THE FUTURE INDUSTRIAL DECARBONISATION WORKFORCE

A development plan

RACE for 2030

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POWERING AUSTRALIA

ACKNOWLEDGEMENTS

his project received grant funding from the Australian Government through Powering Australia. We gratefully acknowledge the additional support provided by the RACE for 2030 Co-operative Research Centre, and the contribution of time and expertise by the Industry Reference Group and the following organisations and individuals in the development of this material:

- Australian Industry Group
- Caterpillar Energy Power Systems
- Electrical Trades Union
- Energy Skills Queensland
- Fortescue
- Hydrogen Council
- Newcastle University
- Rio Tinto
- Xodus

Their contribution is invaluable, although the conclusions are entirely the responsibility of the authors.

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CITATION

Rutovitz, J., Briggs, C., Feenstra, M., Gerrard, E., Crowley-Shaw, J. & Toakley, J. (2026) *Growing an Australian clean-tech manufacturing workforce for industrial decarbonisation*. Report for Powering Australia and RACE for 2030 CRC.

ACKNOWLEDGMENT OF COUNTRY

Powering Australia wishes to acknowledge the First Nations of Australia and recognise their enduring connection to Country through culture, people, place and story. We honour the knowledge systems that have sustained these lands and waters for thousands of generations and recognise the vital role of First Nations leadership and self-determination in shaping a just and sustainable future. As Australia undergoes a significant clean energy and industrial transition, we acknowledge the importance of respectful partnership, cultural integrity, and shared purpose to realise the full opportunity of the Clean Energy Transition.

PROJECT CONTEXT

Australia is well placed to take advantage of many clean tech opportunities by leveraging its global leadership in critical minerals and renewable energy resources. There are also challenges including a sparse industrial ecosystem, a relatively small workforce, sectoral fragmentation and international competition.

The project aims to contribute to the development of Australia's clean tech manufacturing sector by:

- Growing Australian manufacturing capability in a way that drives exports and ensures domestic energy security.
- Identifying potential skill shortages and priority actions to provide a suitably skilled workforce for clean-tech manufacturing.
- Growing jobs and providing pathways to secure employment for those in priority cohorts or who are transitioning from carbon-intensive industries.
- Accelerating the commercialisation of Australian technologies related to clean-tech manufacturing.
- Accelerating the path to a decarbonised future.
- Delivering better economic outcomes for First Nations communities.

SECTOR COMPETITIVENESS PLANS (SCPS) – CYAN VENTURES AND DELOITTE

Powering Australia has developed sector competitiveness plans (SCPs) that identify the primary opportunities where Australia has competitive advantages to foster clean tech manufacturing across six areas:

1. Renewable Energy Generation
2. Industrial Decarbonisation
3. Transport
4. Electricity Transmission and Distribution
5. Carbon
6. **Opportunities for First Nations businesses and workers across these sectors.**

Each SCP identifies 'anchor opportunities' based on national need and likelihood of success, outlines workforce requirements, and recommends targeted actions to leverage Australia's strengths and build resilient supply chains.

WORKFORCE DEVELOPMENT PLANS (WDPS) – INSTITUTE FOR SUSTAINABLE FUTURES, UNIVERSITY OF TECHNOLOGY SYDNEY

One of the key challenges to building clean tech manufacturing in Australia is developing the workforce amidst widespread skill shortages. Responding to this challenge, Powering Australia has partnered with the RACE for 2030 Cooperative Research Centre and commissioned the Institute for Sustainable Futures at the University of Technology Sydney to develop Workforce Development Plans (WDPs). The WDPs are focused on the anchor opportunities and begin with the workforce requirements identified in the SCP.

Executive summary

The SCP estimates 4,500 direct jobs in 2035 and 1,800 in 2050 under the Current Trajectory scenario, rising to 16,800 in 2035 and 28,000 in 2050 under the Focused Ambition scenario. Workforce growth associated with green aluminium was not quantified.

The fundamental constraint to developing green heavy industry is not workforce but product demand and investment certainty, which at this stage would need to be driven by government. Operating the future facilities is not itself a major concern, as they build on existing chemical and metals manufacturing workforces, with two exceptions: the use of hydrogen in smelting, where operational knowledge is not yet present domestically, and process safety for green iron and aluminium, a current and growing gap. The more acute concern is the workforce for the pathway itself: the construction of greenfield facilities, the electrification of existing processes, and the renewable generation needed to power them, with shortages most challenging at greenfield sites in regions without an existing industrial base.

Underlying this is a tight labour market, with strong wage competition from mining and construction, negative perceptions of manufacturing careers, and low diversity, with women and First Nations people underrepresented despite often being located where facilities will be sited. Meeting the challenge will depend as much on attraction, training capacity and reskilling as on the technology itself: expanding trades training, opening mid-career pathways for an ageing and electrifying workforce, and drawing in the people the sector has historically overlooked.

GROWTH AND WORKFORCE PROJECTIONS

The SCP models two scenarios: a lower bound 'Current Trajectory' scenario and an upper bound 'Focused Ambition' scenario to quantify economic value and employment[1]. The SCP projects 4,500 direct jobs in 2035 and 1,800 jobs in 2050 under the Current Trajectory Scenario. Under the Focused Ambition scenario this increases to 16,800 jobs in 2035 and 28,000 jobs in 2050 (Figure E1). The workforce growth associated with the development of green aluminium was not quantified.

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Introduction

The Clean Tech Manufacturing Workforce Development Plans (WDPs) aim to profile the workforce requirements for fostering a thriving green industrial base, identify possible workforce challenges and solutions, and set the foundations for innovative collaboration between industry, government, education, and training providers to develop a robust workforce.

The WDPs support the ambitions of the Future Made in Australia comprehensive $22.7 billion investment plan, spanning the coming decade and aimed at transforming Australia into a clean energy superpower and strengthening its economic resilience (Australian Government, 2024). Establishing and growing clean tech manufacturing in Australia requires people to build and operate the manufacturing plant, and the advanced skills to design and market those products with a competitive advantage.

The WDPs take the anchor opportunities identified by Powering Australia and the expected demand for labour and look at the key factors that influence workforce development, including the current state of the labour market, the adequacy of the training system, and anticipated technological change.

The current workforce in the most comparable industry is analysed to gain insight in the projected new workers and identify an initial set of in-demand occupations, supplemented by information from stakeholder interviews. The key in-demand occupations of these proxy industries are examined for training and employment pathways and the key trends and challenges shaping workforce demand and workforce supply. Relevant opportunities and initiatives are identified, and recommendations are given for developing the necessary skills.

The work is informed by literature review, stakeholder interviews, and an Industry Reference Group (IRG). ISF conducted nine stakeholder interviews overall, with five focused on the industrial decarbonisation anchor opportunities and three that were cross-sector, working more broadly in clean tech manufacturing and industrial decarbonisation. The conclusions and recommendations are the responsibility of the authors alone.

1. Sector Competitiveness Plans: anchor opportunities for clean tech manufacturing in industrial decarbonisation

The Industrial Decarbonisation Sector Competitiveness Plan (SCP) identified three "anchor" opportunities – areas where Australia is cost-competitive, offers market differentiation, or where local resilience needs to be built due to supply chain risks. These are:

- **Green ammonia** is produced by generating green hydrogen through electrolysis of water using renewable energy, then combining it with nitrogen. Australia's shift from grey ammonia, made with natural gas-based hydrogen, to green ammonia is a competitive opportunity given its abundant renewables and potential for low-cost clean electricity.
- **Green iron** is produced with near zero emissions, for example using green hydrogen as a reductant or electrolysis. This is a competitive opportunity in Australia due to abundant renewable energy resources, potential for low-cost renewable electricity and large domestic reserves of iron ore.
- **Green aluminium** is produced with near zero emissions by using renewable electricity in the smelting process and green alumina refined through similarly low-emission methods as feedstock. Australia is well placed to compete in green aluminium production, with its abundant renewable energy resources, low-cost renewable electricity and large bauxite reserves.

The SCP projects that Australia could be within the top 5 lowest cost regions for producing green ammonia, green iron and green aluminium. Acknowledging that the "anchor" opportunities exist within a wider eco-system of a future green industrial base, the SCP identified 'adjacent value-chain opportunities' and 'wider supply chain ecosystem opportunities.

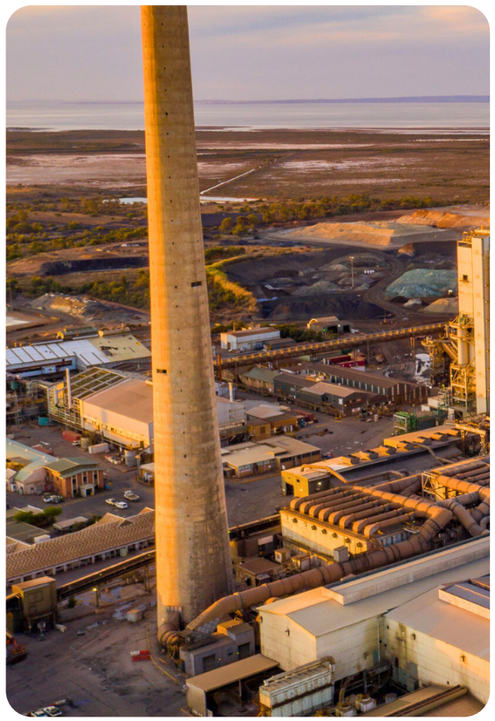


Figure 1: Wider ecosystem opportunities

Anchor opportunities: Specific focus areas within priority value-chains.

