Engineers: Augmentation analysis (1/2)

Job role	Qualifications, memberships & workplace experiences	Base/current job role	Expected changes to job role from hydrogen activities (i.e. how the job role will be augmented)
Chemical engineer (ANZSCO code: 233111)	• Engineers Australia membership (inc. accredited degree as specified) • Bachelor's Degree or higher in Chemical Engineering • At least five years experience in related projects.	Chemical engineers are expected to design and develop chemical production processes that transform raw materials in a range of contexts. Their work includes designing and preparing specifications for chemical processes, and the construction and planning of chemical plants. They may also be expected to supervise industrial processing and the fabricating of project materials. *Note: This job role is also seen as encapsulating materials sciences engineers and related specialisations.*	• Knowledge of hydrogen's property risks and interactions with various materials will be an expected part of a chemical engineers' work • Embrittlement and crack propagation caused by molecular interaction between steel and hydrogen will influence the materials that chemical engineers select on their project • Business needs to find more efficient methods of storing, transporting and converting hydrogen to other forms or compounds will require chemical engineers to advise others on the relative advantages and disadvantages of hydrogen's various states in terms of calorific and heating content, and its interchangeability with other chemicals (e.g. gases).
Civil engineer (ANZSCO Code: 233211)	• Engineers Australia membership (inc. accredited degree as specified) • Bachelor's Degree or higher in Civil Engineering • At least five years experience in related projects.	Civil engineers oversee the planning, design and construction of large structures such as plants, pipelines, and gas supply schemes. They also examine the operations of these structures, and test their materials for durability and integrity. They are responsible for project management activities, including ensuring activities run according to schedule, cost and labour constraints.	• When planning structures that will house hydrogen and consider their environmental impact, civil engineers will need familiarity with hydrogen's property risks and the various production and storage methods available for hydrogen • Knowledge of high pressure gas systems will be critical to fully account for all safety considerations inherent to working with hydrogen • A familiarity with power electronics may also be needed in hydrogen plant design.
Commissioning engineer (ANZSCO code: 233512)	• Engineers Australia membership (inc. accredited degree as specified) • Bachelor's Degree or higher in an Engineering discipline or Computer Science • At least five years experience in related projects.	Commissioning engineers are those who oversee the installation and testing of equipment near the conclusion of a project. They inspect the functioning of facilities and plants to confirm they meet project specifications and the broader compliance environment. They verify these elements and give final approval to a project.	• Commissioning engineers will need to understand the breadth of production and storage methods for hydrogen, such as electrolysis, steam methane reformation, and in the short term, coal gasification • Liquefaction of hydrogen and storage in this liquefied form will change the material handling systems and processes • They will also need an understanding of high pressure gas systems and vessels, as these are necessary when storing or transporting hydrogen.
Electrical engineer (ANZSCO Code: 233311) Note: We have also used this ANZSCO code for Grid Connection Engineer job roles	• Engineers Australia membership (inc. accredited degree as specified) • Bachelor's Degree or higher in Electrical Engineering • At least five years experience in related projects.	Electrical engineers design and develop equipment and systems necessary for the generation and distribution of electrical power. They oversee the construction, installation and operation of these systems and equipment, and analyse the data arising from them. They may also be responsible for their ongoing maintenance and any problem solving required to ensure optimal performance.	• In some cases, electrical engineers will be expected to work with large high voltage power electronics used to supply energy to hydrogen production plants (e.g. substations, transformers) • In design and planning, electrical engineers will need to recognise the importance of hazardous areas and the danger of ignition sources when designing hydrogen production and storage facilities • Integration of electric vehicle drivetrains with hydrogen fuel cells will also be critical in certain sectors of industry, though this expertise may take some years to fully build within the market given the overseas location of the majority of fuel cell manufacturers.

