewer jobs in coal-powered energy and natural gas.

There were approximately 16,050 enrolments in Electricity, Gas, Water and Waste Services related qualifications (excluding skill sets) in 2020 in Victoria.

Occupations in the industry are highly skilled and require development over time with practical experience, which is why apprenticeships are an important part of the enrolment pipeline, with the strong employment prospects they generate (particularly for electrical workers). Enrolment activity is spread across different qualification levels as the industry provides a diversity of opportunities, including for school leavers and mature aged workers with no post school qualifications.

In 2020, there were around 50 enrolments in Electricity, Gas, Water, and Waste Services related the skill set 'Course in New Energy Technology Systems' in Victoria.

People enrol in VET courses for one of three main reasons:

- to prepare for employment
- to support current employment
- to progress their careers within the industry.

VET Activity

VET activity can be categorised as prior to employment, with employment (as an apprenticeship or traineeship), and upskilling once qualified as shown in Table 9. The table shows the enrolments in 2020 VET courses on the Victorian Funded Course List (FCL) and the Victorian Funded Skill Set List

ⁿ This number is determined by taking the total number of VET enrolments in courses undertaken prior to employment, combined with 1/3 of the total number of HE enrolments in AQF 5-8 courses (as these courses are traditionally undertaken prior to employment and the average bachelor's degree is three years, so therefore only those in their final year of study will enter the workforce the following year)

(FSSL) related to this industry.^{121,122, o}. The enrolment numbers are drawn from Total VET Activity (TVA) which comprises enrolments supported by public funding or private contribution.

As part of preparing this report, industry representatives provided their perspectives on the purpose of these qualifications. Course purpose is summarised in Figure 2 and helps to read Table 9.

Figure 2 | VET pipeline key

- 'AT' indicates a classroom-based course is also available as an apprenticeship or traineeship option
- 'Q' indicates industry values the course as a qualification
- 'SS' indicates industry values the course as a skill set
- 'EIR' indicates it is an Endorsed Industry Requirement as noted by industry
- 'OL' indicates the course leads to an Occupational Licence as noted by industry

Note: Industry has not provided feedback on all qualifications and where indicated; each value assignment can be reviewed in the future.

Table 9 | VET pipeline for Electricity, Gas, Water and Waste services for Victoria^P

Prior to employment	
Qualifications (7,108 TVA enrolments 2020)	
Advanced Diploma	352
Advanced Diploma of Computer Systems Engineering (Q,AT)	120
Advanced Diploma of Electronics and Communications Engineering (SS,AT)	72
Advanced Diploma of Engineering Technology - Electrical (Q,SS,AT,OL)	160
Certificate II	5,605
Certificate II in Electrotechnology (Career Start) (Q,AT)	2,873
Certificate II in Electrotechnology (Pre-vocational) (SS)	2,432
Certificate II in ESI - Powerline Vegetation Control (Q,AT,OL)	283
Certificate II in Gas Supply Industry Operations (Q,SS,AT,EIR)	17
Certificate III	781
Certificate III in Business Equipment (SS,AT)	-
Certificate III in Data and Voice Communications (Q,AT)	-
Certificate III in Electrical Fitting (Q,SS,AT,OL)	285
Certificate III in Electrical Machine Repair (Q,SS,AT)	-
Certificate III in Electronics and Communications (Q,AT)	-
Certificate III in Electrotechnology Electrician (Q,SS,AT,OL)	131
Certificate III in ESI - Distribution Overhead (Q,SS,AT,OL)	42
Certificate III in ESI - Distribution Underground (Q,AT,OL)	57
Certificate III in ESI - Rail Traction (Q,AT,OL)	<5
Certificate III in ESI - Transmission Overhead (Q,AT,OL)	8
Certificate III in Gas Supply Industry Operations (Q,SS,AT,EIR)	49

^o Note that the Victorian Funded Skill Set List was formally introduced from 2021 onwards.

^P VET courses can support a range of occupations across a range of industries, and occupations can also support a range of industries. To present the likely VET trained employment pipeline by industry, enrolments for a course have been assigned to the most common industry in which people seek employment.

Certificate III in Instrumentation and Control (Q,SS,AT)	13
Certificate III in Renewable Energy - ELV (AT)	-
Certificate III in Water Industry Operations (Q,AT,EIR)	194
Certificate IV	369
Certificate IV in Computer Systems (Q,AT)	-
Certificate IV in Electronics and Communications (Q,AT)	-
Certificate IV in Industrial Automation and Control (Q,SS)	33
Certificate IV in Instrumentation and Control (Q,SS,AT,OL)	28
Certificate IV in Integrated Technologies	308
Certificate IV in Renewable Energy (AT)	-
Diploma	<5
Diploma of Air Conditioning and Refrigeration Engineering (Q,AT,OL)	<5
With employment (apprenticeship and traineeship)	
Qualifications (8,916 TVA enrolments 2020)	
Certificate II	<5
Certificate II in Electrotechnology (Career Start) (Q)	<5
Certificate III	8,878
Certificate III in Data and Voice Communications (Q)	25
Certificate III in Electrical Fitting (Q,SS,OL)	70
Certificate III in Electrical Machine Repair (Q,SS)	14
Certificate III in Electronics and Communications (Q)	46
Certificate III in Electrotechnology Electrician (Q,SS,OL)	8,571
Certificate III in ESI - Distribution Overhead (Q,SS,OL)	76
Certificate III in ESI - Distribution Underground (Q,OL)	8
Certificate III in ESI - Rail Traction (Q,OL)	16
Certificate III in ESI - Transmission Overhead (Q,OL)	<5
Certificate III in Gas Supply Industry Operations (Q,SS,EIR)	29
Certificate III in Instrumentation and Control (Q,SS)	12
Certificate III in Water Industry Operations (Q,EIR)	9
Certificate IV	36
Certificate IV in Electrical - Instrumentation (Q,SS)	6
Certificate IV in Energy Management and Control (Q,SS)	7
Certificate IV in Instrumentation and Control (Q,SS,OL)	23
Upskilling once qualified	
Qualifications (23 TVA enrolments 2020, 47 Skill Set enrolments 2020)	
Certificate IV	18
Certificate IV in Electrical - Instrumentation (Q,SS,AT)	15
Certificate IV in Electrical - Photovoltaic systems (Q,SS,AT)	-
Certificate IV in Electrotechnology - Electrical Contracting (SS,AT)	-
Certificate IV in Electrotechnology - Systems Electrician (SS,AT,OL)	-
Certificate IV in Energy Management and Control (Q,SS,AT)	<5
Diploma	5
Diploma of Electrotechnology Project Management	5
Skill Set	47
Course in New Energy Technology Systems (Q,EIR)	47