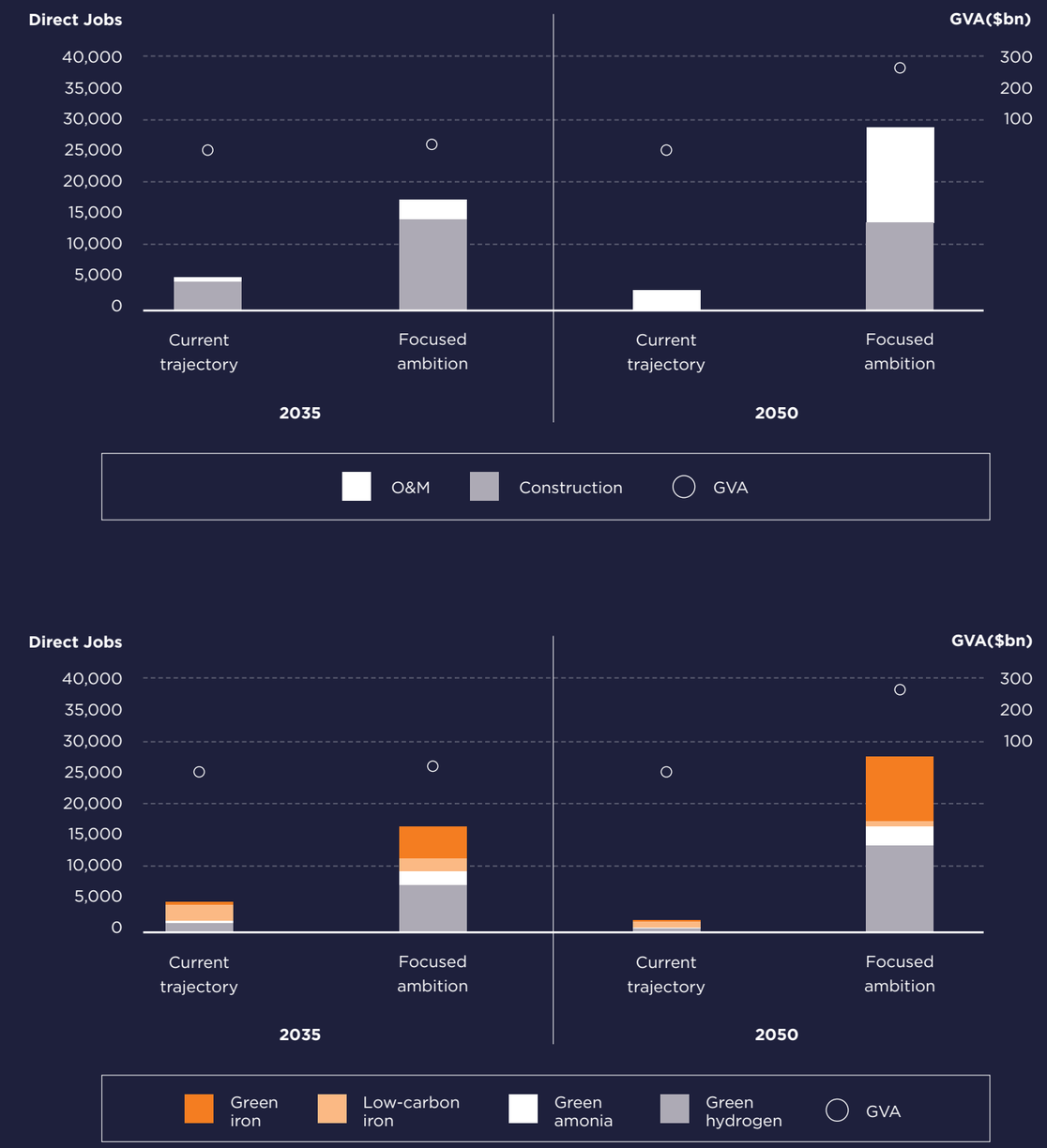
Adjacent value-chain: Complimentary segments up or downstream from the anchor opportunity.

Wider supply-chain ecosystem Supporting services, equipment and feestock that Australia can deliver competitively to support the anchors.

Anchor opportunities	Anchor on significantly large opportunities where Australia can be strongly competitive. This includes: • Green ammonia • Green iron • Green aluminium
Adjacent value-chain	Integrate across established value-chains and grow into new areas to improve competitiveness. This may include: • Partnering with iron ore and bauxite miners • Establishing domestic green steel • Growing steel and aluminium recycling
Wider supply-chain ecosystem	Develop the ecosystem of suppliers, services and innovators to further improve competitiveness and grow the opportunity space, for example: • Commercialising innovations in electrolysers, industrial heat, ESF, electrowinning and ore benefication • Engineering, design and project management, leveraging Australia's strong industrial base • Digital services such as AI and automation to optomise plants

The three green industrial anchor opportunities can generate an additional A$2 billion in GVA by 2035, and A$5 billion in 2050. The Focused Ambition scenario provides an even higher estimate with A$31 billion of in 2035 and A$259 billion in 2050.The SCP projects 4,500 direct jobs in 2035 and just 1,800 jobs in 2050 under the Current Trajectory Scenario. Under the Focused Ambition scenario, these numbers increase to 16,800 jobs in 2035 and 28,000 jobs in 2050 (Figure 2).

Figure 2 Direct jobs and GVA estimated for anchor opportunities in SCP



2. The current construction workforce: green iron, ammonia and hydrogen

There is a common construction workforce to build manufacturing facilities across the Industrial Decarbonisation anchor opportunities in green iron, green ammonia, and green hydrogen, which makes up over 80% of the identified labour demand in both scenarios at 2035 (Figure 2).

The construction workforce disappears by 2050 in the Current Trajectory scenario as there are no new facilities being built. Under the Focused Ambition scenario about 13,000 construction jobs are projected in 2050, very close to the 2035 figure, and total construction workers make up 50% of the projected employment. Green iron and green hydrogen account for the greatest share of the projected construction jobs, with a combined share of more than 85% of the total projected direct employment.

The key features of the current construction workforce structure (Figure 3) are:

- The most in-demand occupations are labourers[8], civil engineers, construction managers, and earthmoving operators.
- Six of the ten most common occupations are in national shortage[9], one in every state except Tasmania, and two are in shortage in at least one state or territory. Only labourers are not in shortage in any state or territory.
- It is a male-dominated workforce, with only an 18% share of women compared to 43% in the general population.
- There is a good geographical spread across the country, with 75% of the workforce located in the eastern states, and 16% in Western Australia.
- The workforce has lower levels of university education and higher levels of VET qualifications compared to the total workforce. There are 27% with a university degree or graduate diploma (49% of total employed persons), and 32% with a VET qualification (19% of total employed persons), and 31% without a tertiary qualification (29% of total employed persons).

This current heavy civil engineering workforce was approximately 106,000 in 2025, up from 63,000 in 2016. The estimated requirements for construction of new manufacturing facilities are small relative to the overall workforce at a maximum of 13,300 in the Focused Ambition scenario (Figure 3). However, there are already three occupations in persistent shortage, and this is likely to worsen without active support policies to increase supply of construction trades.

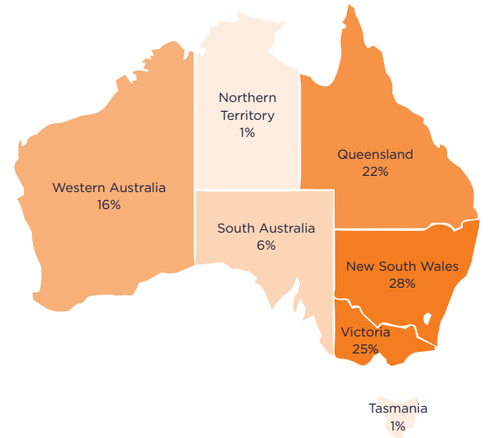
Several stakeholders highlighted the difficulty of getting construction workforces if greenfield sites were to be developed to establish new manufacturing plants. This is particularly acute in regional and remote areas, and would apply if, as has been suggested, there was to be substantial development in the Pilbara. The difficulty in obtaining remote construction workforces, and competing with other construction projects, would be significant. In the case of green ammonia and green hydrogen, the construction workforce to build the required renewable generation infrastructure was particularly highlighted. This is likely to be significantly larger than the workforce to build manufacturing facilities and was identified as a major issue.

In the case of expansion or conversion of existing manufacturing facilities and incumbent operations, as has been suggested as the primary case for the green iron anchor opportunity, construction is not an issue as facilities already exist.

Notes/Sources: 8. This is a combined category, including five codes: building and plumbing labourers, building and plumbing labourers, paving and surfacing labourers, railway track workers, other construction and mining labourers, and other miscellaneous labourers. 9. Construction managers are shown on the chart as being in national shortage; they are in shortage in all states except Tasmania.

Figure 3: Construction workforce for green iron, green NH3, and green H2 (Focused Ambition scenario)

Total workforce by state or territory [2]



Projected growth to 2034 [3]	% Female workforce [2]	% Workforce First Nations [2]
9%	**18%** (43% for general workforce)	**3.3%** (3.3% for general workforce)

Median age [3]	% Workforce aged 24 or below [2]	% Workforce aged 60 and over [2]
39 (39 for general workforce)	**8%**	**10%**

Employment trends [4]