Engineers: Augmentation analysis (2/2)

Job role	Qualifications, memberships & workplace experiences	Base/current job role	Expected changes to job role from hydrogen activities (i.e. how the job role will be augmented)
Electronics engineer (ANZSCO code: 233411) Note: We have also used this ANZSCO code for integration specialist job roles.	• Engineers Australia membership (inc. accredited degree as specified) • Bachelor's Degree or higher in an Engineering discipline or Information Systems • At least five years experience in related projects • Prior experience with programming languages and automation suites.	Electronics engineers plan, design and monitor equipment that helps maintain manufacturing or operating processes within a set of parameters. They ensure that processes and finished work continuously remains within specifications and, in some instances, may design ways for this monitoring to be undertaken remotely. *Note: This job role is also seen as encapsulating mechatronics and robotics engineers and related specialisations.*	• Electronics engineers will need to factor in hydrogen's specific properties when they design and program control modules that will ensure chemical processes occur safely and efficiently • This programming may also demand integrating specific components from various suppliers who specialise in hydrogen production • They will also need an understanding of high pressure gas systems and vessels, as these are necessary when storing or transporting hydrogen.
Grid connection engineer Note: No ANZSCO code is currently available for this job role. The best match is 233311 – Electrical Engineer	• Engineers Australia membership (inc. accredited degree as specified) • Bachelor's Degree or higher in Electrical Engineering • At least five years' experience in related projects.	Grid connection engineers plan, design and monitor the connection of energy projects with the wider electrical grid in a region. They are responsible for ensuring that the connection is technically feasible, collaborate with national service providers, and undertake network analysis of the generation, transmission and distribution systems.	• Grid connection engineers will need to have an understanding of the power electronics systems that may be used in conjunction with some hydrogen production facilities, but this is typically expected knowledge of the job • Depending on the number of industry participants in their project and the regulatory environment that they operate within, they may also need experience with navigating and managing social considerations to operate for their projects.
Marine engineer (ANZSCO code: 231213) Note: We have also used this ANZSCO code for Marine master/operator job roles	• Certificate III in Maritime Operations (Master up to 24 metres Near Coastal) or higher • Medical health standards for a seagoing career as prescribed by the Australian Maritime Safety Authority • Completion of relevant sea service requirements depending on licence class.	Marine engineers are those who install, operate, and maintain machinery and equipment on ships and vessels. They inspect the functioning of vessels and in some cases undertake servicing activities to correct faults or damage to parts of a vessel.	• Marine engineers will require an understanding of fuel cell technology, how it functions, and what components in the propulsion system may be safely handled for repair • Marine engineers will need an understanding of hydrogen's property risks. Knowledge of hazardous areas is also required when dealing with containment issues (e.g. leakages, crack propagation in materials) • They will also need an understanding of high pressure gas systems and vessels and how they function, as these are necessary when storing or transporting hydrogen.
Mechanical engineer (ANZSCO Code: 233512)	• Engineers Australia membership (inc. accredited degree as specified) • Bachelor's Degree or higher in Mechanical Engineering • At least five years' experience in related projects.	The typical tasks of a mechanical engineer involve designing and planning mechanical products and systems in a range of contexts. They oversee the construction, installation and operation of these components and systems, and analyse the data arising from them. They may also be responsible for their ongoing maintenance and any problem solving required to ensure optimal performance.	• Knowledge of hydrogen's property risks and interactions with various materials will be critical domain knowledge for mechanical engineers designing systems and components • Embrittlement and crack propagation caused by molecular interaction between steel and hydrogen will influence the materials that mechanical engineers select on their project • Understanding hydrogen's flammability and ignition factors will also be important to designing processes safely.

Technicians and tradespersons: Augmentation analysis (1/5)

