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Interim Research Report:

Hydrogen Industry -

Job Roles, Skills, Qualifications and Experience

Connecting industry with skills

Contents

Foreword by Energy Skills Queensland's Chief Executive Officer, Mr David Cross

As a rapidly emerging opportunity, it understandable that to date, the Hydrogen Industry has centred its measures of success on technological and economic factors. These will remain important as they marshal interest, investment, and growth as efforts continue to create a viable and cost-effective energy alternative; complete with export and domestic applications as well as storage.

Just as critical though, is the human element. These are the skills that drive success and help analyse gaps in knowledge, know-how and identify opportunities for expansion. Whilst some references have been made about skills and workforce requirements within the myriad of strategy documents and conferences around the country, the human element – that is, ensuring the right skills at the right time - has been largely overlooked. Even international research has offered very little in terms of Hydrogen-related career paths or the workforce intelligence that this Industry will need to accelerate its development.

In 2019, Energy Skills Queensland (ESQ) was commissioned by the Just Transition Group to conduct research into the skill requirements of this clean energy opportunity, among others. This work centred on identifying the roles associated with each aspect of each industry, on high level workforce projections, and on key elements of each industry's supply chain. Hydrogen was identified as one of the most prominent, especially given its potential for high employment outcomes - as illustrated in the National as well as Queensland Hydrogen Strategy documents.

The following material provides an excerpt on Hydrogen. It provides perspectives from Industry-experts, capturing their opinions on which roles they believe will most benefit progress. Combined with further desktop research, ESQ has qualified these views and tried to outline the qualification levels needed, and the skills and experience that likely to be needed by prospective employers at this time.

The research is a starting point only. Further research is necessary, as well as Industry-led discussions and forums on capacity needs and detailed capability requirements. Ultimately, we seek a collaborative effort. One that involves all stakeholders, and one that agrees a true national framework for the type of workforce development programs needed to meet demand.

ESQ's *Hydrogen Skills Australia (H2SA)* division, will willingly work with other state and national stakeholders across the country. The goal is to connect Industry with the most suitable and appropriate training available, or if there is a gap, work with them to create the right programs to fill these gaps. Most important, is that these skills must be accepted nation-wide.

We welcome further developments and research in this area.

David Cross
Chief Executive Officer

Introduction

As part of wider research into job roles, skills and supply chain analysis for the renewable energy sector, Energy Skills Queensland (ESQ) conducted research in 2019 into the job roles and functions, skills, experience and qualifications required to grow and sustain the ever-growing Hydrogen industry in Australia.

The research was mainly conducted through consultation with industry experts and collating open sources through desktop research. It revealed that a large-scale Hydrogen production, transport and export industry, will require a mix of new roles - necessitated by the introduction of new technologies, and traditional roles that have been a part of the LNG/CSG industries. These job roles can be categorised as follows:

- Existing trades and disciplines which can be adapted/specialised for the hydrogen sector e.g. Pipeline Technicians;
- Related capabilities e.g. WH&S, Project Management, Financial Analysis; and
- New roles e.g. Fuel Cell Technicians.

In terms of specialist skills that will support the hydrogen industry, new skills in the areas of mechanical engineering, electrical engineering, chemistry and physics will have to be maintained and expanded to meet the growing demand.

To expand on the initial research above, follow up research projects will be required to establish an Australian career map/pathway for the hydrogen industry. This career map will then form the basis for educational and training strategies to ensure specialist skills and knowledge can be acquired in a timely manner as several of these may have a long lead-in time towards competence. To benefit from this research, solutions to the following questions should be sought:

- Which new job roles are envisaged to grow and sustain the Hydrogen sector?
- Which job roles within existing trades and disciplines can be adapted and/or contextualised to transition into the hydrogen industry and what training programs would be required for each?
- What would the role of “white-collar” job roles be to grow and sustain the Hydrogen strategy?
- Would the required skills and knowledge be acquired through accredited training and what other micro-credential type training will be required?
- Would the job profiles of the LNG/CSG workforce be the most suitable to transition into the Hydrogen sector or would there be a need to recruit from other sectors? If so, which sectors would be most impacted?
- What lead times are required to ensure that:
    - the relevant national standards are in place to ‘train the trainers’ who will be responsible for the accreditation of new technicians for the Hydrogen Industry?
    - the necessary numbers of future technicians required for the Hydrogen industry to successfully get off the ground are available when needed?
    - sufficient notice is provided to adequately promote and engage the required number of new or transitioning technicians to successfully support the creation of a viable Hydrogen industry?