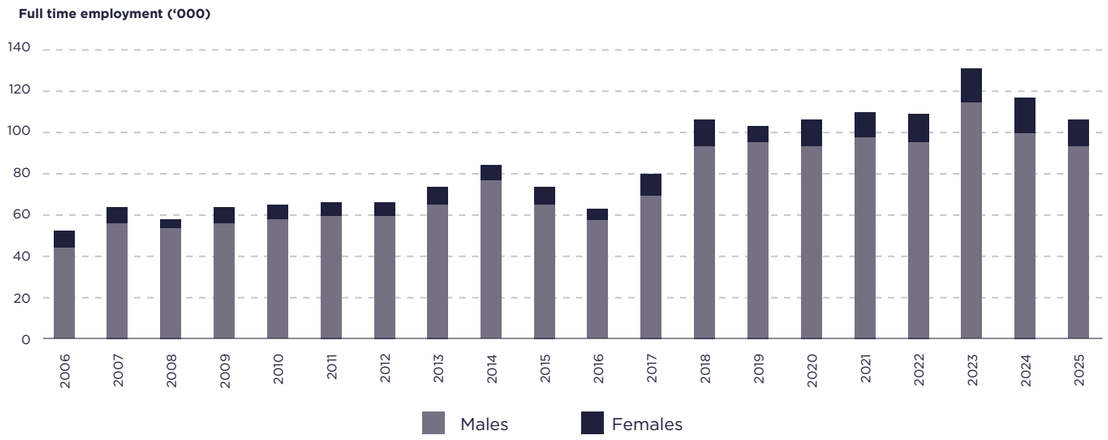
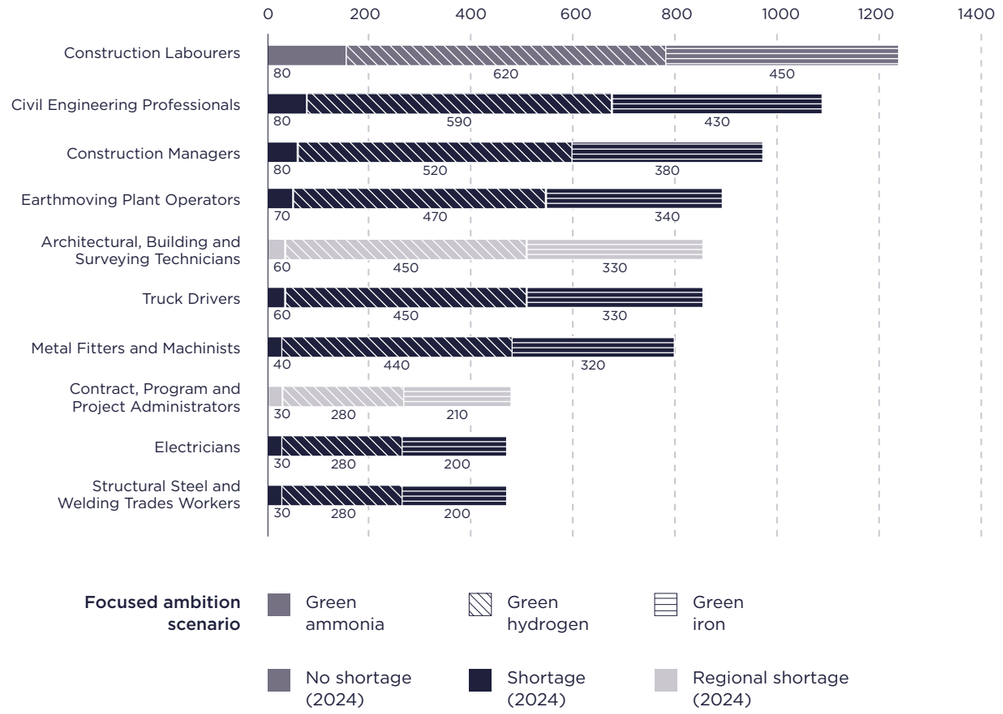
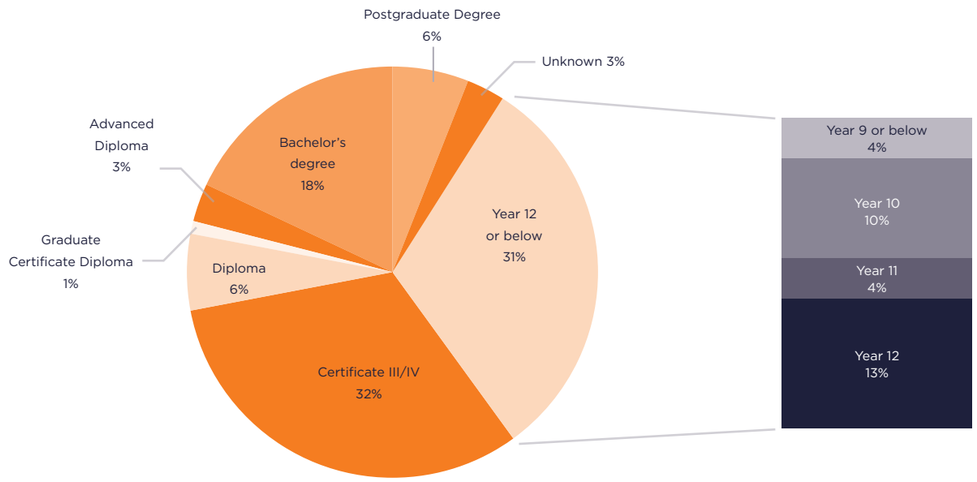


Figure 3: Construction workforce for green iron, green NH3, and green H2 (Focused Ambition scenario)

Top 10 ANZSCO occupations: jobs projected in 2050 (Focused Ambition scenario) [1]



Education level [2]



Sources: [1] Jobs and Skills Australia, Occupation Shortage List, 2025; ABS (2021), Census Table Builder; Cyan Ventures & Deloitte, Industrial Decarbonisation Sector Competitiveness Plan. [2] ABS (2021), Census TableBuilder. [3] Jobs and Skills Australia, Jobs and Skills Atlas, Industry Profiles. [4] ABS, Labour Force, Australia, Detailed, Table EQ06 - Employed persons by Industry group of main job (ANZSIC), Sex, State and Territory, November 1984 onwards (Pivot Table).

3. The current operations and maintenance workforce: green iron, hydrogen and ammonia

Green iron

The basic ferrous metal manufacturing sector is used as a proxy for the nascent green steel/green iron industry, with stakeholders anticipating little change in the skills or occupations required with the exception of process safety roles. The top occupation is sheet metal workers, with employment projected to reach 1,300 by 2050 in the SCP Focused Ambition scenario. Engineering production workers (700), clerical and office support workers (600) and construction, distribution and production managers (500) are also projected to be significant occupations by 2050 in the Focus\ed Ambition scenario.

The basic ferrous metal manufacturing sector is currently predominantly situated along the eastern states, with 38% of the workforce in NSW, 24% in Victoria and 17% in Queensland.

There is projected to be 11% growth in the workforce across the basic ferrous manufacturing industry from May 2024 to 2034[10]. The current workforce has below average diversity, with only 17% of the workforce being female and 1.8% First nations workers, compared to 43% and 3.3% in the general workforce.

The median age for the industry is 44, modestly above the median age for the general population (39). This indicates that an ageing workforce could be a barrier in the future. 9% of the workforce is below the age of 24 and 13% above the age of 60.

The industry has higher levels of VET qualifications, and lower levels of university or diploma qualifications:

- 34% of workers highest qualification is Year 12 or below, compared to 29% for all employed persons
- 37% of workers highest qualification is a Certificate III or Certificate IV (19 % for all employed persons)
- 18% of the workforce completed a diploma or a university degree (49% for all employed persons)

Green hydrogen and green ammonia

The basic chemical manufacturing sector is used as a proxy for the nascent green hydrogen and green ammonia industry, with stakeholders reporting that there would be little change to their current operational workforces who would receive on the job training as needed. The top occupation is clerical and support workers, with employment projected to reach 100 in green ammonia and 60 for green hydrogen by 2050. Construction, distribution and production managers (90 for green ammonia, 60 for green hydrogen), chemical, gas, petroleum and power generation plant operators (90 for green ammonia and 60 for green hydrogen) and sales and marketing professionals (80 for green ammonia and 50 for green hydrogen) are also projected to be significant occupations for the nascent industry by 2050.

The basic chemical manufacturing sector is distributed throughout the country, with New South Wales (32%), Victoria (25%), Western Australia (18%) and Queensland (17%) the leading states.

There is expected to be 19% workforce growth across the basic chemical manufacturing industry from May 2024 to 2034. The current workforce has below average diversity, with only 24% of the workforce being female and 1.6% First nations workers, compared to 43% and 3.3% in the general workforce.

The median age for the industry is 42, above the median age for the general population (39). This indicates that an ageing workforce could be a barrier in the future. 5% of the workforce is below the age of 24 and 12% above the age of 60.

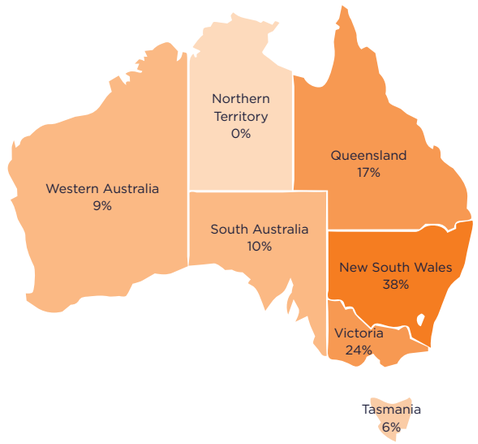
The industry has slightly higher levels of tertiary qualifications than the general working population:

- 26% of workers highest qualification is Year 12 or below, compared to 29% for all employed persons
- 24% of workers highest qualification is a Certificate III or Certificate IV (19% for all employed persons)
- 38% of the workforce completed a diploma or a university degree (49% for all employed persons)

Sources: [10] Jobs and Skills Australia (2025), Jobs and Skills Atlas, Industry Profiles.