Job role	Qualifications, memberships & workplace experiences	Base/current job role	Expected changes to job role from hydrogen activities (i.e. how the job role will be augmented)
Automotive electrician (ANZSCO Code: 321111)	• *Certificate IV in Automotive Electrical Technology* • Experience with Original Equipment Manufacturers (OEMs) may be required.	Automotive electricians install, maintain and repair electrical wiring and electronic components in motor vehicles. They dismantle and remove electrical/electronic components and assemblies. They test, repair and replace faulty components, and connect power-operated vehicle equipment and accessories to a power supply.	• They will need a basic understanding of the operations and functions of proton exchange membrane fuel cells, including their limitations and when replacement may be necessary • Automotive electricians will need to work with high voltage systems, including learning how to depower them so that repair or maintenance work can be undertaken • In some cases, automotive electricians may need to have a familiarity of different supplier parts that have been integrated into the electric vehicle's assemblies. This may assist with diagnostic fault-finding and testing.
Automotive electric vehicle technician Note: No ANZSCO code is available for this job role. The best match is 321211 – Motor Mechanic (General)	• *Certificate III in Heavy Commercial Vehicle Mechanical Technology*, *Certificate III in Light Vehicle Mechanical Technology*, or *Certificate III in Automotive Electric Vehicle Technology* • Experience with OEMs may be required.	Automotive electric vehicle technicians are an emerging job role who specialise in maintaining, testing and repairing electrical vehicles and their mechanical systems, such as their transmission, suspension, steering and braking. They may also be expected to work with software and undertake diagnostic activity on vehicles to synthesise and interpret data from a number of electronic systems.	• They will need a basic understanding of the operations and functions of proton exchange membrane fuel cells but also their limitations and when replacement is necessary (e.g. due to the cell's degradation over time) • They will need to work with high voltage systems, including learning how to depower them so that repair or maintenance work can be undertaken • A knowledge of fuel cell cooling systems within the vehicle and how they maintain temperature homogeneity will also be needed.
Control room officer (ANZSCO code: 399213) Note: We have also used this ANZSCO code for the Power production plant operator job role	• *Certificate IV in ESI Generation – Operations* • At least three years post-trade experience in related projects.	Control room officers monitor operations within a power plant to ensure they function as intended. They identify abnormal plant operating conditions and equipment, track and log data for all operational systems, and communicate to other operators recommended changes to improve plant performance, reliability and overall output.	• Control room officers will face little to no change to their responsibilities, as the fundamental tasks and processes of their work will remain unaltered • However, they may need to build domain knowledge in order to understand the interchangeability of hydrogen with other gases (in this case natural gas) and the properties on which it differs, such as its calorific content • They would also need knowledge of hydrogen storage techniques and the risks that come with handling it in its various forms, (e.g. its flammability and high compression when stored as a gas, and the need for low temperatures for storage when it is liquefied).
Electrical fitter (ANZSCO Code: 341111) Note: We have also used this ANZSCO code for Electrician job roles	• *Certificate III in Electrical Fitting* • Electrical Equipment in Hazardous Areas certification • Restricted Electrical Licence in relevant jurisdiction • Occupational Health and Safety white card.	Electrical fitters manufacture, assemble, test, alter and repair electrical equipment, wiring and other components in a plant or machinery context. This equipment is above extra-low voltage and fitters are not authorised to install any electrical wiring systems in accordance with the Australian/New Zealand Wiring Rules. They examine wiring diagrams and specifications and use electrical/electronic equipment to analyse and find faults in systems.	• Electrical fitters will need to build an understanding of the gas trades, as well as hydrogen's unique properties and risks • Depending on the type of plant being constructed, they may need certification to engage with high voltage power electronics (e.g. substations, transformers) • Stakeholder consultations with engineering, procurement and construction firms noted that, given the multidisciplinary nature of hydrogen projects, a mutual understanding of electrical and gas fitting systems is needed.

Technicians and tradespersons: Augmentation analysis (2/5)