Note: Enrolment figures in the table above are as reported by NCVER, Total VET student and courses 2020: program enrolment. There may be instances where program enrolments are not reported by providers to NCVER and therefore not included in the enrolment figures in the total VET training activity data. Total VET activity for 2021 is expected to be released in August 2022.

Several qualifications have been updated or developed to respond to the needs of the renewables sector such as the Certificate IV in Wind Power Generation. Guidance will be sought to better understand their value to the industry.

Higher education related occupations will be in high demand across sectors

Higher education supports pathways into the Electricity, Gas, Water and Waste Services industry, with 31.8 per cent of workers holding a degree or above as their highest level of education.¹²³ A higher education qualification is required in electrical and network engineering, which is a key occupation within the electricity sector. There are also higher education pathways for critical occupations in water and waste, including civil, chemical environmental and water engineers, environmental scientists, and microbiologists.

Occupations in the industry that rely heavily on higher education qualifications are projected to grow over the next five years.¹²⁴ Due to the deep knowledge of (emerging) technologies and engineering that is required in these sectors, longer periods of study are required to enter the industry through higher education.

In 2019, there were around 16,910 enrolments across relevant courses delivered by Victorian universities.¹²⁵ The Electricity, Gas, Water and Waste Services industry pipeline in the higher education system is shown in Table 10. Only high enrolment courses with equivalent full-time study load (EFTSL) over 100 are included, excluding relevant sciences. Many of these courses serve multiple industries, and the total EFTSL numbers are reflective of this broader pipeline.

Table 10 | Higher education pipeline for Electricity, Gas, Water and Waste services for Victoria, high enrolment courses with EFTSL over 100⁹

Electrical and Electronic Engineering and Technology (3,087 EFTSL, Victoria, 2019)	
Australian Qualifications Framework (AQF) 9+ (e.g., Master and above) (938 EFTSL)	AQF 5-8 (e.g., Diploma, Bachelor, Hons) (2,149 EFTSL)
<p>Examples include:</p> <ul style="list-style-type: none"> • Doctor of Philosophy (Electrical and Electronic Engineering) (129) • Master of Science (Network Systems) (109) • Master of Engineering (Electrical and Electronic Engineering) (109) 	<p>Examples include:</p> <ul style="list-style-type: none"> • Bachelor of Engineering (Electrical and Electronic Engineering) (Hons) (1,000) • Bachelor of Engineering (Electrical Engineering) (Hons) (483) • Bachelor of Engineering (Computer and Network Engineering) (Hons) (115) • Bachelor of Engineering (Software Engineering) (Hons) (112)
Civil Engineering (4,898 EFTSL, Victoria, 2019)	
AQF 9+ (e.g., Master and above) (1,269 EFTSL)	AQF 5-8 (e.g., Diploma, Bachelor, Hons) (3,629 EFTSL)
<p>Examples include:</p> <ul style="list-style-type: none"> • Doctor of Philosophy (295) • Master of Construction and Infrastructure Management (290) • Doctor of Philosophy – Engineering (126) 	<p>Examples include:</p> <ul style="list-style-type: none"> • Bachelor of Engineering (Civil and Infrastructure) (Hons) (1,211) • Bachelor of Civil Engineering (Hons) (502) • Bachelor of Engineering (Civil) (Hons) (447)

⁹ A course may be allocated to different narrow field of educations by different higher education providers based on the primary purpose of the course. Higher education enrolments reported against a course under a specified narrow field of education reflect only the portion of enrolment allocated to the narrow field of education and are not reflective of the total enrolment for the course.

Mechanical and Industrial Engineering and Technology (2,430 EFTSL, Victoria, 2019)	
AQF 9+ (e.g., Master and above) (530 EFTSL)	AQF 5-8 (e.g., Diploma, Bachelor, Hons) (1,900 EFTSL)
Examples include: <ul style="list-style-type: none"> • Doctor of Philosophy (Mechanical and Manufacturing Engineering) (144) 	Examples include: <ul style="list-style-type: none"> • Bachelor of Mechanical Engineering (Hons) 298 • Bachelor of Engineering (Mechanical) (Hons) (288) • Bachelor of Engineering (Mechanical Engineering) (Hons) (127)
Relevant Sciences[†] (6,495 EFTSL, Victoria, 2019)	
AQF 9+ (e.g., Master and above) (3,016 EFTSL)	AQF 5-8 (e.g., Diploma, Bachelor, Hons) (3,479 EFTSL)
Examples include: <ul style="list-style-type: none"> • Master of Environment (235) • Master of Environment and Sustainability (172) 	Examples include: <ul style="list-style-type: none"> • Bachelor of Environmental Science (Environmental Management and Sustainability) (215) • Bachelor of Environments (211) • Bachelor of Environmental Science (101)

Consultation highlighted other qualifications that are important to the industry that have fewer than 100 EFTSL. For example, the Bachelor of Environmental Engineering (Honours) is an important pathway for water and wastewater treatment engineers, as well as more broadly for the waste sector.

[†] Figure includes Biological Sciences, Chemical Sciences, Environmental Studies, and relevant courses under Natural and Physical sciences (Bachelor of Environmental and Conservation Science, Bachelor of Geosciences, Bachelor of Science (Special in Biotechnology Chemistry or Environmental Management) and Bachelor of Science (Environmental Sustainability)).