Job functions, skills, experience and qualifications

The following table illustrates the job roles that were identified through consultation with industry experts and how they will contribute to the industry:

Job Role	Rationale
Project Manager	Qualified persons are required to oversee the implementation of hydrogen projects from start to finish. This will include all aspects such as financial management to technical expertise.
Process/Industrial Engineer	Process engineers are required throughout the manufacturing process of hydrogen. To optimise the industrial processes, they'll need to understand the unique chemical properties of hydrogen.
Drafter	Drafters will be required to plan and design cost-effective hydrogen production and transfer facilities.
Electrolyser Manufacturing and maintenance	Domestic manufacturing of electrolysers or ancillary equipment (e.g pressure vessels) is an industry and government priority aimed at maximising employment and achieving equipment cost savings. Local maintenance capability will be essential for the efficient operation of the industry.
Fuel Cell Engineer/Technician	The emergence of FCEV will require more technicians to install and maintain fuel cells.
Hydrogen Pipeline Construction	The transportation of hydrogen will require pipelines for both local and potentially regional scale networks. Specialist fabrication skills will be required.
WH&S Experts (Gas industry)	Hydrogen safety is paramount and any safety incidents could impact community confidence in the technology resulting in reputational damage that will stall investments and development.
Financial experts (Business Development function included)	Financial feasibility is critical for the longevity of the hydrogen industry. Financial experts are required to develop the financing arrangements for projects and exports. Business development is required to optimise a variety of hydrogen applications.
Specialist Trainers and Assessors	The Gas Training Package addresses qualifications and knowledge pertaining to Natural Gas and LNP. No specific references are made to Hydrogen.

Publications and job vacancies comparable to these job roles summarised their functions, required skills and qualifications as follows:

Project Manager

Based on BSB61218 - Advanced Diploma of Program Management[1]

- Implement a monitoring, evaluation and reporting program;
- Manage finances;
- Lead and manage organisational change;
- Develop and use emotional intelligence;
- Plan and manage the flexible workforce;
- Enable program execution;
- Manage program delivery;
- Manage program risk;
- Provide leadership for the program; and
- Facilitate stakeholder engagement.

Based on the Institute of Management's Course Outline[2]

- successfully manage projects in oil and gas fields and develop a solid grasp of everyday project management terminology;
- gain a solid underpinning knowledge in support of their current or emerging skills in the application of project management;
- learn how to deliver more certain outcomes to project stakeholders;
- build project management capabilities and understand importance of effective management of a team and stakeholders;
- refine skills in managing scope, time, cost and quality in oil and gas field projects; and
- develop skills for: communicating to influence; creating win-win collaborative relationships; managing conflict and inspiring others to a common purpose and goal.

Based on Job Description[3]

Required Qualifications:

- Bachelor's Degree from an accredited college or university required, preferably in engineering, computer science or a related technical discipline;
- 5+ years of experience in project/program management;
- Strong transversal leadership skills; and
- Strong command of English language.

[1] BSB61218 - Advanced Diploma of Program Management. www.training.gov.au. Accessed 15/07/2019.
[2] Project Management in Oil and Gas Fields. Institute of Management. July 2019.
[3] Senior Project Manager (USA). www.indeed.com Accessed 15 July 2019.

Preferred Qualifications:

- Knowledge of / background in software and expertise in targeted industries such as Industrial Gases & Chemical, Oil & Gas, Energy/Utilities, Asset Monitoring, Discrete, Mining, Advanced Analytics, Remote Monitoring & Diagnostics;
- Prior experience in Project Management, application engineering, sales, field services, commercial finance, contract negotiation and execution; and
- Prior experience with contract services drafting and Statement of Work review – managing technical, commercial and legal terms.

Preferred Competencies:

- Strong project/program management skills along with verbal, written, and presentation skills;
- Strong negotiation and interpersonal skills;
- Strong integrity & demonstrated ability to identify opportunities for growth;
- Highly organized, self-starter and ability to work independently;
- Strong problem-solving skills and decision-making ability; and
- Can work in a matrix organization and influence cross-functionally.