Job role	Qualifications, memberships & workplace experiences	Base/current job role	Expected changes to job role from hydrogen activities (i.e. how the job role will be augmented)
Electrical instrumentation technician (ANZSCO Code: 342315)	• *Certificate III in Instrumentation and Control* • Electrical Equipment in Hazardous Areas certification • Occupational Health and Safety white card • Relevant licence depending on state/territory jurisdiction.	Electrical instrumentation technicians examine and test machines, equipment and control systems to diagnose faults. They replace defective parts, install, wire and maintain machines and equipment. They are expected to hold knowledge of electrical, electronic, mechanical and pneumatic systems in undertaking this work.	• Electrical instrumentation technicians will need to be prepared for high pressure gas systems, particularly as hydrogen's lightness poses a risk to small bore tubing and other vessels' ability to keep the gas contained • Installation and inspection of these components will require a high skill level and familiarity with degradation mechanisms, such as vibration, pitting corrosion and chloride induced stress corrosion cracking • A key hydrogen property risk that they will need to consider is hydrogen's ignition sources and flammable areas • In consultation, hydrogen producers noted that Electrical Equipment in Hazardous Areas (EEHA) certification is critical to working with hydrogen.
Electrician (ANZSCO Code: 341111) Note: We have also used this ANZSCO code for Electrical Fitter job roles	• *Certificate III in Instrumentation and Control* • Electrical Equipment in Hazardous Areas certification • Occupational Health and Safety white card • Relevant licence depending on state/territory jurisdiction.	Electricians install, test, connect, commission, maintain and modify electrical equipment, wiring and control systems. They examine wiring diagrams and specifications, connect wire and cable to terminals and connectors, and use electrical/electronic equipment to analyse and find faults in systems. They may also be expected to service and repair some complex electronic circuitry.	• Electricians working on hydrogen production plants may need certification to engage with high voltage power electronics (e.g. substations, transformers) that supply power to electrolysers, for example • They may also need a general understanding of hydrogen fuel cells and their operating principles • A key hydrogen property risk that they will need to consider is hydrogen's ignition sources and flammable areas • In consultation, hydrogen producers noted that EEHA certification is critical to working with hydrogen.
Fitter and turner (ANZSCO Code: 322311)	• *Certificate III in Engineering – Mechanical Trade* • Electrical Equipment in Hazardous Areas certification • Occupational Health and Safety white card • Relevant licence depending on state/territory jurisdiction.	Fitters and turners grind, shape, fit and assemble metal parts to fabricate production machines and other equipment. They check the fabricated parts for conformance to specifications, and determine suitable materials, methods and sequences of operation for these machines. They assemble and fit both plant machinery and vehicle components depending on the configuration of the hydrogen project.	• They will need a basic understanding of hydrogen and its property risks (including its flammability, odour, appearance, and hazardous areas) • They will also need to know the chemical reactions that hydrogen has with steel and other materials, which frequently contributes to pipeline embrittlement and crack propagation. This may influence the materials fitter and turners select in their work • Depending on the type of plant being constructed, they may need knowledge of electrical systems and how those will interface with the plant's processes.
Gas fitter (industrial) (ANZSCO Code: 334114) Note: We have also used this ANZSCO code for Gas Fitter (general) & Gas Industry Operator job roles.	• *Certificate III in Gas Supply Industry Operations* • Electrical Equipment in Hazardous Areas certification • Confined space entry permit • Relevant licence depending on state/territory jurisdiction.	Industrial gas fitters install, maintain and service gas mains, piping systems, and any appliances and ancillary equipment typically in industrial environments upstream of the gas meter, where the gas is used as a fuel or feedstock for another process.	• As most gas fitters in industrial contexts likely already work with high pressure gases, they may only need a basic understanding of hydrogen and its property risks (including its flammability, odour, appearance, and hazardous areas) • While already assumed knowledge in their role, high pressure gas systems and the potential consequences of a loss of gas containment are critical to safe work in this job role • They will also need to know the chemical reactions that hydrogen has with steel and other materials to maintain containment, given that reactions contribute to pipeline embrittlement and crack propagation.

Technicians and tradespersons: Augmentation analysis (3/5)