Workforce priorities

Key workforce priorities centre on upskilling existing workers and ensuring a smooth transition to renewable energy

Key challenges exist to address the supply and skill of labour. Some challenges extend beyond the remit of the Skills Plan, such as industry awards and remuneration. Other challenges relate to a low number of individuals choosing to enter the industry, and difficulty retaining existing workers.

The Skills Plan identifies three key priorities for the Electricity, Gas, Water, and Waste Services industry. Responsibility for delivering on these priorities lies with many stakeholders. Education and training has a key role to play (see next section for a proposed response to these priorities).

Strengthening pathways from entry-level to specialist roles and stimulating demand

Apprenticeships remain the dominant pathway into the industry. However, some critical pathways are not working as intended or required. These include pathways to specialisations such as transmission and distribution, cable joining and signal technicians. There are also no current apprenticeship pathways for waste, recycling and resource recovery operations.

Industry noted that secondary school students and career starters have low awareness of the range of opportunities available and that there is an opportunity to attract cohorts that are not well represented in these specialist roles, including women and culturally and linguistically diverse people.

Essential service workers hold specialist knowledge. Tapping into that knowledge to provide support for entry-level specialist roles can increase retention of subject matter expertise and build the skills of apprentices more rapidly.

Table 11| Issues to address to stimulate demand and strengthen pathways to specialisation

- Ageing workforce who have significant industry expertise
- Lack of awareness among school leavers and diverse cohorts of the breadth of career opportunities
- Existing pathways to specialisation are not being utilised effectively

Upskill the existing workforce to remain relevant in a transitioning industry

The Electricity, Gas, Water, and Waste Services industry is undergoing a period of significant transition. Without the incentive for continuous development through post-trade training, the industry is struggling to increase uptake of emerging skill sets.

Many workers are unable to justify the cost or time of upskilling without a clear understanding of the opportunities it might provide. Workers may also not be aware of the broad pathways available to them, especially when it comes to highly specialised businesses.

Energy Safe Victoria has implemented a regulatory requirement for compulsory continuous professional development (CPD) on licence renewal for licensed electrical workers. This will be mandated from 2023.¹²⁶ There are also plans for CPD to be introduced for plumbing practitioners.¹²⁷

While mandated continuous professional development is a first step, the requirement alone is not sufficient to drive the scale of skills transition required.

Table 12 | Issues to address to upskill the existing workforce

- Existing workforce will need the necessary skills for transition to renewable energy and circular economy
- Workers lack awareness of the broad spectrum of career pathways

Increase supply of specialist water workers in regional areas

The water industry is facing a critical shortage of skilled workers, particularly in regional areas. Water corporations in the regions struggle to compete with large corporations in Melbourne for highly skilled workers.

Training providers are unable to supply sufficient enrolments for essential qualifications, leading to declining availability of important, and specific, qualifications. These qualifications are highly valued by industry, with an expectation for example that operators hold the Certificate III in Water Operations. The issue is compounded with only one registered training organisation delivering relevant courses in Victoria.

There is a stronger educational offering in higher education, but without work experience or programs providing direct pathways to regional employment, these qualifications typically feed the Melbourne workforce. Effort must be concentrated on lifting the availability of employment pathways into critical roles; for example, for occupations relevant to water networks and quality, source management, hydrography, irrigation, and trade waste.

Table 13 | Issues to address to increase supply of specialist water workers in regional areas

- High competition for workers between metro and regional corporations
- Limited availability of relevant education and training available in regional areas
- Lack of regional employment pathways from higher education related courses

Collaborative response

The education and training response can focus on meeting workforce demand and developing capability

The education and training response has a key role to play in addressing the three key workforce issues for the industry:

1. Stimulating demand by strengthening pathways from entry-level to specialist roles.
2. Upskilling the existing workforce to remain relevant in a transitioning industry.
3. Increasing supply of specialist water workers in regional areas.

The industry faces strong competition from other industries (for example, construction and manufacturing) for graduates in common areas of need as Victoria transitions to clean energy and a circular economy. There is also a high need for emerging and specialist roles (for example, wind turbine technicians, energy efficiency engineers, line workers and water operations technicians) that need to be skilled and retained, as well as a significant portion of the workforce which will require upskilling and/or reskilling to meet industry needs.

Opportunities exist to further align education and training to industry needs. This is important for renewable energy, waste services and water operations, where there is low awareness and interest among school leavers and prospective students. Study options ideally provide an experience that retains student interest and demonstrates the possibilities of a broad and changing industry, particularly for high school students considering career options. Demand for courses in priority areas could also be stimulated among diverse cohorts (including women, people with disabilities and culturally and linguistically diverse people). The education pipeline could focus on maintaining niche but vital qualifications (such as the Certificate III in Instrumentation and Control). This is particularly important in regional areas where there is forecast growth due to significant investments in renewable energy and major projects.

The education and training response can focus on strengthening pathways into specialist roles and enabling the workforce to adapt to the energy transition.

Electrical trades apprenticeships have highly diverse employment pathways, suggesting there is an opportunity to increase interest and awareness across sectors prior to employment. Pre-apprenticeship courses, such as Career Start, are promising entry-level programs that could highlight the different streams of work available to students. This will ensure education activity aligns with the breadth and need across the electrical workforce. These courses ideally provide an experience that retains student interest and demonstrates the possibilities of a broad and changing industry, particularly for high school students considering career options. Collaboration with industry will be essential to provide appropriate exposure. Flexible models of education that respond to the importance of practical experience can also ensure attraction and quality outcomes.

Supervisory and specialist roles within the industry need to be stimulated as well. Key in doing so is offering a more dynamic blend of qualifications and micro-credentials. These might include a focus on solar or battery, non-trade skills such as business, or pathways from and to higher education. Similarly, streamlined pathways between VET and higher education will permit workers with trade qualifications to transition into roles in emerging or highly technological areas (such as engineering). Facilitating post trade study opportunities without access to teachers with specialist capability will be challenging.