Figure 4: Green iron operations and maintenance workforce profile (from current industry)

Total workforce by state or territory



Projected growth to 2034 [3]	% Female workforce [2]	% Workforce First Nations [2]
11%	**17%** (43% for general workforce)	**1.88%** (3.3% for general workforce)

Median age [3]	% Workforce aged 24 or below [2]	% Workforce aged 60 and over [2]
46 (39 for general workforce)	**9%**	**13%**

Employment trends [4]

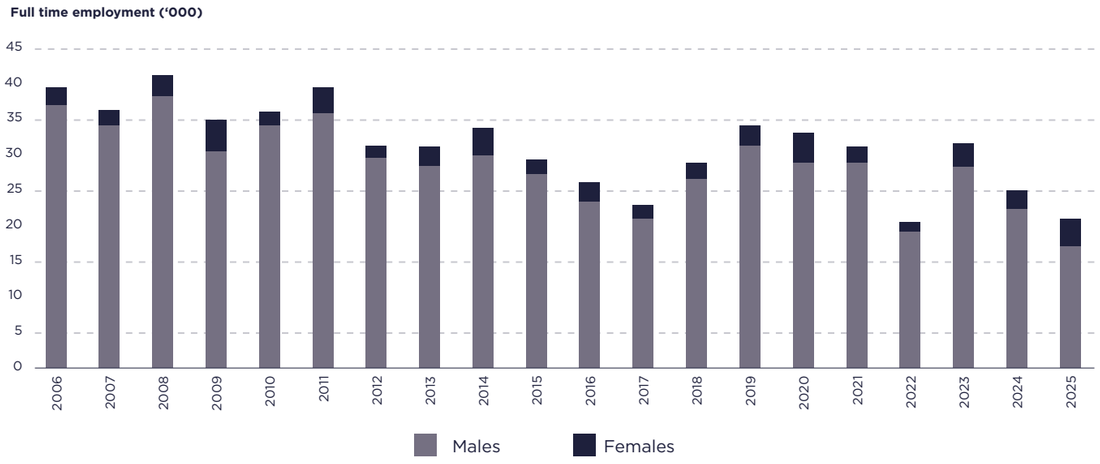
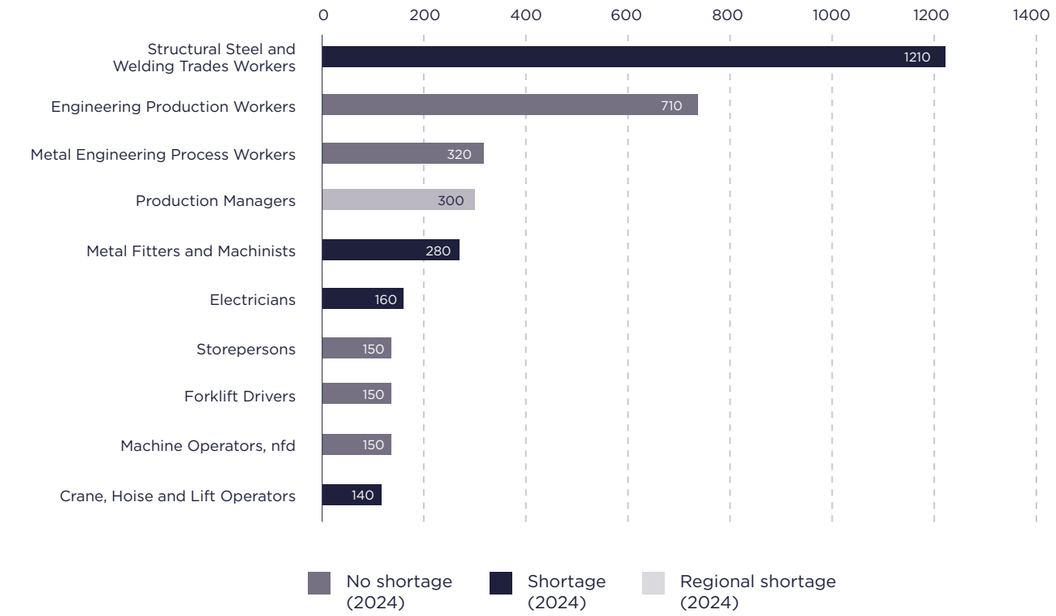
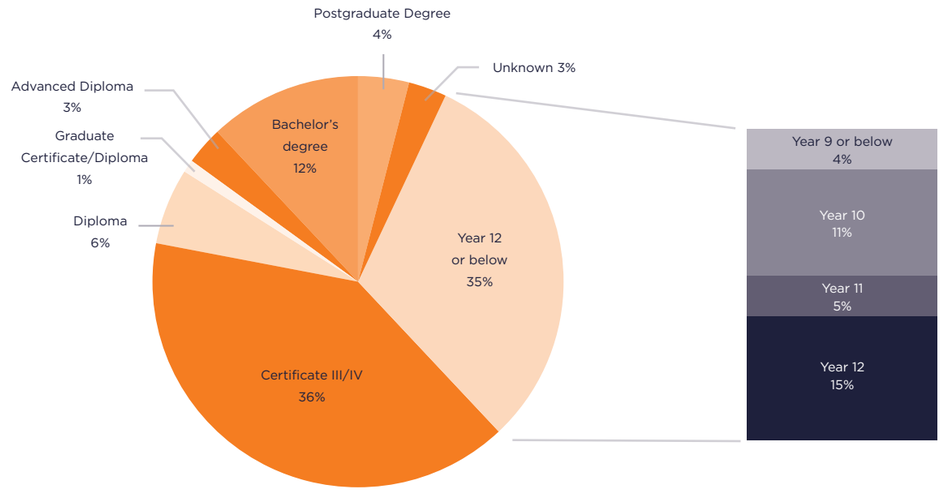


Figure 4: Green iron operations and maintenance workforce profile (from current industry)

Top 10 ANZSCO occupations: jobs projected in 2050 (Focused Ambition scenario) [1]



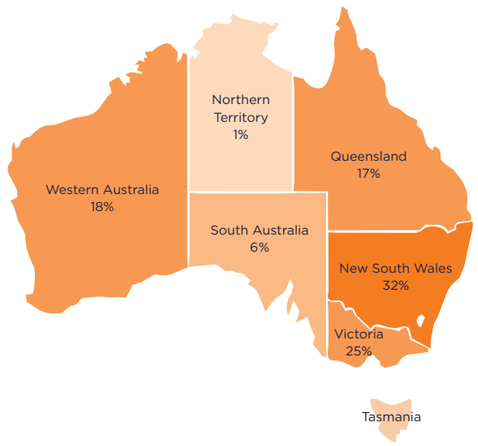
Education level [2]



Sources: [1] Jobs and Skills Australia, Occupation Shortage List, 2025; ABS (2021), Census Table Builder; Cyan Ventures & Deloitte, Industrial Decarbonisation Sector Competitiveness Plan. [2] ABS (2021), Census TableBuilder. [3] Jobs and Skills Australia, Jobs and Skills Atlas, Industry Profiles. [4] ABS, Labour Force, Australia, Detailed, Table EQ06 - Employed persons by Industry group of main job (ANZSIC), Sex, State and Territory, November 1984 onwards (Pivot Table).

Figure 5: Green hydrogen and green ammonia operations and maintenance workforce profile (from current industry)

Total workforce by state or territory [3]



Projected growth to 2034 [4]	% Female workforce [3]	% Workforce First Nations [3]
19%	24% (43% for general workforce)	1.61% (3.3% for general workforce)

Median age [4]	% Workforce aged 24 or below [3]	% Workforce aged 60 and over [3]
42 (39 for general workforce)	5%	12%

Employment trends [5]

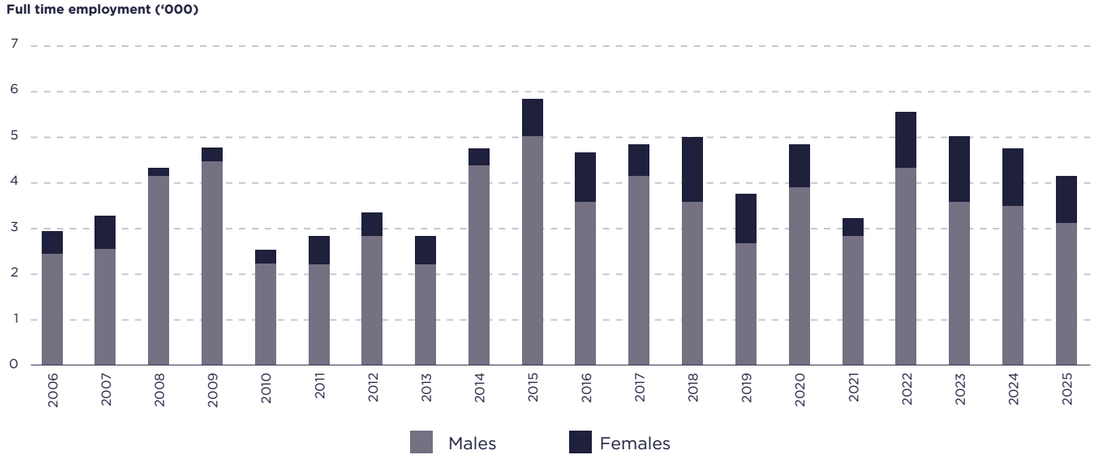
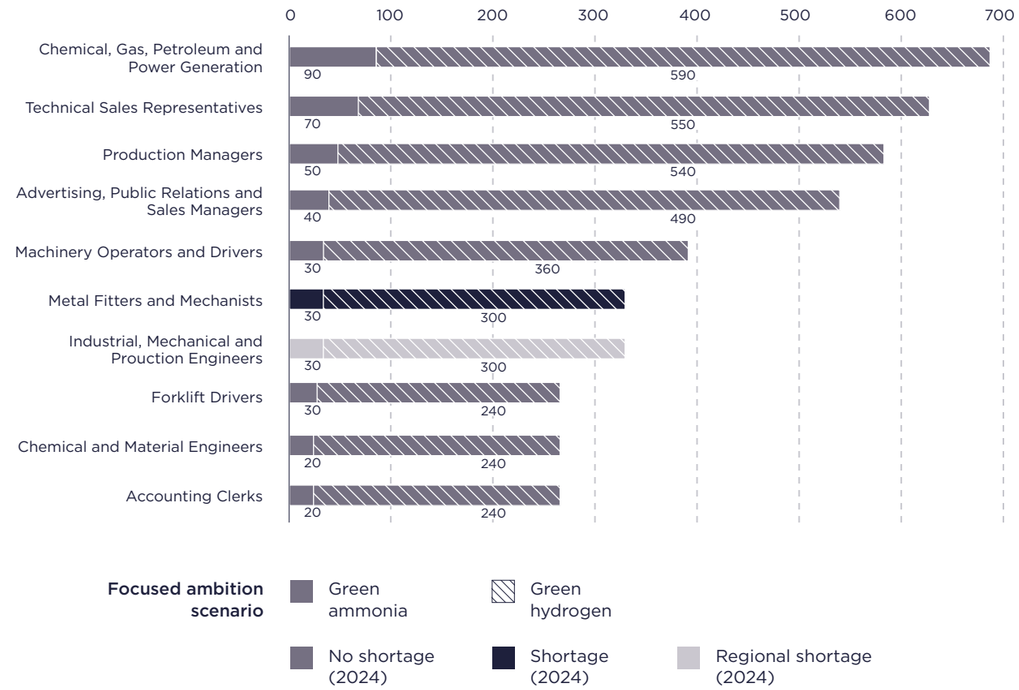
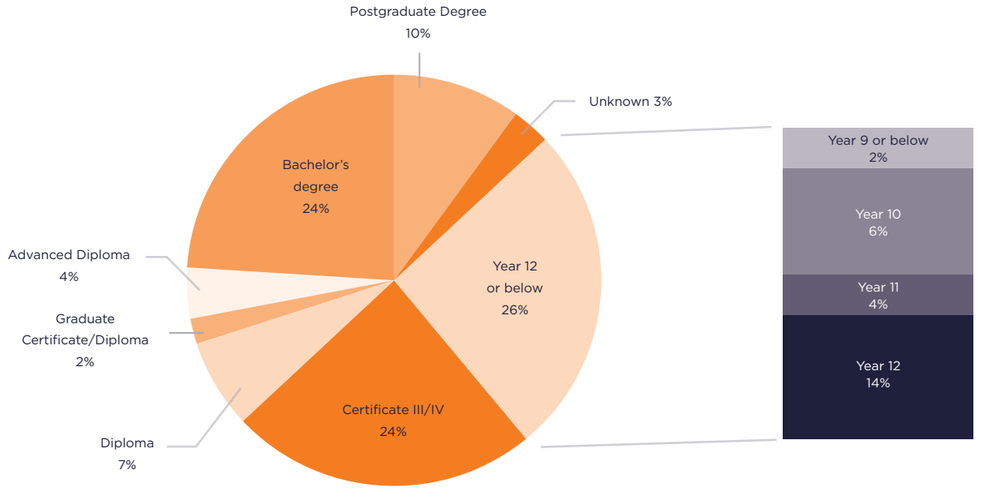