Job role	Qualifications, memberships & workplace experiences	Base/current job role	Expected changes to job role from hydrogen activities (i.e. how the job role will be augmented)
Gas fitter (general) (ANZSCO Code: 334114) Note: We have also used this ANZSCO code for Gas Fitter (general) & Gas Industry Operator job roles.	• *Certificate III in Gas Fitting* • Electrical Equipment in Hazardous Areas certification • Confined space entry permit • Relevant licence depending on state/territory jurisdiction.	Gas fitters install, maintain and repair gas mains, piping systems, and any appliances and ancillary equipment associated with the use of fuel gases, including liquefied petroleum gas systems. They also install gas appliances and any pressure regulating devices.	• They will need a basic understanding of hydrogen and its property risks (including its flammability, odour, appearance, and hazardous areas) • They will also need to know the chemical reactions that hydrogen has with steel and other materials to maintain containment, given that reactions contribute to pipeline embrittlement and crack propagation • Consultation noted that fitters may need retraining to work with differences in the fundamental materials and larger sizing of pipes utilising hydrogen • Knowledge of how electrical systems work would assist gas fitters in understanding the hydrogen appliances that may arrive in the market in the near future (e.g. LAVO appliances).
Gas industry operator (ANZSCO Code: 334114) Note: We have also used this ANZSCO code for Gas Fitter (general & industrial) job roles. This role amalgamates a number of identified occupations, including gas distribution officer, gas transmission officer, mains layer, service layer, and pipe layer.	• *Certificate III in Gas Industry Supply Operations* • Electrical Equipment in Hazardous Areas certification • Confined space entry permit • Relevant licence depending on state/territory jurisdiction.	Gas industry operators coordinate the distribution and transmission of gas by undertaking repair, maintenance and commissioning/decommissioning work on gas pipelines. They review components and materials to specifications and may seal cracks to repair pipelines.	• Gas industry operators will need a basic understanding of hydrogen and its property risks (including its flammability, odour, appearance, and hazardous areas), as well as the faults that may arise from hydrogen's chemical reactions with steel (e.g. embrittlement and crack propagation) • Given that hydrogen gas appliances occasionally interface with electrical systems, consultations noted that an awareness of both low and high voltage systems would be necessary as well.
Heavy duty fitter (ANZSCO code: 323211)	• *Certificate III in Heavy Commercial Vehicle Mechanical Technology*, *Certificate III in Mobile Plant Technology*, or *Certificate III in Engineering – Fixed or Mobile Plant Mechanic* with at least two years of on the job experience • Experience with OEMs may be required • Hazardous Area Certification may be required.	Heavy duty fitters fit and assemble metal parts and subassemblies to heavy vehicles and plant equipment (e.g. trucks, buses, some earthmoving equipment). They assemble these parts to form large pieces of equipment, fit them using precision measuring instruments, diagnose faults, and undertake operational maintenance of this equipment. In some workplaces, they may also be expected to service power generation units utilising hydrogen.	• Hydrogen fuel cell electric vehicles utilise compressed gas tanks of hydrogen to hold the fuel. Heavy duty fitters will need an understanding of high pressure gas vessels and how these systems work in order to operate safely around these vehicles • An understanding of hydrogen's hazardous areas and potential ignition sources will be critical if the fitter undertakes any work with electrical equipment • In consultation, hydrogen transport fuel operators noted fitters with previous experience working with hydraulic systems (e.g. experience working in the oil and gas industries) would be well suited in the transition to working with hydrogen.

Technicians and tradespersons: Augmentation analysis (4/5)

Job role	Qualifications, memberships & workplace experiences	Base/current job role	Expected changes to job role from hydrogen activities (i.e. how the job role will be augmented)
Light vehicle technician (ANZSCO Code: 321211) Note: We have also used this ANZSCO code for Automotive electric vehicle technician job roles	• *Certificate III in Light Vehicle Mechanical Technology* with at least two years of on the job experience • Experience with OEMs may be required.	Light vehicle technicians maintain, test and repair engines and the mechanical parts of lightweight motor vehicles (e.g. commercial passenger cars, motorcycles), such as their transmission, suspension, steering and braking systems. They diagnose and repair mechanical and electrical faults in vehicles, undertake scheduled maintenance checks, and undertake some electronic testing of vehicle systems with the assistance of computers.	• Automotive light vehicle technicians will need a basic understanding of the operations and functions of proton exchange membrane fuel cells and the differences they present in comparison to vehicles with internal combustion engines • They may generally need to develop problem-solving and analytical skills to diagnose some of the unique electrical faults that arise with fuel cells • They will need to safely work with high voltage systems, including learning how to depower them so that any further repair or maintenance work can be undertaken.
Heavy vehicle technician (ANZSCO Code: 321212)	• *Certificate III in Heavy Commercial Vehicle Mechanical Technology*, *Certificate III in Mobile Plant Technology*, or *Certificate III in Engineering – Fixed or Mobile Plant Mechanic* with at least two years of on the job experience • Experience with OEMs may be required.	Heavy vehicle technicians maintain, test and repair heavy vehicles and their mechanical systems, such as their transmission, suspension, steering and braking. Heavy vehicles include trucks, coaches and buses. Technicians diagnose and repair mechanical and electrical faults in vehicles, undertake scheduled maintenance checks, and undertake some electronic testing of vehicle systems with the assistance of computers.	• Heavy vehicle technicians will need a basic understanding of the operations and functions of proton exchange membrane fuel cells and the differences they present in comparison to vehicles with internal combustion engines • They may generally need to develop problem-solving and analytical skills to diagnose some of the unique electrical faults that arise with fuel cells, and issues that may arise with built-for-purpose vehicle components (e.g. fuel connectors) • They will need to safely work with high voltage systems, including learning how to depower them so that repairs or maintenance work can be undertaken • Knowledge of cryogenics may be required as heavy vehicles may also require additional cooling systems.
Process control technician (ANZSCO Code: 312412)	• *Diploma of Instrumentation and Control Engineering* or a Bachelor's Degree in a related Engineering discipline or Information Systems • Up to five years experience in related projects.	Process control technicians conduct tests of electronic systems, collect and analyse data and assemble circuitry. They may support electronics engineers in their work. They develop, construct, test and maintain electronic equipment on the site.	• They will need a basic understanding of hydrogen and its property risks (including its flammability, odour, appearance, and hazardous areas), as these will affect their programming of control modules and how they moderate its chemical processes • They will also need an understanding of the interchangeability of hydrogen with other gases in terms of its heating and calorific value, and what processes result in these transformations.
Refuelling technician (ANZSCO Code: 399212)	• *Certificate III in Gas Industry Supply Operations* • Up to five years experience in related projects in gas or oil processing.	Refuelling technicians operate equipment to pump gas from storage tanks to gas vehicles. They set automated operating controls, inspect equipment for malfunctions and arrange for maintenance, and control records of production, including quantities transferred and other operational details.	• They will need a basic understanding of hydrogen and its property risks (including its flammability, odour, appearance, and hazardous areas), as these will affect how they operate the control modules and components that moderate its chemical processes • They will also need a recognition of the high pressure gas vessels that transport and hold hydrogen as well as the faults that may arise from hydrogen reactions with steel (e.g. embrittlement and crack propagation).