The existing workforce can be supported to obtain the skills required to work in renewable energy, new technology and environmental sustainability. Flexible pathways that can be undertaken while

employed will support retention of workers. Partnerships between industry and education providers would assist in delivering continuing professional development that is both effective and timely.

Industry cannot assume that the current workforce wants to or can transition to these roles. Mature aged workers may instead decide they wish to transition into an equivalent (or lower level) role in another industry or move into early retirement. Education and training efforts can focus on how these workers can be supported to ensure they maximise the learning opportunities on offer.

To assist regional operators in meeting industry demands, the education and training response can focus on strategies that provide opportunities and practical experience outside Melbourne. Stronger connections between the higher education and VET system in regional areas, supported by industry partnerships, can assist in increasing employment pathways into critical roles. Areas of growth include Gippsland, Great South Coast and the Mallee, where there is significant renewable energy investment and major projects that have commenced in recent years.

Government and industry investment can better align with the evolution of workforce capacity and capability

The education and training response alone cannot deliver on the three workforce priorities to improve how the Electricity, Gas, Water and Waste Services industry attracts and manages talent. It is critical that the system works together with government and industry to support the training and skilling requirements necessary to meet future demand and deliver a coordinated response.

Government has made significant progress in investing in the transition to renewable energy and a circular economy, consistent with its ambition to reduce greenhouse gas emissions and waste disposal across the state. Success relies on the effective transition of existing workforces and the attraction of new workers to the renewable energy sector and the waste and recycling sector. This requires time and support for workers to upskill and reskill, including when completing additional micro-credentials, skill sets or qualifications. This is an important area of focus in the Clean Economy Workforce Capacity Building Fund, highlighting the priority that government is placing on supporting workforces to undergo further education and training.¹²⁸

Case study | Women in renewable energy

The Victorian Government is supporting subsidised apprenticeships, professional mentoring, and access to ongoing education to lift the number of women participating in the renewables industry as part of Solar Victoria's \$11 million comprehensive training and workforce development package. Around 50 per cent of the cost of new apprenticeships will be subsidised to help women enter the industry and provide apprentices a tool allowance, along with six-monthly incentive payments. For women working in related energy industries, free or low-cost training delivered by registered training organisations will be available to help transition to clean energy or to upskill in renewables.

The package also includes targeted support for women working in, entering or thinking of entering the solar industry through access to online workshops, conversational information sessions promoting a career in solar, and professional mentoring. Targeted safety and mental health first aid training is also provided.

The implementation of mandatory continuing professional development for licensed electrical workers (and across the industry more broadly) will require appropriate learning modules to be available. Partnerships with industry will assist in determining the format, frequency and content of these modules that are consistent with regulation.

Effective workforce transition can also align with economic and social development in regional and rural areas. It is already clear that there will be significant public investment in renewables across regions such as Gippsland and Great South Coast. The challenge for government is to sustain this

growth and to build community within target regions as large projects pass through, while ensuring workers remain able to take pathways to other industries and/or sectors as required.

From an industry perspective, there is an opportunity for employers to strengthen the value proposition of the industry and undertake broader workforce planning initiatives to attract new workers and prospective students. As described above, this is critical in regional areas where communities are built around large projects.

Employers can continue to focus on upskilling workers through flexible work arrangements, supporting formal recognition of learning on the job, providing study leave and subsidising professional development opportunities. This will assist in insulating workers against redundancy or pressure to relocate in response to emerging technologies or project lifecycles.

Actions for consideration for education, industry, and government

- Expand interest and awareness in Electricity, Gas, Water and Waste Services related career pathways (particularly renewable energy) to build the pipeline of workers, especially with women and other underrepresented groups in the industry.
- Expand the availability of skill sets and short courses to enable more people to undertake post-trade study in specialist roles, and consider approaches to maintaining niche qualifications vital to the industry in priority areas.
- Consider a dynamic blend of skill sets and qualifications (including updating existing offerings) to support the existing workforce transition toward renewable energy, new technology and environmental sustainability.
- Strengthen opportunities and practical experience in the industry outside metropolitan Melbourne.
- Ensure continuing professional development for electrical workers is supported by the education and training response and are based on industry needs.
- Strengthen the value proposition for working in the Electricity, Gas, Water and Waste Services industry, specifically around flexible work arrangements and supporting further learning.

Appendix A – Data methodology

VSA Employment Model overview

The VSA Employment Model produces estimates of:

- projected employment growth between 2022 and 2025
- projected retirements between 2022 and 2025
- projected total new workers needed between 2022 and 2025.

Table 14 further defines the model outputs and identifies the primary source for each output.

Table 14 | Employment model outputs

	Employment growth 2022-25	Retirements 2022-25	New workers needed 2022-25
Definition	Change in the number of workers employed from 2022 to 2025	Workers expected to permanently leave the workforce from 2022 to 2025	Workers needed from 2022 to 2025 to meet demand from growing employment and to replace retirees
Primary source	Benchmarked to the NSC Employment Projections	Derived from retirement rates from Australian Census Longitudinal Dataset	The sum of employment growth and retirements

All outputs are modelled at the occupation, industry and region level:

- occupations are defined by 4-digit occupation unit groups in the Australian and New Zealand Standard Classification of Occupations (ANZSCO)
- industries are defined by 1-digit industry divisions in the Australian and New Zealand Standard Industrial Classification (ANZSIC)
- regions are defined by the nine Regional Partnerships of Victoria as outlined by the Victorian Department of Jobs, Precincts and Regions.

Benchmark data from the NSC give estimates of projected employment growth. Using an approach called iterative proportional fitting, the detailed occupation, industry and region breakdowns are generated by applying the distribution of employment in ABS Census and other data to the benchmark projections.

The model was developed by the VSA with the support of Nous and Deloitte Access Economics (DAE). The sections further below describe how the key outputs were modelled.

The VSA Employment Model gives a best estimate of employment by industry, occupation and region. It provides an indication but does not, and cannot, tell the full story of the region's economy.