Figure 5: Green hydrogen and green ammonia operations and maintenance workforce profile (from current industry)

Top 10 ANZSCO occupations: jobs projected in 2050 (Focused Ambition scenario) [1,2]



Education level [3]



Sources: [1] Jobs and Skills Australia, Occupation Shortage List, 2025; ABS (2021), Census Table Builder; Cyan Ventures & Deloitte, Industrial Decarbonisation Sector Competitiveness Plan. [2] Cyan Ventures & Deloitte, Transmission Sector Competitiveness Plan. [3] ABS (2021), Census TableBuilder. [4] Jobs and Skills Australia, Jobs and Skills Atlas, Industry Profiles. [5] ABS, Labour Force, Australia, Detailed, Table EQ06 - Employed persons by Industry group of main job (ANZSIC), Sex, State and Territory, November 1984 onwards (Pivot Table).

4. Developing the future workforce: green hydrogen and green ammonia

Key occupations for the operational workforce in green hydrogen and green ammonia are listed in Table 2, based on the current workforce for basic chemical manufacture. The numbers and percentage of each occupation is listed for the current industry workforce, as well as the additional demand for those roles if the Focused Ambition scenario for the development of the anchor opportunities was to be achieved. Two occupations are currently in national shortage: metal fitters and machinists, and structural steel and welding trades workers.

The operational workforce was not seen as a barrier to the development of the industry, rather the lack of demand for products. Stakeholders did not anticipate any significant changes to the composition or skills of the workforce and expected that operations would be handled without problems by expansion of the current chemical manufacture workforce. Training for any additional handling or safety requirements were anticipated to be easily achieved in-house.

The volume of workforce required should the Future Ambition scenario be realised is significant compared to the current basic chemicals workforce, with an increase of just under 80%. For most occupations, the increase is small (1% or less) compared to the growth projected across the economy by Jobs and Skills Australia[11]. The main training and employment pathways for key occupations are shown in Table 1.[12]

Chemical plant operators are the exception, with 28% of the growth by JSA potentially absorbed by the new manufacturing capacity. Machinery operators and drivers would also absorb a high proportion (6%), as would chemical and materials engineers (4%). None of these occupations are currently in shortage.

Table 1 Key occupations and qualifications for green hydrogen, green ammonia and green iron

Occupation	Key training and employment pathways
Chemical, Gas, Petroleum and Power Generation Plant Operators	Cert III incl. at least two years of on-the-job training, or Cert IV (skill level 3) E.g. Cert III in Process Plant Operations.
Production Managers	No formal qualifications, but a cert III in process plant operations or a diploma in process plant technology may be useful. Cert II in Manufacturing Technology is also related[13]. **(regional shortage)**
Metal Fitters and Machinists	Cert III incl. at least two years of on-the-job training, or Cert IV (skill level 3) Cert III in Engineering – Mechanical trade. **(national shortage)**
Industrial, Mechanical and Production Engineers	Bachelor's degree or higher (skill level 1) E.g. Bachelor of Engineering. **(regional shortage)**
Chemical and Materials Engineers	Bachelor's degree or higher (skill level 1) E.g. Bachelor of Engineering. **(regional shortage)**
Structural Steel and Welding Trades Workers	MEM31925 – Cert III in Engineering – Fabrication Trade / welding trade specialisations/ extensive experience.[14] AWCR certification may be useful[15].
Engineering Production Workers	No formal qualifications required, cert II or III in engineering studies may be useful.
Electricians	Certificate III or IV in Electrotechnology or Electrical Trade, often completed as part of an apprenticeship[16]. An electrical license is also required[17].
Metal Engineering Process Workers	No formal qualifications required, cert II or III in engineering studies may be useful.
Engineering Production Workers	Skill Level 4: Cert II or III, or at least one year of relevant experience. engineering studies.

Sources: [11] Employment Projections (May 2025 - May 2035), produced by Victoria University for Jobs and Skills Australia, Table 6. [12] Other building and engineering technicians are not included as the occupational code is non-specific. [13] https://www.yourcareer.gov.au/occupations/133512/manufacturing-production-manager?tab=how-to-become [14] https://www.yourcareer.gov.au/occupations/322313/welder-first-class?tab=how-to-become [15] https://awcr.org.au/about/how-it-works/ [16] https://www.yourcareer.gov.au/occupations/341111/electrician-general?tab=how-to-become [17] https://www.nsw.gov.au/business-and-economy/licences-and-credentials/building-and-trade-licences-and-registrations/electrical

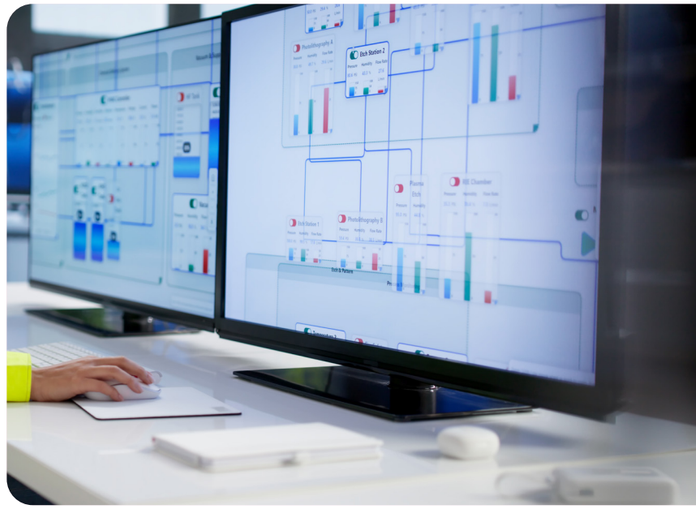


Table 2: Key occupations supply pipeline - green hydrogen and green ammonia

	Current supply and JSA growth projection			Projected growth 2035		Supply pipeline (all industries)		Median age
	Current Volume[18]							
	All Industries	Parent industry[9]	JSA growth projection (2035)[19]	SCP growth projection[20]	SCP demand/ JSA growth	Commencements **Completions**	Net exit/ entry	All Industries, not proxy
Chemical, Gas, Petroleum and Power Generation Plant Operators	9,500	320	+900 (9%)	250	28%	Unknown	65	45
Production Managers	62,200	170	+10,500 (17%)	130	1%	Shortage in NT Net exit/entry unknown		47
Machinery Operators and Drivers[21]	18,300	120	+1,600 (9%)	90	6%	N/A		-
Metal Fitters and Mechanists	123,000	110	+8,900 (7%)	80	1%	National shortage 2,445 (Cert III) 691 (Cert III)	420	38
Industrial, Mechanical and Production Engineers	40,100	100	+9,200 (23%)	80	1%	Shortage in SA, WA and NT Net exit/entry unknown		38
Chemical and Materials Engineers	7,100	80	+1,700 (23%)	70	4%	Shortage in QLD and NT Net exit/entry unknown		36
Other Building and Engineering Technicians	39,400	70	+4,600 (12%)	60	1%	N/A		43
Contract, Program and Project Administrators	164,500	70	+28,500 (17%)	50	0.2%	Shortage in WA, NT		43

Sources: [18] ABS TableBuilder, 2021 Census Population and Housing data [19] Employment Projections (May 2025 - May 2035), produced by Victoria University for Jobs and Skills Australia. Table 6. [20] Growth projection for the Focused Ambition scenario in 2035 [21] This is a composite which groups together four codes Machine and Stationary Plant Operators, nfd, Stationary Plant Operators, nfd, Other Machine Operators, and Machinery Operators and Drivers, nfd.