Process/Industrial Engineer

Based on Job Description[4]

Required Qualifications:

Bachelor's Degree in chemical engineering or equivalent.

- Process engineering experience in the refining industry;
- Proven expertise in Hydro-processing. If the candidate doesn't have experience in this area, the candidate must be willing to learn the new technology. Experience in other technology areas, such as Crude and Distillation, Reforming, Alkylation, Solvent De-asphalting, Hydrogen Manufacturing, and/or Amine/Sour Water is also beneficial;
- Demonstrated ability to effectively interface with Operators, Mechanics, Supervisors, and Management to complete projects and tasks on time and on budget to meet the business objectives;
- Proven ability to teach control operators about optimization opportunities and technical issues related to their units;
- Self-motivated with the ability to originate and facilitate the rollout of new ideas;
- Proven ability to step up and take ownership of specific team efforts;
- Proven ability to proactively champion technical issues and see them through to completion;
- Proven ability to handle multiple activities simultaneously;

[4] Senior Process Engineer (Hydroprocessing) in United States. https://au.oilandgasjobsearch.com. Accessed 15 July 2019.

- Demonstrated ability to seek out customer's needs and prioritise own work accordingly;
- Demonstrated good written and oral communication skills;
- Strong ability to work well with other refinery groups in cross-functional teams;
- Demonstrated ability to communicate technical ideas to a wide range of groups within the refinery;
- Demonstrated ability to mentor and teach less experienced engineers engineering principles and the use of process engineering tools;
- Proven ability to lead teams and projects often in high profile situations; and
- Proven ability to plan and organize projects from inception to start up.

Preferred Qualifications:

- A minimum of 10 years of process engineering experience;
- Operations experience in a refinery;
- Experience in one or more of the following areas:
    - Turnaround planning or capital project work;
    - Environmental project impacts and permits;
    - Planning/business side of refinery;
    - Advanced Process Controls; and
    - Process simulation software packages (ProII, ProMax, UniSim, HYSYS).

Drafter

Based on Job Description[5]

Associated Titles:

- Computer-Assisted Design (CAD) and Drafting Technologist;
- Design and Drafting Technologist;
- Engineering Design and Drafting Technologist;
- Mechanical Draftsperson;
- Computer Aided Design (CAD) Operator;
- CAD Specialist;
- Document Controller;
- Piping Designer;
- Civil Engineering Technologist; and
- Process Designer/Technologist.

Certifications:

- Trade certification for draftspersons is available;

[5] Drafting Technologist. www.careersinoilandgas.com Accessed 15 July 2019.

- Certification in engineering design and drafting technology or in a related field through provincial associations of engineering/applied science technologists may be required by employers; and
- A period of supervised work experience, usually two years, is required before certification.

Skills and qualities required for plant layout and piping designs:[6]

- Sufficient knowledge of the process being used including function of each equipment. This information is obtained from the process group in the form of Process Flow Diagrams (PFDs);
- Knowledge of the operating and maintenance procedures used for equipment;

- Common sense and attention to detail;
- Ability to think creatively to solve layout problems and challenges;
- Ability to think and visualize spatial relationships between plant items in three dimensions;
- Ability to effectively use computer tools such as 3D modelling software and pipe stress analysis software;
- Excellent communication skills;
- Ability to function effectively as a member of a multi-disciplinary project team;
- Effectively communicate and resolve layout issues and problems with project management;
- Ability to produce, maintain and update project drawings and documents; and
- Awareness that conscientious, quality effort during the design and engineering phase can shorten project schedules resulting in economic benefits and client goodwill.

Electrolyser Manufacturer

Generalised skills sets and qualifications are available in the areas of fabrication, manufacturing and assembly. The following skills would be relevant in the manufacturing of electrolysis equipment:

At an entry level (Certificate III in Engineering – Fabrication Trade)[7]

Core Units of Competence:

- MEM09002 – Interpret technical drawing;
- MEM11011 – Undertake manual handling;
- MEM12023 – Perform engineering measurements;
- MEM12024 – Perform computations;
- MEM13015 – Work safely and effectively in manufacturing and engineering;
- MEM14006 – Plan work activities;
- MEM16006 – Organise and communicate information;
- MEM16008 – Interact with computing technology;

[6] Introduction to Process Plant Layout and Piping Design. Engineering Institute of Technology. July 2019.
[7] MEM30319 – Certificate II in Engineering – Fabrication Trade. www.training.gov.au Accessed 15 July 2019.