Employment growth, 2022-25

Source: VSA and Nous (2022), *modelling of NSC (2022) Employment Projections*

This modelling takes the NSC Employment Projections as the benchmark data for 2022-25 and breaks it down into occupation by industry by region tables.

The benchmark data sources provide ‘control totals’ for occupation, industry and region breakdowns independently. However, they do not provide the interaction between each of the variables. For example, they do not give the breakdown of occupations within industries.

Iterative proportion fitting uses a detailed ‘seed’ data table with the necessary breakdowns from a representative dataset and scales that distribution to control totals in the new dataset. Over many iterations, the seed data is transformed to sum up to the occupation, industry and region control totals.

The seed data comes from the ABS Census 2016. The control totals for occupation and industry come from the NSC's Employment Projections, and the control totals for region come from the NSC's Small Area Labour Markets data. Table 15 describes the inputs in detail.

The modelling results in:

- industry and occupation projections that align with the NSC Employment Projections
- regional data that matches the distribution across NSC Small Area Labour Markets
- industry by occupation by region data tables that approximate the distribution within the ABS Census 2016.

Table 15 | Data sources used to model employment growth from 2022 to 2025

Type	Data	Source
Seed	Employment x 3-digit industry (ANZSIC3) x 4-digit occupation (ANZSCO4) x Statistical Area Level 2 (SA2)	ABS, <i>Census of Population and Housing</i> , place of usual residence data
Control total	Employment x SA2	NSC, <i>Small Area Labour Markets</i> , ‘SALM smoothed SA2 Datafiles (ASGS 2016) - March quarter 2022’.
Control total	Employment x ANZSIC1	NSC, <i>Employment Projections, 2020-25</i>
Control total	Employment x ANZSCO4	NSC, <i>Employment Projections, 2021-26</i>

Notes:

1. Following the modelling, SA2 data is aggregated up to Regional Partnership region. Where an SA2 spans multiple regions, the estimates have been apportioned based on geographic area.
2. The NSC industry projection is often not available until some months after the occupation projections. As at May 2022, there were no 2021 to 2026 ANZSIC1 by state forecasts available. The previous release of 2020 to 2025 ANZSIC1 by state forecasts were used and scaled up to match the Australian total employment numbers in the ANZSCO4 forecasts.

Retirements, 2022-25

Source: VSA, *Deloitte Access Economics (DAE) and Nous (2022), Retirement projections 2022-2025*

Retirements are estimated by applying occupation-specific retirement rates to the employment projections.

Using the Australian Census Longitudinal Dataset, an estimate of the size of the labour force aged 50 and over in 2016 was taken and compared to the size of the labour force aged 45 and over in 2011. After adjusting for migration, the gap is an estimate of retirements between 2011 and 2016. The relative age structures of occupations in the Census 2011 were then used to estimate retirements at the detailed occupation level (ANZSCO4).

The outputs were used to estimate an occupation-specific retirement rate, calculated as:

$$\text{Retirement rate} = \text{retirements between periods } t \text{ and } t+1 / \text{employment at } t$$

The retirement rates were applied to the employment projections to estimate the number of retirements between 2022 and 2025 at the region (Regional Partnerships), industry (ANZSIC1) and occupation (ANZSCO4) level.

New workers needed, 2022-25

New workers needed is the simple sum of employment growth and retirements. It is calculated at the region (Regional Partnerships), industry (ANZSIC1) and occupation (ANZSCO4) level.

New workers needed is an estimate of demand for workers to join an industry, occupation or region. In this model, demand comes from growth in employment (as business, government and other employers expand their operations) and the need to replace retirees who leave the workforce.⁵

New workers needed is not an estimate of skills shortage. In the VSA Employment Model, demand is always met by supply of new workers who enter the work force from study, unemployment, migration, a change in industry or occupation, or other avenues.

This means that the VSA Employment Model is not suitable for identifying current or future skill shortages. The Victorian Skills Plan draws on the National Skills Commission's Skills Priority List and stakeholder feedback to identify skills shortages within industries and across Victoria.

⁵ This will generally underestimate demand as it does not account for the need to replace workers who leave a job for other reasons, such as switching occupations or migrating out of Victoria.

Appendix B – Victorian VET pipeline methodology

Enrolment numbers

Sources:

National Centre for Vocational Education Research (NCVER) (2021), Total VET students and courses 2020, available [here](#).

Victorian Department of Education and Training (2022), Funded Course List, available [here](#).

Victorian Department of Education and Training (2022), Funded Skill Set List, available [here](#).

The Victorian VET pipeline table estimates the number of enrolments in each qualification and skillset for the 2020 academic year in Victoria. The NCVER total VET students and courses is used as the dataset. Only courses on the Victorian Funded Course List (FCL) and the Victorian Funded Skill Set List (FSSL) are included.

The following steps were taken to develop the information contained in Table 12:

1. Each course was reviewed by Industry Advisory Group (IAG) members and allocated to only one of three main reasons for studying: to prepare for employment; to support current employment (apprenticeship or traineeship); or to progress their career. Each course is then listed under their respective allocation.
2. The numbers of students who enrolled in that course in 2020 is then noted in the VET pipeline table.
3. Courses that provide **an apprenticeship and traineeship option and a classroom-based option** are duplicated twice in the table, with enrolment numbers split across the other two options: the number of apprentice and trainee enrolments are reported under the header 'with employment (apprenticeship and traineeship)'; the number of classroom-based enrolments is shown under the purpose for completing the classroom-based option (either to prepare for enrolment or to progress their career). An ('AT') is noted next to these duplicated classroom-based courses to indicate they are also delivered as an apprenticeship or traineeship.
4. Where industry has provided feedback on the value of qualification or skill set, a ('Q') indicates it is valued as a qualification, while a ('SS') indicates it is valued as a skillset. A ('EIR') indicates it is an Endorsed Industry Requirement and ('OL') indicates it is an Occupational Licence. Industry has not provided feedback on all qualifications and where indicated; and each value assignment can be reviewed in the future.
5. Numbers are then totalled in their respective headers above. For the Skills Plan, the number of enrolments 'prior to employment' is a key focus for industry as it indicates how many students are being trained but are not yet employed.