5. Developing the future workforce – green iron

Key occupations for the operational workforce in green iron are listed in Table 2, based on the current workforce for basic ferrous metal manufacturing. The numbers and percentage of each occupation is listed for the current industry workforce, as well as the additional demand for those roles in 2050 if the Focused Ambition scenario for the development of the anchor opportunities was to be achieved; the SCP does not anticipate any significant operational workforce in 2035.

Four occupations are currently in national shortage: structural steel and welding trades workers, metal fitters and machinists, electricians, and crane, hoist and lift operators, while production managers are in shortage in the NT[22].

The primary barrier to the development of the industry is the lack of demand for product, which was raised by multiple stakeholders. The operational workforce is generally not seen as a barrier to the development of the industry. Stakeholders did not anticipate any significant changes to the composition or skills of the workforce and expected that operations would be handled without problems by expansion of the current metals manufacturing workforce.

The exception was process safety roles for green iron/ hydrogen reduction, which are not found in current operations. These were anticipated to be drawn from the oil and gas industry, and it was anticipated that niche roles such as these would be filled via skilled migration in the first place.

The volume of workforce required in 2050 should the Future Ambition scenario be realised would add 25% to the ferrous metal sector workforce, a relatively modest increase in 25 years. The workforce demand is compared to the current expectations of occupational growth from JSA for 2035. The three most in-demand occupations (structural steel and welding trades, engineering production, and metal engineering process workers) would require significant increased growth for green steel, albeit over a relatively long-time horizon of twenty-five years. For other occupations, the increase is a small proportion (1% or less) compared to the growth projected across the economy[23].

The main training and employment pathways for key occupations are shown in Table 1.

Table 3: Key occupations supply pipeline - green iron

	Current workforce				Projected demand[35]		Supply pipeline (all industries)		Median age
	All Industries	Proxy industry[36]	Shortage status	JSA growth projection (2035)[24]	SCP growth projection for 2050	SCP demand 2050/ JSA growth 2035	Commencements [Completions][27]	Net exit/ entry	All Industries
Structural Steel and Welding Trades Workers	77,200	4,140 (18%)	National shortage	+5,800 (7%)	1,210	21%	30 [20]	280	37
Engineering Production Workers	23,000	2,420 (10%)	No shortage	+2,700 (12%)	710	26%	330 [140]	30	43
Metal Engineering Process Workers	8,000	1,110 (5%)	No shortage	+400 (5%)	320	78%	545 [370]	-155	37
Production Managers	62,200	1,040 (4%)	Shortage in NT	+10,500 (17%)	300	3%	Not applicable	-	47
Metal Fitters and Machinists	123,000	950 (4%)	National shortage	+8,900 (3%)	280	3%	2,445 (Cert III) [691]	420	38
Electricians	194,900	540 (2%)	National shortage	+23,300 (12%)	160	1%	13,085 [7,765]		32
Crane, Hoist and Lift Operators	15,200	480 (2%)	National shortage	+1,200 (8%)	140	40%	40 [25]		46

Sources: [11] Employment Projections (May 2025 - May 2035), produced by Victoria University for Jobs and Skills Australia, Table 6. [12] Other building and engineering technicians are not included as the occupational code is non-specific. [13] https://www.yourcareer.gov.au/occupations/133512/manufacturing-production-manager?tab=how-to-become [14] https://www.yourcareer.gov.au/occupations/322313/welder-first-class?tab=how-to-become [15] https://awcr.org.au/about/how-it-works/ [16] https://www.yourcareer.gov.au/occupations/341111/electrician-general?tab=how-to-become [17] https://www.nsw.gov.au/business-and-economy/licences-and-credentials/building-and-trade-licences-and-registrations/electrical

Notes/Sources: 2: Cyan Ventures & Deloitte, Networks Sector Competitiveness Plan, 2025, Figure B1 and B2, p54. The current industry is described as including cable, transformers, and substations. 3: Combining relevant engineering roles accounts for just under 10% of the workforce.

6. Key findings

The key findings from the desktop analysis and stakeholder engagement are listed below.

1. **Product demand and investment certainty is the fundamental constraint to the development of green heavy industry (ammonia, hydrogen, iron, and aluminium)**
   The key barrier to development was identified strongly as a lack of demand for product and investment certainty, which at this stage would need to be driven by government, either for decarbonisation or energy security and economic resilience imperatives. Regulatory signals and investment certainty are the primary drivers of industrial development, with project timing, skill deployment, and workforce transition all downstream of clear policy signals and/ or financial support for industry development. Workforce planning was not an issue some stakeholders even wanted to discuss because they are focused on demand certainty and clear policy signals to develop the industry.

2. **There were two skill gaps identified for future clean tech manufacturing operations – safety and the use of hydrogen in smelting - but the operational workforce is a secondary issue which was not of major concern to firms interviewed for this study**
   Workforce availability to operate manufacturing facilities is not considered a fundamental constraint. The anchor opportunities in the SCP for green ammonia and green hydrogen would build on existing Australian chemical manufacturing workforces. Firms consider the volume of workforce required to operate facilities to be manageable and that there will be little change required in the existing workforce, with any additional skills gained in-house.

> *'There's nothing fundamentally different in green iron, green ammonia or green aluminium compared to conventional production. These are still chemical and minerals processing operations, meaning much of the existing infrastructure and capability can support the transition' (industrial company 1).*
>
> *'We're currently establishing a pilot green iron plant at (location redacted). Some of the team involved have experience from steel operations on the east coast. They don't see major differences in core skill requirements inside the plant itself, though the technologies used — particularly hydrogen — will influence training needs' (industrial company 2).*

This was broadly similar for green iron and green aluminium, which build on existing metals manufacturing workforces. Each generally also consider there will be potential to supplement internal workforce development with recruitment from other facilities within the regional ecosystems within which they are located.

- The use of hydrogen in smelting. Australia lacks direct experience with first-of-a-kind processes. Large-scale hydrogen-based direct reduced iron and commercial inert anode aluminium smelting involve embedded operational knowledge not yet present in the domestic workforce. These specialist gaps require targeted, transitional knowledge transfer from international partners during commissioning and early operations, but they are narrow and time-limited rather than indicative of a broader capability deficit.
- Process safety role for green iron and green aluminium: there are very high and exacting safety processes and requirements in these facilities. All of the major industrial firms highlighted that process safety skills was a current gap and growing need.

> *'As the hydrogen economy grows, we'll see strong demand for skills in process safety, major hazard management, and assurance. For our hydrogen project, we relied on overseas specialists, including firms with strong experience in process safety. That's a capability that will need to be developed locally' (industrial company 3).'*

It was noted there are staff with these skills in the oil and gas industry which could be a future labour source.

3. **Workforce shortages for the construction of greenfield manufacturing facilities, electrification and industrial decarbonisation and the construction of renewable energy generation to power green hydrogen production or aluminium smelting are acute**
   If workforce development for operating future manufacturing facilities was not of concern, workforce shortages were a major concern for the pathways towards a green industrial sector. Workforce shortages were highlighted for the electrification of current industrial processes, construction of new manufacturing facilities, and the construction of renewable energy generation to power both existing and new facilities.

   For firms with ambitious decarbonisation targets, workforce training, training system capacity and shortages are a pressing issue:

> *For green iron specifically, workforce training is not currently the primary barrier. The decarb program requires far more retraining of existing workers than green iron does … We have a strong understanding of how decarbonisation impacts critical roles across the business. Maintenance roles are front of mind — particularly mechanical fitters, auto electricians, and electricians (industrial company 2).*

   In the case of green hydrogen at scale, the workforce for construction of the associated renewable generation is a major issue.

> *'Securing a permanent operational workforce is comparatively the easier and lower-cost part. The real challenge is the construction workforce needed to deliver these facilities. We're already seeing constraints, with trades like steel fixers and concreters needing to be flown in to meet demand' (industrial company 1).*

   Both cost and timeframes for building new infrastructure are being impacted by wider shortages across heavy infrastructure construction.

   The shortage of construction workers, and the resultant increase in project cost, was also seen as crucially important for delivering the renewable generation needed to power each of the SCP opportunities but is not within the scope of this workforce development plan. These shortages are, in any case, well known.

   The general shortage of construction workers, and electrical workers in particular, increased the difficulty in attracting or retaining electrical maintenance workers, with this shortage especially acute in Western Australia.

4. **Workforce issues will be acute for greenfield sites if these eventuate**
   Brownfield and greenfield industrial decarbonisation present distinct workforce challenges. Brownfield sites require a managed workforce transition, upskilling existing operators to run processes while maintaining current operations. Stakeholders anticipated these to be well within normal practices of in-house training, with the potential to have some additional hiring via skilled migration for key process roles in green iron or green aluminium where there were gaps in local capacity and experience.

   Greenfield developments face a different challenge: attracting and assembling a workforce in regional locations without an existing industrial employer base, where housing, amenity, and training infrastructure must be established alongside the facility itself. These sites will also require construction, with the inherent competition with other infrastructure. Attracting either the temporary construction workforce or the longer-term operational workforce is seen as very challenging, as it is difficult to compete with infrastructure build in metropolitan areas.

   While not within the scope of this workforce development plan, stakeholders highlighted that shortages in service sectors, especially health, to be a significant issue in attracting workers to regional areas in such an overall tight labour market.

5. **The labour market is tight for current operations**
   The manufacturing sector faces tight labour market conditions, strong wage competition from mining and construction, and negative perceptions in relation to long-term manufacturing careers. These factors combine to constrain attraction and retention even where the underlying skills exist in the labour market.

The challenge is not a shortfall in relevant capability but a competition and perception problem that limits how quickly and reliably the sector can increase staff levels.

Low diversity in the industrial workforce is a material supply constraint. Women's participation in heavy industry remains low in most sub-sectors, and First Nations communities, often located in regions where green industrial facilities will be sited, are significantly underrepresented. In a tight labour market, expanding participation among these groups represents one of the largest available opportunities to expand the pool of incoming labour.