- MEM17003 - Assist in the provision of on-the-job training;
- MEM18001 – Use hand tools;
- MEM18002 – Use power tools/hand-held operations; and
- MSMENV272 – Participate in environmentally sustainable work practices.

Relevant (Elective) Units of Competence from Certificate IV in Process Plant Technology (Not extensive)

- MEM05012C – Perform routine metal arc welding;
- MEM09002B – Interpret technical drawing;
- MEM09003B – Prepare basic engineering drawing;
- MSMBLIC002 – Licence to operate an advanced boiler;
- MSMOPS102 – Perform tasks to support production;
- MSMOPS400 – Optimise process/plant area;
- PMAOPS217 – Operate wet milling equipment;
- PMAOPS223 – Operate and monitor valve systems;
- PMAOPS230 – Monitor, operate and maintain pipeline stations and equipment; and
- UEPOPS319B – Operate and monitor gas production plant.

Fuel Cell Engineers/Technicians

Based on job role description[8]

- Recommend improvements to fuel cell design or performance;
- Perform routine vehicle maintenance procedures, such as part replacements or tune-ups;
- Document or analyse fuel cell test data, using spreadsheets or other computer software;
- Collect or maintain fuel cell test data;
- Calibrate equipment used for fuel cell testing;
- Test fuel cells or fuel cell stacks, using complex electronic equipment;
- Assemble fuel cells or fuel cell stacks according to mechanical or electrical assembly documents or schematics;
- Troubleshoot fuel cell test equipment;
- Order fuel cell testing materials;
- Report results of fuel cell tests;
- Perform routine or preventive maintenance on fuel cell test equipment;
- Build fuel cell prototypes, following engineering specifications;
- Conduct tests or provide technical support for tests of prototype fuel cell engines or thermal management systems;
- Install or test spark ignition (SI) or compression ignition (CI) engines;

[8] Fuel Cell Technician. Job Description – Part 1 – Duties and tasks. https//job-descriptions.careerplanner.com. Accessed 15 July 2019.

- Install, calibrate, or operate emissions analysers, cell assist software, fuelling systems, or air conditioning systems in engine testing systems; and
- Perform electrochemical performance or durability testing of solid oxide fuel cells.

Based on job role description[9]

Key Responsibilities:

- Develop test plans based on a Design Failure Mode and Effect Analysis (DFMEA);
- Collaborate with component owners to develop and refine test methods;
- Identify, source and qualify alternative measurement techniques
- Implement system components in stack testing;
- Support safety audits of new test setups;
- Collaborate with a team of engineers, technicians and technologists to execute a wide variety of tests;
- Analyse data, assess conformity of a design to requirements and prepare appropriate reports and/or presentations to support your findings;
- Present to internal and external customers;
- Work with internal lab equipment support teams to maximize data quality and equipment uptime; and
- Develop alternative methods to boost test team bandwidth, overcome equipment limitations and explore unexpected results.

Qualifications:

- B.Sc. Degree in Engineering Physics, Mechanical, Chemical, Materials, Fuel Cell or related Engineering program with 1 – 5 years of related experience;
- Ability to interpret test data and compare against design objectives;
- Familiarity with engineering tools such as design verification planning, tolerance stack-up, structured problem solving and DFMEA; and
- Strong technical writing skills.

Hydrogen Pipeline Construction

Roles with respect to pipeline construction range from construction labourers to highly qualified Pipeline Engineers.

Based on the job description[10]

Tasks and responsibilities (Senior Pipeline Engineer):

[9] Fuel Cell Test Engineer. www.ballard.com. Accessed 22 July 2019.
[10] Senior Pipeline Engineer. https://au.indeed.com. Accessed 15 July 2019.