The 2020 enrolment figures are a best estimate of the pipeline of workers for industry to draw on. The 2020 figures were the latest dataset available from the NCVER at the time of developing the Skills Plan and will be updated in future iterations of this document. They intend to provide an indication of the pipeline but do not and cannot tell the full story of workforce supply. Factors such as completion rates and the COVID-19 pandemic during 2020 are also likely to impact the availability of the future workforce.

¹ The Victorian Skills Authority's Industry Engagement Framework is the main way for industry, unions and employers to inform and engage with the state's training system. Ten Industry Advisory Groups are an important part of this Framework. Further information can be found on the VSA's website, [here](#).

Appendix C – Stakeholder engagement process

The VSA would like to thank the many stakeholders engaged in the development of this report, who provided their time, expertise and experience to input, test, update and validate the content of the Electricity, Gas, Water and Waste Services Industry Insight Report.

Stakeholders from organisations across government, education and industry were engaged to provide input to the report and the Skills Plan more broadly. Specifically, stakeholders provided insight on economic outlook, workforce and skilling challenges and an education and training response across three rounds of consultations. Engagements guided initial thinking and research, as well as opportunities to test and revise the insights. We would like to thank the following organisations for their participation in the stakeholder engagement process. Table 16 lists the organisations involved.

Table 16 | Consultation participation

Organisation
Air Conditioning and Mechanical Contractors Association
Australian Energy Council
Clean Energy Council
Department of Environment, Land, Water and Planning
Department of Jobs, Precincts and Regions
Department of Premier and Cabinet
Energy Networks Australia
Energy Safe Victoria
Energy Safe Victoria
ETU Vic Branch
Gippsland Institute of TAFE
Gordon Institute of Technical and Further Education
Invest Victoria
Jobs Victoria
National Electrical & Communication Association
National Electrical Switchboard Manufacturers Association
Office of Projects Victoria
Regional Development Victoria
Victorian Building Authority
Victorian Department of Premier and Cabinet