6. **Industry voiced concerns about the volume and quality of trade training system**
   There was general agreement among stakeholders that trade training was insufficient in scale to meet industry needs, and that the required scale up was not happening quickly enough. Many expressed concern that trades in general were insufficiently promoted and remarked on the need for attraction campaigns to counter the view these are second best to university education.

   Views on the quality of VET training and industry alignment varied. Some stakeholders considered the problems to be just scale and insufficient training places, while others reported that courses were out of date and lacked specificity for new areas. Concern was expressed about credentials developed outside the accreditation system due to the level of quality control. Large firms have responded by enlarging their in-house apprenticeship programmes, particularly for electrical trades, and noted constraints on the capacity of TAFEs to manage growth.

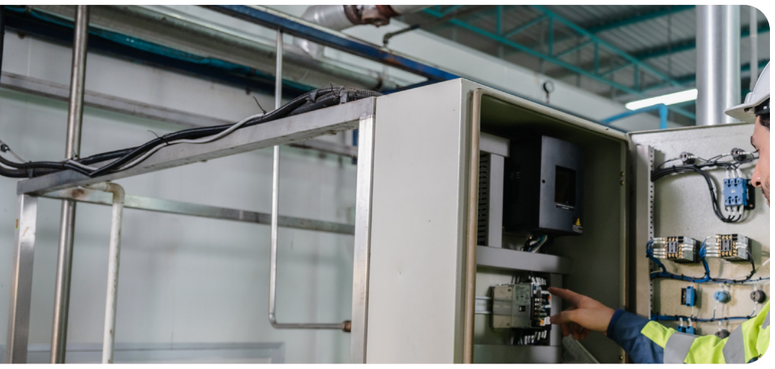
   Stakeholder views on university course alignment were similarly various, although there was general agreement that more attention should be paid to emerging areas such as hydrogen.

7. **Reskilling workers for technology and process changes and mid-career transitions are one of the key challenges to be managed**
   Firms in these sectors are well-established with large workforces that are older on average than the wider workforce. Reskilling the existing workforce is therefore one of the core tasks for workforce development for industrial decarbonisation. There are various contexts in which the challenges for reskilling were identified.

   Both automation and the augmentation of technologies are expected to increase and gradually alter rather than transform workforce composition, but uncertainty remains. For both brownfield and greenfield assets, the general expectation is that automation will shift job profiles incrementally, increasing demand for monitoring, data interpretation, and advanced maintenance, rather than fundamentally changing the skills mix or workforce size. This means workforce planning should prepare for evolution in role content rather than wholesale displacement, while maintaining flexibility to respond if the pace of automation accelerates beyond current projections.

   Mid-career reskilling and transition pathways were highlighted in the context of the broader electrification occurring across heavy industry and a workforce where electrical, electrical-adjacent and digitally enabled maintenance roles are increasingly important. Workforce transitions for mechanical trades to undertake electrical fitting tasks to ease the constraints relating to electricians is an example that was highlighted.

> *The biggest gap is mid career transition. Experienced tradespeople often have to restart a four year apprenticeship to gain electrical licences, with significant pay cuts and no recognition of prior experience. That's not scalable … We need smoother, nationally consistent pathways that recognise existing skills and allow targeted upskilling. Identifying key trades that need transition pathways — and designing those pathways deliberately — would make a significant difference. (industrial company).*



7. Recommendations and actions

Stakeholder interviews and literature were analysed for common barriers, opportunities and policy recommendations. Recommendations covered three main recurring issues: creating the demand drivers to provide a stable industry base, strengthening the workforce supply pipeline, and improving the training system.

One area for policymakers to consider is the very strong feedback from industry that the demand and investment certainty do not currently exist. The grant programs and production tax incentives under FMIA are newly established and there are other complementary policy mechanisms under development or scheduled to come into operation (e.g. renewable energy guarantee of origin). However, stakeholders engaged for this project found do not consider current industry policy settings adequate to drive investment or deliver industry decarbonisation, leaving workforce planning a secondary concern.

Detailed recommendations are not included as industry policy is not within scope but there are strong linkages with workforce development. Clear regulatory signals on decarbonisation pathways are the upstream condition for industry development on which all workforce outcomes depend. Project timing drives employer training investment, worker career decisions, and training provider planning. Regulatory and procurement levers are the most direct mechanisms available to government to ensure that public investment in green industrial facilities simultaneously delivers the suitable workforce.

Investment certainty is a more prominent constraint for industrial decarbonisation than for sectors where project pipelines are already committed. Brownfield conversions are particularly sensitive to policy signals and require long term policy certainty. Operators will not invest in process transformation until regulatory and market settings make the business case clear, and planning horizon may be several decades. Workforce constraints will become material if this wider industrial decarbonisation is to proceed.

Assuming industrial policy will be implemented to deliver decarbonisation, there is a strong imperative to coordinate with workforce policy. Training system activation without project certainty produces trained workers with nowhere to deploy, while project commitment without training system activation risks producing labour shortages.

Procurement linked training requirements and mandatory workforce standards for publicly funded or underwritten projects ensure that skills, trainings, and just transition are embedded in project delivery. This is particularly important given inconsistent application of workforce commitments across different contracting and financing pathways. Key recommendations and actions are outlined below.

Recommendation 1: Ensure any manufacturing facility construction and industrial decarbonisation assisted by public programmes includes provision for training and workforce development.

Rationale: Stakeholder feedback was that overall industry expected building a workforce for operating facilities to be manageable but that workforce shortages in construction of facilities and implementation of major electrification projects were a significant barrier to industrial decarbonisation.

Discussion: Community benefit principles under development for FMIA include a principle for 'developing more skilled and inclusive workforces, including by investing in training and skills development and broadening opportunities for workforce participation'. Examples of activities that could be considered as a 'threshold requirement' for larger projects include hiring plans for local skills and employment, identified targets for labour hours for apprentices, trainees and graduates, and diversity and inclusion plans. The principles state that national targets should apply where relevant which should lead to alignment with the Australian Skills Guarantee.

It is important that these principles are applied to the EPCs that undertake any construction activities through FMIA as this is the key area of the workforce that requires investment.

More broadly, it is important that public policy mechanisms for renewable energy integrate workforce development through firm commitments to training with support from the training system. This has often not been the case with renewable energy generation and is a factor in the skill shortages. Wherever there is public funding, workforce development and training should be incorporated alongside other forms of support. The Australian Skills Guarantee provides benchmarks that should be applied to any FMIA projects.

Training and workforce development should be considered in the implementation of technology grants. Where there are new processes (e.g. DRI operations) there may be scope to develop new units for retraining and upskilling other workers. Demonstration of training and workforce development strategies should be included as an assessment criterion in grants, as is seen more frequently now in renewable energy tenders and auctions.

Actions:

- **1.1 The Department of Industry, Science and Resource review of FMIA's community benefit principles threshold requirements to ensure the scope includes manufacturing facility construction.**
- **1.2 ARENA to apply Australian Skills Guarantee benchmarks for learning workers and diversity to the recipients of FMIA grants**
- **1.3 ARENA to include evaluation of training and workforce development opportunities by the Department of Employment and Workplace Relations and Jobs Skills Councils in FMIA grants**

Recommendation 2: Improve workforce attraction, retention and diversity

Rationale: Tight labour market conditions, strong wage competition from mining and construction, and persistent negative perceptions of industrial careers constrain the sector's ability to recruit and retain workers. There is also limited awareness more generally of manufacturing as a career option among younger Australians. participation in heavy industry remains low and First Nations groups, often located near planned greenfield sites, are significantly underrepresented. Improving diversity is a material workforce supply opportunity, not a marginal equity consideration.

Discussion: Industrial decarbonisation offers a new opportunity and narrative for workforce attraction. Green hydrogen, green ammonia, green steel and green aluminium are clean, high-technology, globally significant industries, and provide an opportunity for a new narrative. Campaigns that lead with this green narrative can shift perceptions more effectively than generic manufacturing promotion. Placed-based outreach is critical as brownfield conversions and greenfield developments are concentrated in regional areas where communities may not yet recognise the opportunities.

Transition pathways from existing heavy industry, mining, and fossil fuel operations are among the fastest routes to workforce readiness. Workers in these sectors hold transferable skills that can be leveraged with targeted bridging and recognition of prior learning where new or additional skills are required. Tools for the identification and measurement of transferable skills should also be enacted.

Participation in heavy industry remains low and First Nations people - often located near planned greenfield sites - are significantly underrepresented. Procurement-linked inclusion targets, funded mentoring, flexible work practices, and co-designed First Nations pathways are proven levers that directly address the lack of diversity. Fortescue has demonstrated what is possible with 37 per cent of apprentices recruited in the last couple of years from First Nations backgrounds. Without deliberate action, the sector will continue to recruit from a narrow pool against strengthening competition. Improving diversity is a material workforce supply opportunity, not a marginal equity consideration.

MISA's Pathways Plus initiative, has identified a range of diversity initiatives established to increase the attraction and retention of women into manufacturing and technician and trades careers (see Appendix Two for a list). The programs and initiatives range from hyper-local through to Australia wide, including initiatives that are industry-led or delivered by not-for-profit organisations. While research shows that most industrial sectors have seen an increase in the proportion of hours worked by females over the past two decades, this is coming from a low base. Compared to other sectors, women's participation is still very low in manufacturing and heavy industry. There does not appear to have been any formal evaluation of the effectiveness of a quite disparate group of initiatives to increasing female participation. It is timely to consider what can be learnt from these initiatives and whether a more cohesive approach can yield better results.

Some other comparable sectors, such as infrastructure construction, mining and increasingly renewable energy – appear more advanced in their approaches. Notably, there are often diversity and female workforce participation targets embedded in either procurement tenders or at the company level. Voluntary and mandatory targets, alongside government and industry funded support programs, creating a mix of 'sticks and carrots' can deliver long-term gains in terms of creating more diverse workforces and widening talent pools in the context of tight labour markets and skills shortages.

Without deliberate action, the sector will continue to recruit from a narrow pool against strengthening competition.