Technicians and tradespersons: Augmentation analysis (5/5)

Job role	Qualifications, memberships & workplace experiences	Base/current job role	Expected changes to job role from hydrogen activities (i.e. how the job role will be augmented)
Plumber (ANZSCO Code: 334111)	• *Certificate III in Plumbing* alongside two years of the on-the-job experience • Confined space entry permit • Relevant licence depending on state/territory jurisdiction.	Plumbers install and repair water, drainage, gas and sewerage pipes and systems. They study blueprints and technical drawings to determine the layout of plumbing systems and the required materials and design of water supply systems and pipes, and install sewage and effluent pumping systems.	• Plumbers will need a basic understanding of hydrogen and its property risks (including its flammability, odour, appearance, and hazardous areas), as well as the faults that may arise from hydrogen's chemical reactions with steel (e.g. embrittlement and crack propagation) • Plumbers will also need familiarity with the different materials used in hydrogen piping, such as high-density polyethylene.
Vehicle body repair technician (ANZSCO Code: 324111)	• *Certificate III in Automotive Vehicle Body Repair Technology* with at least two years of on the job experience • Experience with individual OEMs may be required.	Vehicle body repair technicians repair damage to motor vehicle bodies, fit and replace interior trim, and paint vehicles. Vehicle body repair technicians may also be expected to construct new purpose-built bodies for vehicles, and to use mechanical and hydraulic equipment in order to remove, replace and repair damaged panels and parts.	• Vehicle body repair technicians will need a basic understanding of the operations and functions of fuel cell powertrains and the different components they present compared to vehicles with internal combustion engines • They will generally need to safely work with high voltage systems, including learning how to depower them so that repairs or maintenance work can be undertaken. • They will also need to be familiar with gas systems and the work health and safety procedures required in their workshops to work around gases.
Welder (ANZSCO Code: 322313)	• *Certificate IV in ESI Generation Maintenance (Fabrication)* or *Certificate III in Engineering – Fabrication Trade* • Electrical Equipment in Hazardous Areas certification • Confined space entry permit • Occupational health and safety white card.	Welders assemble, weld and repair pressure vessels and pipes to relevant standards. They shape and bend metal sections with machine and hand tools, cut metal sections and shapes with flame and machine tools, and finish products through cleaning with acidic solutions.	• They will need a basic understanding of hydrogen and its property risks (including its flammability, odour, appearance, and hazardous areas) • They will also need to know the chemical reactions that hydrogen has with steel and other materials to maintain containment, given that reactions contribute to pipeline embrittlement and crack propagation. For this reason, welders will most likely be expected to work with materials such as stainless steel or high density polyurethane.