References

- ¹ Australian Bureau of Statistics (ABS) (February 2022), Labour Force Quarterly, Employment by industry (Victoria) available [here](#).
- ² VSA and Nous (2022), modelling of NSC (2022) Employment Projections.
- ³ VSA and Nous (2022), modelling based on Australian Bureau of Statistics, Labour Force, February 2022.
- ⁴ ABS (February 2022), Labour Force Quarterly, Employment by industry (Victoria), available [here](#).
- ⁵ VSA and Nous (2022), modelling of NSC (2022) Employment Projections.
- ⁶ VSA and Nous (2022), modelling based on Australian Bureau of Statistics, Labour Force, February 2022.
- ⁷ ABS (February 2022), Labour Force Quarterly, Employment by industry (Victoria), available [here](#).
- ⁸ Victorian Skills Authority (VSA) and Nous (2022), modelling of National Skills Commission (NSC) (2022) Employment Projections.
- ⁹ VSA and Nous (2022), modelling of NSC (2022) Employment Projections.
- ¹⁰ VSA, Deloitte Access Economics (DAE) and Nous (2022), Retirement projections 2022-2025.
- ¹¹ VSA, Nous (2022), modelling of NSC (2022) Employment Projections.
- ¹² VSA and Nous (2022), modelling of NSC (2022) Employment Projections.
- ¹³ VSA and Nous (2022), modelling based on Australian Bureau of Statistics, Labour Force, February 2022.
- ¹⁴ ABS (2016), Census, Education attainment by industry, Victoria.
- ¹⁵ National Centre for Vocational Education Research (NCVER) (2021), Total VET students and courses 2020, available [here](#).
- ¹⁶ NCVER (2021), Total VET students and courses 2020, available [here](#).
- ¹⁷ Australian Industry and Skills Committee (2022), Construction, available [here](#).
- ¹⁸ ABS (February 2022), Labour Force Quarterly, Employment by industry (Victoria) available [here](#).
- ¹⁹ ABS (February 2022), Labour Force Quarterly, Employment by industry by sex (Victoria) available [here](#).
- ²⁰ ABS (February 2022), Labour Force Quarterly, Employment by industry by age bracket (Victoria) available [here](#).
- ²¹ ABS (2008), Australian and New Zealand Standard Classification (ANZSIC), 2006 (Revision 1.0) Division D – Electricity, Gas, Water and Waste Services, available [here](#).
- ²² ABS (February 2022), Labour Force Quarterly, Employment by industry (Victoria) (Victoria) available [here](#).
- ²³ Australian Energy Market Commission (2022), Changing Generation Mix, Victoria, available [here](#).
- ²⁴ Victorian State Government, Victoria's Climate Change Strategy, available [here](#).
- ²⁵ Australian Energy Market Commission (AEMC) (2022), Changing Generation Mix, Victoria, available [here](#).
- ²⁶ AEMC (2022), Changing Generation Mix, Victoria, available [here](#); EnergyAustralia (2021), 'EnergyAustralia powers ahead with energy transition', 10 March 2021, available [here](#).
- ²⁷ EnergyAustralia (2021), Woorren Energy Storage System project, fact sheet, November 2021, available [here](#).
- ²⁸ Victorian State Government (2022), Department of Environment, Land, Water and Planning, Victorian Government, Renewable Energy Zones, January 2022, available [here](#).
- ²⁹ Victorian State Government (2022), Offshore Wind, Policy Directions Paper, available [here](#).
- ³⁰ Victorian State Government (2022), Offshore Wind, Policy Directions Paper, available [here](#).
- ³¹ Victorian State Government (2021), Solar Victoria, 'Victoria – A Renewable Energy Powerhouse', 26 October 2021, available [here](#).
- ³² Solar Victoria (2022), Solar for Business Program, available [here](#).
- ³³ ABS (February 2022), Labour Force Quarterly, Employment by industry (Victoria) available [here](#).
- ³⁴ AEMC (2022), Gas Supply Chain, available [here](#).
- ³⁵ AEMC (2022), Gas Supply Chain, available [here](#).
- ³⁶ Australian Pipelines and Gas Association (2022), Pipeline Facts and Figures, 2022 – available [here](#).
- ³⁷ Victorian State Government, Engage Victoria (2021), Help Build Victoria's Gas Substitution Roadmap, Consultation Paper, available [here](#).
- ³⁸ Victorian State Government, Engage Victoria (2021), Help Build Victoria's Gas Substitution Roadmap, Consultation Paper, available [here](#).
- ³⁹ ABS (February 2022), Labour Force Quarterly, Employment by industry (Victoria) available [here](#).
- ⁴⁰ AEMC (2022), Gas Supply Chain, available [here](#).
- ⁴¹ Victorian Department of Environment, Land Water and Planning (2022), Water industries and customers, Victorian Water Corporations, available [here](#).
- ⁴² Victorian Department of Environment, Land Water and Planning (2022), Water industries and customers, Victorian Water Corporations, available [here](#).
- ⁴³ Vic Catchments (2022), Our CMA regions, available [here](#).
- ⁴⁴ Victorian Department of Environment, Land, Water and Planning (undated), Target 155, available [here](#).
- ⁴⁵ Melbourne Water (2021), Water, Data and Education, Desalination, 7 September 202, available [here](#).
- ⁴⁶ Victorian Department of Environment, Land, Water and Planning (2021), Managing our water supply and use, available [here](#).
- ⁴⁷ ABS (February 2022), Labour Force Quarterly, Employment by industry (Victoria) available [here](#).
- ⁴⁸ Victorian Auditor-General's Office, Council Waste Management Services, 2 December 2021 – available [here](#).
- ⁴⁹ Victorian Auditor-General's Office, Council Waste Management Services, 2 December 2021 – available [here](#).
- ⁵⁰ Victorian State Government (2021), Building Victoria's circular economy, available [here](#).
- ⁵¹ Victorian State Government (2021), Building Victoria's circular economy, available [here](#).
- ⁵² National Skills Commission employment forecasts, Nous and VSA analysis, April 2022. Numbers have been rounded to the nearest 500.
- ⁵³ PESTLE Analysis (2022), The PESTLE Framework Explained: 6 Important Factors, available [here](#).
- ⁵⁴ Victorian State Government (2021), Solar Victoria, Victoria- A Renewable Energy Powerhouse, October 2021, available [here](#).
- ⁵⁵ Victorian State Government (2022), Department of Environment, Land, Water and Planning, Victorian Government, Renewable Energy Zones, January 2022, available [here](#).
- ⁵⁶ Victorian State Government (2022), Department of Environment, Land, Water and Planning, Victorian Government, Offshore wind energy, November 2021, available [here](#).
- ⁵⁷ Energy Efficiency Council (2020), Victoria's massive energy management investment to drive jobs boom, available [here](#).
- ⁵⁸ Premier of Victoria, The Hon Daniel Andrews (2021), Victorians embracing solar at record levels, Media Release January 2021, available [here](#).
- ⁵⁹ Energy Efficiency Council (2020), Victoria's massive energy management investment to drive jobs boom, available [here](#).
- ⁶⁰ Australian Government, Department of Industry, Science, Energy and Resources (2020), Australian Energy Statistics by state and territory, available [here](#).
- ⁶¹ Skills Plan consultation (2022), Industry forum
- ⁶² Victorian State Government, Department of Environment, Land, Water and Planning (2020), Victorian Renewable Energy Target 2019-20 Progress Report, available [here](#).
- ⁶³ Peacock B, 'Big battery to replace country's dirtiest coal power plant Yallourn, as early closure announced', PV Magazine, March 2021 – available [here](#); EnergyAustralia (2021), EnergyAustralia powers ahead with energy transition, available [here](#).
- ⁶⁴ Australian Energy Market Operator (AEMO) (2022), Integrated system plan, available [here](#).
- ⁶⁵ Australian Industry Standards (2021), Gas Industry Reference Committee, Industry Outlook, 2021, available [here](#).
- ⁶⁶ Alexander, D (2020), Photovoltaic systems, Australian Government YourHome, available [here](#).