Actions:

- **2.1 Funding for the MISA to scale up the 'Make it Manufacturing' initiative to position industrial careers around innovation, decarbonisation, and sustainability, and roll-out across more sectors, targeting more diverse groups including women and First Nations and place-based outreach in industrial regions.**
- **2.2 Develop structured transition pathways from existing heavy industry, mining, and fossil fuel careers, including skill mapping.**
- **2.3 MISA and DEWR to review existing manufacturing diversity initiatives and co-design a nationally coordinated program with industry to increase the attraction and retention of under-represented groups.**

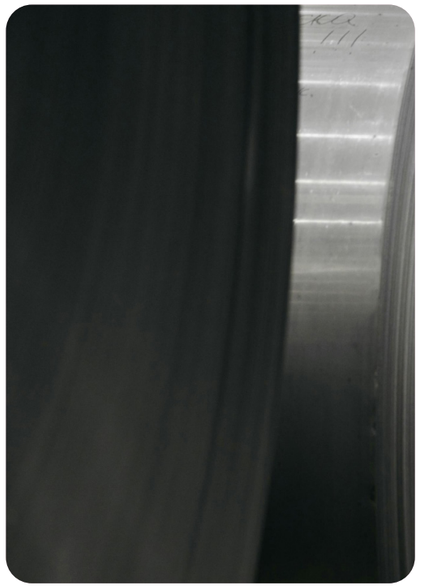
Recommendation 3: Enhance skilled migration pathways

Rationale: skilled migration may be required to ease some skill shortages and where international expertise is required due to first-of-kind, early-stage technology.

Discussion: Stakeholders raised various issues with the current functioning of migration pathways such as delays in processing and working arrangements. Delays in migration pathways for niche occupations where international expertise is required can obstruct the development of Australian industry and increase project costs.

Actions:

- **3.1. Investigate and implement targeted and streamlined skilled migration pathways for first-of-a-kind heavy industry project commissioning expertise with skills transfer for the local workforce**



Recommendation 4: Review units, pathways and pilots to address skills gaps for heavy industry decarbonisation

Rationale: The training system's responsiveness, resourcing and ability to scale is a constraint on skill development for industrial decarbonisation workforce readiness. VET and university curricula do not adequately reflect decarbonised industrial processes and qualification reform cycles are slow.

The tight trade labour force is a constraint on decarbonisation of existing industries, the development of greenfield facilities to manufacture new green products, and the ongoing maintenance of manufacturing facilities. It is hard to address this without a fundamental increase in VET capacity.

Discussion: Higher volumes of apprenticeships are needed to address the technician gap, which could be particularly acute in automated green facilities. Scaling up apprenticeships is the core solution to skills shortages. Various other reports have analysed the causes of apprenticeship shortages and initiatives for scaling. One of the key structural barriers that needs to be addressed is expanding the number and capacity of host employers to take on apprentices. Whilst this can be a challenge for smaller businesses in manufacturing, heavy industry has large businesses with capacity – and indeed industry sources interviewed noted they were being constrained by the training system's resourcing. Developing partnerships and initiatives targeted at large heavy industry employers with capacity to take on apprenticeships is an opportunity to accelerate apprenticeship volumes.

Qualification content is sometimes misaligned to emerging industry practices, with current training too broad and without the process-specific knowledge required for green industrial operations. Reform should be co-designed with industry. Given long lead times and implementation lags, it is prudent to begin this work early.

For the existing workforce, micro-credentials offer a faster response than full qualification reform, enabling brownfield workers to adopt new processes without leaving employment. Establishing micro-credentials and/or skillsets and transition pathways including recognition of prior learning processes for hydrogen safety, electrification and green process operations would enable the sector to draw upon adjacent sectors and upskill its own workforce.

Actions:

- **4.1 Develop initiatives targeted at large heavy industry employers to support their capacity to increase apprenticeship intake**
- **4.2 National Centres of Excellence to support vocational-level curriculum for emerging skills (e.g. skills required to support DRI operations) implemented via funded pilots and innovation grants with industry.**
- **4.3 Investigate initiatives to extend internship programmes to provide work-integrated learning for emerging processes and technologies**
- **4.4 MISA to investigate the development of transition pathways for safety staff from the oil and gas to emerging green heavy industry alongside the development of safety units**

List of tables and figures

Appendix 1: Industry reference group members

Australian Industry Group (AIG)

Mining and Automotive Skills Alliance (AUSMASA)

Powering Skills Organisation (PSO)

Manufacturing Skills Alliance (MISA)

Electrical Trade Union (ETU)

Australian Manufacturing Workers Union

TAFE NSW Net Zero Manufacturing Centres of Excellence

TAFE QLD – Centre of Excellence, Clean Energy Batteries

Department of Training and Workforce Development (WA)
Clean Energy Skills National Centre of Excellence (CESNCE)

Jobs and Skills Australia

Dr Mark Apthorpe

Appendix 2: Diversity programs, manufacturing and energy

Initiative	Who	Type/Detail	Cohort	Region
Busy Sisters Mentoring	BUSY Sisters	BUSY Sisters is a mentoring program that supports women in male-dominated trades by providing support and career guidance.	Women and gender diverse people	Australia-wide
BUSY Sisters, Women In Trades	BUSY Sisters	This program is designed to bridge the gap between female apprentices in male-dominated trades and the businesses that hire them. Male-dominated trades include Mechanics, Engineering, Manufacturing, Construction Trades, Agriculture and more. The program offers mentorship and support to both apprentices and employers.	Women and gender diverse people	Australia-wide
Women In Trades Mentoring Program	Manufacturing Skills Queensland (MSQ)	This program provides intensive support to 100 female apprentices at any stage of their manufacturing apprenticeship. It connects these apprentices with experienced industry-based female and male mentors across the career stages, creating a support network that aids women to navigate the unique tests of working in a male-dominated field. Participants are matched with mentors using a compatibility assessment that considers expertise, location, personality, and learning styles.	Female identifying	Queensland
Women in trades manufacturing toolkit	Manufacturing Skills Queensland (MSQ)	An online resource that equips female manufacturing apprentices and employees with the essential skills they need to thrive in the industry. The aim of this toolkit is to actively support the retention and empowerment of women by assisting female apprentices and employees as they navigate the early stages of their careers in the sector.	Female identifying	Queensland
Girls leading advanced manufacturing	Geelong Manufacturing Council	This program is targeted at Years 9 and 10 and designed to open eyes to the diverse career possibilities within advanced technology, design, and engineering. It engages girls at this critical stage of their education, dispelling outdated myths about the sector, encouraging participants to select the STEM subjects necessary for future professional pathways and trades. Participants attend site visits to leading local manufacturers, job readiness and leadership workshops, and interact directly with industry role models.	Young women	Geelong
Elevate	The Australian Academy of Technological Sciences and Engineering (ATSE)	This program was seed-funded by the Department of Industry, Science and Resources, and awards 500 scholarships to women and non-binary people pursuing STEM studies at university through the course of their whole degrees. It goes beyond financial assistance by providing wraparound support, including significant mentoring, networking opportunities, skills workshops, peer support and access to 24/7 psychosocial and wellbeing support.	Women and Gender Diverse people	Australia-wide
Act on Site, Women's Health Grampians		Women's Health Grampians is transforming local industry through "Act on Site," a workplace gender equity initiative designed for construction and trdes. The program is a fee-for-service consultancy that supports employers to recruit and hold on to a more diverse workforce. It is built on the understanding that increasing female participation requires a fundamental shift in workplace culture not just targets.	Women and Gender Diverse people	Central Highlands, Grampians, and Wimmera regions of Victoria
Women in resources and manufacturing Tasmania awards	The Tasmanian Minerals, Manufacturing and Energy Council (TMEC)	A state-wide recognition program that celebrates the contributions of women across the manufacturing, mining, and energy sectors.	Women	Tasmania
GEMS Program	The Tasmanian Minerals, Manufacturing and Energy Council (TMEC)	This program combines workshops and mentorship to empower women in industry into leadership roles. It is designed for women working in non-traditional roles across the mining, manufacturing, and energy sectors and aims to build the confidence, skills, and networks necessary for career progression	Women	Tasmania
Inclusion habits for operations leaders	The National Association of Women in Operations (NAWO)	NAWO is the leading national network designed to support and empower women working in operational industries, including manufacturing, supply chain, and logistics. A microlearning program to help frontline leaders build inclusive team culture and habits through real-world operational scenarios.	Women	Australia-wide
Mentoring program	The National Association of Women in Operations (NAWO)	A development program run by NAWO that offers one-on-one and group mentoring for women, in addition they also run dedicated allyship training for male leaders.	Women	Australia-wide
Make Tomorrow in Manufacturing	Bara Barang	A co-designed program led by Bara Barang, that supports Aboriginal participants 15-30 years with a unique approach to culture and careers. It focuses on awareness-raising for manufacturing industry occupations, specialist mentoring, support in skill acquisition and career development.	First Nations	Central Coast, NSW
Sistas in Trade	Bamara	Sistas in Trade program is aimed at helping First Nations women kickstart careers in construction, infrastructure and manufacturing. It connects local employers and training organisations to build opportunities for First Nations women.	First Nations Women	Dubbo and surrounds

Table of abbreviations

Name	Abbreviations
Australian Bureau of Statistics	ABS
Artificial Intelligence	AI
Australian and New Zealand Standard Classification of Occupations	ANZSCO
Australian Renewable Energy Agency	ARENA
Direct Reduced Iron	DRI
Engineering Procurement and Construction firms	EPC
Future Made in Australia	FMIA
Group Training Organisation	GTO
Gross Value Added	GVA
Industry Reference Group	IRG
Jobs and Skills Australia	JSA
National Centre for Vocational Education Research	NCVER
Sector Competitiveness Plan	SCP
Science, Technology, Engineering and Mathematics	STEM
University of Technology Sydney / Institute for Sustainable Futures	UTS / ISF
Vocational Education and Training	VET
Workforce Development Plan	WDP