- Maintains familiarity with the Contract Scope of Work, monitors scope changes and promptly raises change notification in the Change Management system;
- Prepares pipeline design basis for Front End Engineering Design (FEED) and/or detailed design as applicable;
- Undertakes mechanical design and pipeline stress analysis during FEED and/or detailed design as applicable;
- Prepares specifications for pipeline, tie-in spools & jumpers, risers and appurtenances;
- Prepares Material Take Off (MTO), datasheets, technical requisitions and carry out technical bid evaluation and review of vendor data;
- Develops conceptual layouts based on experience and good offshore engineering practice.
- Develops these through the detail design phase;
- Liaises with the Project Engineer where appropriate and complete progress reports as required;
- Assists in design reviews as required in formalising and actioning outcomes from these meetings;
- Detailed technical review of all documents produced by the Pipeline Design team, ensuring that all single discipline/inter-discipline checks are carried out as per Company procedures;
- Reviews all detailed drawings/ design control report ensuring technical correctness, professional presentation and that fabrication and installation requirements are satisfied;
- Reviews multidiscipline deliverables and vendor data. Provides comments to ensure all interfaces are detailed and clash free;
- Reviews and incorporates comments from clients & other agencies on documents and drawings produced;
- Assists procurement and project engineering personnel in the procurement of line pipe, coatings, risers, jumpers, subsea production equipment (such as wye, tee, manifolds & valves);
- Ensure the designers have sufficient input information for the drawing or model being undertaken;
- Provide technical support to all fabrication related queries and assist on site as required in the resolution of construction difficulties issues arising from design problems, clashes, material shortages etc; and
- Promote a cooperative 'single design group' mentality across all discipline groups involved in the project.

Based on Certificate II in Gas Supply Industry Operations[11]

Core Units of Competence:

- UEGNSG005 – Prepare to work in the gas industry;
- UEGNSG132 – Carry out basic work activities in a gas industry work environment;
- UEGNSG140- Apply environmental policies and procedures in the utilities industries; and
- UEGNSG141 – Apply workplace health and safety regulations, codes and practices in the gas supply industry.

[11] UEG20118 – Certificate II in Gas Supply Industry Operations. www.training.gov.au Accessed15 July 2019.

Elective units related to pipelines:

- RIICCM210D – Install trench support;
- RIICRC208D – Lay pipes;
- UEGNSG134 – Establish a utilities infrastructure work site;
- UEGNSG136 – Carry out transmission pipeline construction work activities;
- UEGNSG219 – Conduct excavations in the utilities industry;
- UEGNSG221 – First on site response to gas pipeline emergencies;
- UEGNSG224 – Construct and lay copper and stainless steel gas distribution pipelines;
- UEGNSG226 - Assist with the construction and laying of gas distribution mains;
- UEGNSG330 - Coat metallic pipelines;
- UEGNSG331 - Establish right of way access for transmission pipeline construction;
- UEGNSG332 - Undertake hydro-testing for transmission pipeline construction;
- UEGNSG333 - Work in proximity of transmission pipeline construction plant and equipment; and
- UEGNSG342 - Maintain pipeline easements.

Work Health & Safety Experts (Gas Industry)

From Jobs board[12]

- Bachelor's Degree required;
- Demonstrated work experience in safety-related positions (including prior Australian oil & gas experience);
- Previous offshore oil and gas experience;
- Knowledge of security processes and procedures;
- Proficient in use of computers and programs such as PowerPoint, Excel, Word and Microsoft Office;
- Read, write, and speak fluent English, as required to function effectively within a project team;
- Demonstrated ability to deliver excellence in project SHE performance; and
- Demonstrated ability to develop successful internal and external working relationships with emphasis on interfacing in a team environment

Based on Diploma of Work Health and Safety[13]

Core Units of Competence:

- BSBWHS502 – Manage effective WHS consultation and participation processes;
- BSBWHS503 – Contribute to the systematic management of WHS risk;
- BSBWHS504 – Manage WHS risks;

[12] HSE Advisor – Oil and Gas – onshore and offshore. www.seek.com.au Accessed 16 July 2019.
[13] BSB51315 – Diploma of Work Health and Safety. www.training.gov.au. Accessed 16 July 2019.

- BSBWHS505 – Investigate WHS incidents; and
- BSBWHS06 – Contribute to developing, implementing and maintaining WHS management systems.