- ⁶⁷ Premier of Victoria, The Hon Daniel Andrews (2021), Hydrogen Production Success for World First Project, Media Release 12 March 2021, available [here](#).
- ⁶⁸ Victorian State Government (2021), H2 Victorian Renewable Hydrogen Industry Development Plan, available [here](#).
- ⁶⁹ Victorian Department of Environment, Land, Water and Planning (2021), Commercialisation pathway fund, available [here](#).
- ⁷⁰ Victorian Department of Environment, Land, Water and Planning (2021), Business ready fund, available [here](#).
- ⁷¹ Victorian Department of Education and Training (2022), Projects funded by the Victorian Higher Education State Investment Fund, available [here](#).
- ⁷² Australian Gas Infrastructure Group, About Hydrogen Park Murray Valley, available [here](#).
- ⁷³ Victorian Department of Environment, Land, Water and Planning (2022), Hume hydrogen highway, available [here](#).
- ⁷⁴ Premier of Victoria, The Hon Daniel Andrews (2021), Hydrogen Production Success for World First Project, Press Release 12 March 2021, available [here](#).
- ⁷⁵ Victorian State Government, Engage Victoria (2021), The Draft Water Cycle Climate Change Adaption Action Plan, available [here](#).
- ⁷⁶ Victorian State Government, Engage Victoria (2021), The Draft Water Cycle Climate Change Adaption Action Plan, available [here](#).
- ⁷⁷ Victorian Department of Environment, Land, Water and Planning (2022), Water grid and markets, Desalination, available [here](#).
- ⁷⁸ Australian Department of Agriculture, Water and the Environment (2021), Off-farm Efficiency Program, November 2021, available [here](#).
- ⁷⁹ Water Services Association of Australia and Water Environment & Reuse Foundation (2017), Workforce skills of the future, available [here](#);
Australian Industry Standards (2021), Gas Industry Reference Committee, Industry Outlook, 2021, available [here](#).
- ⁸⁰ Victorian State Government (2021), Strengthening Victoria's waste and recycling industry, October 2021, available [here](#).
- ⁸¹ Australian Associated Press (2020), 'Waste crisis: Victoria offers businesses \$96.5 million to process recycling', 25 February 2020, available [here](#).
- ⁸² Australian Associated Press (2020), 'Victoria to introduce container deposit scheme to tackle recycling crisis', The Guardian, 24 February 2020, available [here](#).
- ⁸³ Australian Government (2021), Department of Agriculture, Water and the Environment, Australian Government, Exports of Waste Plastic, available [here](#).
- ⁸⁴ VSA and Nous (2022), modelling of NSC (2022) Employment Projections.
- ⁸⁵ VSA and Nous (2022), modelling of NSC (2022) Employment Projections.
- ⁸⁶ VSA and Nous (2022), modelling based on Australian Bureau of Statistics, Labour Force, February 2022.
- ⁸⁷ ABS (February 2022), Labour Force Quarterly, Employment by industry (Victoria), available [here](#).
- ⁸⁸ VSA and Nous (2022), modelling of NSC (2022) Employment Projections.
- ⁸⁹ VSA and Nous (2022), modelling based on Australian Bureau of Statistics, Labour Force, February 2022.
- ⁹⁰ ABS (February 2022), Labour Force Quarterly, Employment by industry (Victoria), available [here](#).
- ⁹¹ VSA and Nous (2022), modelling of NSC (2022) Employment Projections.
- ⁹² National Skills Commission (NSA), Nous (2022), VSA analysis, April 2022.
- ⁹³ ACIL Allen Consulting (2019) *Victorian Renewable Energy Transition – Economic Impacts Modelling. Report to Department of Environment, Land, Water and Planning*, August 2019, available [here](#).
- ⁹⁴ Skills Plan Consultation (2022), Government forum.
- ⁹⁵ Skills Plan Consultation (2022), Government forum.
- ⁹⁶ Skills Plan Consultation (2022), Industry forum.
- ⁹⁷ Federation University (2021), APRETC Launch – Training the renewable energy workforce of the future, available [here](#).
- ⁹⁸ Skills Plan Consultation (2022), Industry forum.
- ⁹⁹ Mazengarb, M and Parkinson, G (2021), *Energy Australia to close Yallourn coal plant in 2028, to build massive big battery*, Renew Economy, available [here](#).
- ¹⁰⁰ EnergyAustralia (2021), EnergyAustralia powers ahead with energy transition, available [here](#).
- ¹⁰¹ Australian Energy Market Operator (2020), Integrated System Plan 2020, available [here](#).
- ¹⁰² Clean Energy Council (2020), Renewable Energy Jobs in Australia: Stage One, available [here](#).
- ¹⁰³ VSA and Nous (2022), modelling of NSC (2022) Employment Projections.
- ¹⁰⁴ VSA and Nous (2022), modelling of NSC (2022) Employment Projections.
- ¹⁰⁵ VSA and Nous (2022), modelling based on Australian Bureau of Statistics, Labour Force, February 2022.
- ¹⁰⁶ NSC (2022), What are emerging occupations?, available [here](#).
- ¹⁰⁷ NSC (2022), What are emerging occupations?, available [here](#).
- ¹⁰⁸ Briggs C., Rutovitz J., Jazbec M., Langdon R., Nagrath K., University of Technology Sydney with Infrastructure Australia (2021), Market Capacity for Electricity Generation and Transmission Projects, available [here](#).
- ¹⁰⁹ Public safety, public sector, corrections, water and local government Industry Advisory Group, 10 March 2022.
- ¹¹⁰ Rutovitz, J., Visser, D., Sharpe, S., Taylor, H., Jennings, K., Atherton, A., Briggs, C., Mey, F., Niklas, S., Bos, A., Ferraro, S., Mahmoudi, F., Dwyer, S., Sharp, D., and Mortimer, G. (2021). Developing the future energy workforce. Opportunity assessment for RACE for 2030, available [here](#).
- ¹¹¹ Skills Plan Consultation (2022), Industry forum.
- ¹¹² NSC (2021), Skills Priority List, available [here](#).
- ¹¹³ Skills Plan Consultation (2022), Feedback from Victorian Department of Environment, Land, Water and Planning.
- ¹¹⁴ Skills Plan Consultation (2022), Feedback from Victorian Department of Environment, Land, Water and Planning.
- ¹¹⁵ Rutovitz, J., Visser, D., Sharpe, S., Taylor, H., Jennings, K., Atherton, A., Briggs, C., Mey, F., Niklas, S., Bos, A., Ferraro, S., Mahmoudi, F., Dwyer, S., Sharp, D., and Mortimer, G. (2021). Developing the future energy workforce. Opportunity assessment for RACE for 2030, available [here](#).
- ¹¹⁶ Skills Plan Consultation (2022), Industry forum.
- ¹¹⁷ Skills Plan Consultation (2022), Government forum.
- ¹¹⁸ Skills Plan Consultation (2022), Government forum.
- ¹¹⁹ Skills Plan Consultation (2022), Government forum.
- ¹²⁰ Australian Bureau of Statistics, (2016) Census.
- ¹²¹ Victorian State Government, Department of Education and Training (2022), Funded course list, available [here](#).
- ¹²² Victorian State Government, Department of Education and Training (2022), Funded Skill Set List, available [here](#).
- ¹²³ ABS (2016) Census.
- ¹²⁴ National Skills Commission (NSC) (2021), Skills Priority List, available [here](#).
- ¹²⁵ Department of Education, Skills and Employment (2021), Selected Higher Education Statistics – 2019 Student data, available [here](#).
- ¹²⁶ Energy Safe Victoria (2022), CPD notice 2022, available [here](#).
- ¹²⁷ Victoria Department of Environment, Water, Land and Planning (2020), Have your say – continuing professional development framework, available [here](#).
- ¹²⁸ Victorian Department of Education and Training (2021), Clean economy workforce capacity building fund, available [here](#).