Specialists: Augmentation analysis (1/2)

Job role	Qualifications, memberships & workplace experiences	Base/current job role	Expected changes to job role from hydrogen activities (i.e. how the job role will be augmented)
Fuel cell fabrication and testing technician Note: No ANZSCO code is currently available for this job role. The best match is 312312 – Electrical Engineering Technician	• Bachelor's Degree or higher in Mechanical or Chemical Engineering, *Advanced Diploma of Manufacturing Technology* or *Advanced Diploma of Engineering*.	Hydrogen fuel cell fabrication and testing technicians specialise in the installation, operation and maintenance of fuel cells or their prototypes and the equipment used to test them. They test fuel cells for degradation and may fabricate the metal casing that is used to house the cell within the vehicle or plant.	• Fuel cell fabrication and testing technicians will need to understand the operations and functions of proton exchange membrane and alkaline fuel cells, the two most currently widespread fuel cells in the wider market, as well as their relative advantages and disadvantages. Alkaline fuel cells for instance, have lower operating temperatures and are quick to start-up, but are sensitive to carbon dioxide presence in fuel and air • Fuel cell technicians will also need to understand the ongoing technological developments in rarer fuel cell types that are still being prototyped for different application, such as molten carbonate and solid oxide fuel cells.
Integration specialist Note: No ANZSCO code is currently available for this job role. The best match is 233411 – Electronics Engineer	• Bachelor's Degree or higher in Information Systems or Electrical Engineering.	Integration specialists implement solutions which coordinate electronic systems within a project into a larger whole. They evaluate existing components or systems to determine integration requirements and ensure that the final solutions meet product or workplace needs. They also perform information technology system troubleshooting when needed.	• Integration specialists will need to understand how electrolysis functions as a hydrogen production method and what controls and instrumentation are needed to ensure electrolysers function effectively • They will need familiarity with some of the non-electrical systems they may encounter in electrolysers, including high pressure gas systems and water treatment systems • In mobility and materials handling contexts, they will need an understanding of fuel cell technologies (particularly proton exchange membrane and alkaline fuel cells) and how to combine them together within the other systems of a vehicle.
Loading master (ANZSCO code: 5912) Note: No ANZSCO code is currently available for this job role. The best match is a 4-digit ANZSCO code 5912 – Transport and Despatch Clerks. The 6-digit ANZSCO codes were too specialised for this job role	• *Certificate III in Stevedoring* • Relevant licence depending on state/territory jurisdiction.	Loading masters are logistics personnel who work on marine docks and supervise the handling and movement of gas and petroleum products from the terminal to a marine vessel while it is berthed. They organise the dispatch of the products and ensure there is no leakage or contamination into the environment.	• Loading masters will need to understand the basic chemical properties of hydrogen and how it differs from natural gas, most notably in its flammability and the higher pressures it is frequently transported in • This will influence the material handling processes they have in place and they will need to educate all team members on hydrogen's hazardous areas and safety zones • Loading masters will need familiarity with the various forms in which hydrogen can be stored, particularly liquefied hydrogen, which requires cryogenics and extremely low temperatures in order to maintain in a stable form.

Specialists: Augmentation analysis (2/2)