Relevant Elective Units of Competence:

- BSBMGT516 – Facilitate continuous improvement;
- BSBSUS501 - Develop workplace policy and procedures for sustainability;
- BSBWHS408 - Assist with effective WHS management of contractors;
- BSBWHS409 - Assist with workplace monitoring processes;
- BSBWHS410 - Contribute to work-related health and safety measures and initiatives;
- BSBWHS507 – Contribute to managing WHS information systems;
- BSBWHS508 - Manage WHS hazards associated with plant;
- BSBWHS509 - Facilitate the development and use of WHS risk management tools;
- BSBWHS510 - Contribute to implementing emergency procedures;
- PUAWER003B - Manage and monitor workplace emergency procedures, equipment and other resources; and
- TAEDEL401 - Plan, organise and deliver group-based learning.

Financial Experts

From Jobs board[14]

- Bachelor's Degree in Business or related discipline (major in accounting, finance or similar);
- CA or CPA qualified;
- Strong financial and management reporting experience within the Oil & Gas industry;
- Demonstrated experience in managing statutory requirements;
- Sound commercial and business acumen along with the ability to influence;
- Strong knowledge of business processes with a track record of process improvement; and
- Candidates with ASX listed experience within the oil & gas industry will be advantageous.

Based on Advanced Diploma of Financial Planning[15]

Core Units of Competence:

- FNSFPL601 - Provide technical and professional guidance;
- FNSFPL602 - Determine client requirements and expectations for clients with complex needs;
- FNSFPL603 - Provide comprehensive monitoring and ongoing service;
- FNSFPL604 - Develop complex and innovative financial planning strategies;
- FNSFPL605 - Present and negotiate complex and innovative financial plans;

[14] Financial Controller – Oil & Gas company. https://au.indeed.com. Accessed 22 July 2019.
[15] FNS60415 – Advanced Diploma of Financial Planning. www.training.gov.au. Accessed 22 July 2019.

- FNSFPL606 - Implement complex and innovative financial plans; and
- FNSPRM601 - Establish, supervise and monitor practice systems to conform with legislation and regulations.

Specialist Trainers and Assessors

From Jobs board[16]

- Assess training needs and work with leadership to prioritise course development;
- Create and execute project plans to ensure course requirements are met and course development is completed on time;
- Solicit and integrate input from stakeholders and subject matter experts to ensure courses meet business needs;
- Use appropriate instructional and delivery strategies, leveraging technology and distance learning applications when needed to deliver state-of-the-art training;
- Write course design documents, learning objectives, course content, scenarios, media scripts, practice activities, and post tests;
- Create engaging learning activities and compelling course content that enhances retention and transfer; and
- Define, create, and implement assessments that measure training effectiveness.

Qualifications/Requirements:

- Bachelor's Degree from an accredited college or university; and
- Minimum of 3 years of experience developing technical training.

Based on Certificate IV in Training and Assessment[17]

Core Units of Competence:

- TAEASS301 - Contribute to assessment
- TAEASS401 - Plan assessment activities and processes
- TAEASS402 - Assess competence
- TAEASS403 - Participate in assessment validation
- TAEASS502 - Design and develop assessment tools
- TAEDEL401 - Plan, organise and deliver group-based learning
- TAEDEL402 - Plan, organise and facilitate learning in the workplace
- TAEDES401 - Design and develop learning programs
- TAEDES402 - Use training packages and accredited courses to meet client needs
- TAELLN411 - Address adult language, literacy and numeracy skills

[16] Lead Training Specialist. www.rigzone.com. Accessed 22 July 2019.
[17] TAE40116 – Certificate IV in Training and Assessment. www.training.gov.au. Accessed 22 July 2019.

Conclusion

The above information is not intended to be definitive. Rather it is a starting point on which future research projects can build, without having to duplicate research. Skilling workers for the Hydrogen Industry will require incorporating qualifications, skills sets and micro-credentials from various industry sectors and from various Training Packages including Gas, Manufacturing, Automotive, Construction and Business Services, amongst others.

Establishing more precise information on likely workforce demands for the Hydrogen Industry will need to be a priority. It will also evolve as the Industry develops with new technologies and new applications. There is much more to be done.