Job role	Qualifications, memberships & workplace experiences	Base/current job role	Expected changes to job role from hydrogen activities (i.e. how the job role will be augmented)
Power production plant operator (ANZSCO code: 399213) Note: We have also used this ANZSCO code for the Control Room Officer job role	• *Certificate III in ESI Generation – Operations*, including at least two years of on-the-job training • At least three years post-trade experience in related projects.	Power production plant operators control boilers, turbo-generators and other associated plant equipment to generate electrical power. They operate plant controls to produce the required load, monitor operations and interpret instrument readings, and undertake authorised procedures to isolate low and high voltage electrical apparatus.	• Power production plant operators will need to understand the interchangeability of hydrogen with other gases (in this case natural gas) and the properties on which it differs, such as its calorific content • They would also need knowledge of hydrogen storage techniques and the risks that come with handling it in its various forms, (e.g. its flammability and high compression when stored as a gas, and the need for low temperatures for storage when it is liquefied).
Technical sales representative (ANZSCO code: 225499)	• Bachelor's Degree or higher in Business Studies, Marketing or Commerce, or *Certificate III, IV and/or Diploma of Business*.	Technical sales representatives are company representatives who sell the company's goods or services to a range of other industrial and business entities. They market goods to their customers and maintain relationships by anticipating their clients' needs. They acquire knowledge of market conditions and competitor activities, and visit prospective client businesses to act on selling opportunities.	• Technical sales representatives will need to understand the basic chemical properties of hydrogen and be able to speak to the key safety considerations arising from its properties. These considerations could include its flammability, high pressure storage in industrial contexts, and environmental impact • Depending on their company, they may need to demonstrate knowledge of the various production and storage methods available for hydrogen, such as how electrolysers function and the equipment required to store hydrogen as a gas.
Water treatment plant operator (ANZSCO code: 712921)	• *Certificate III in Plumbing* or *Certificate III in Water Industry Operations* • Confined space entry permit • Chlorine gas handling certification • Working at heights certification.	Water treatment plant operators use plant equipment to store, distribute and treat water, including purification where a high quality is needed for electrolysers. They also maintain and calibrate field equipment (such as pH meters), and undertake testing of water samples for quality.	• Water treatment plant operators will need to understand the electrolysis process and how it produces hydrogen • They will also need an understanding of the basic hydrogen property risks that come with working with hydrogen in its gaseous form, such as its high compression, flammability, and the potential for leakage in pipes and canisters • Alongside this knowledge of hydrogen as a gas, their knowledge of high pressure gas systems generally may need to be augmented.

Safety and Quality Control: Augmentation analysis

Job role	Qualifications, memberships & workplace experiences	Base/current job role	Expected changes to job role from hydrogen activities (i.e. how the job role will be augmented)
Gas inspector (ANZSCO code: 312999)	• *Certificate III in Gas Supply Industry Operations* or higher • *Diploma of Government Investigations* may be required in some regulatory positions • At least three years of work experience may substitute for formal qualifications • On-the-job training may also be required in addition to formal qualifications.	A gas inspector is responsible for assessing the safety of all gas appliances and ensuring the systems are working safely and properly. This may involve checking safety devices and their efficiencies, ensuring no harmful gases are leaking and appliances are set up properly.	• Knowledge of hydrogen properties, its risks and interactions with various materials will be expected skills to ensure safe hydrogen processes and that pipelines are in safe physical conditions • In addition, gas inspectors will need to recognise the faults in vessels that may arise from hydrogen chemical reactions (e.g. crack propagation) and the impacts this may have from a safety perspective.
Quality assurance technician (ANZSCO code: 139914)	• *Diploma of Engineering* or *Diploma of Manufacturing Technology* or higher education degree in these areas • *Certificate IV in Hazardous Areas – Electrical* in some industries • At least five years of work experience may substitute for formal qualifications • On-the-job training may also be required in addition to formal qualifications.	Quality assurance technicians are required to plan, organise, direct, control and coordinate the deployment of quality systems and certification processes within an organisation. These technicians may have specialist or technical expertise in a particular regulatory framework or industrial process that allows them to conduct audits and examinations of specific environmental factors or workplace tasks (e.g. certificates of origin, energy audits, sustainability checks, material purity tests etc.).	• Knowledge of hydrogen's property risks and interactions with various materials will be an expected skill, coupled with ensuring quality and environmental standards are met • In addition, quality assurance technicians will need to have a sound knowledge of the various hydrogen production techniques such as electrolysis, steam methane reforming and compressed hydrogen so they can conduct tests to ensure quality.
Work Health and Safety officer (ANZSCO code: 251312)	• *Certificate IV in Work Health and Safety* or *Bachelor's Degree in Occupational Health & Safety* or higher • Specialisations in Occupational Hygienist or Workplace Rehabilitation Officer • On-the-job training may also be required in addition to formal qualifications.	Work, Health and Safety (WHS) officers are required to develop, implement and evaluate risk management policies and programs and train employees in WHS procedures. They also monitor and audit the workplace and record and investigate incidents to ensure safe and healthy working conditions. These officers may also have specialist or technical expertise in an industrial process that enables them to have oversight of particular safety systems and standards depending on the workplace (e.g. Electrical Inspectors overseeing high voltage systems),	• Knowledge of hydrogen properties, its risks, and interactions with various materials will be expected skills to ensure safe hydrogen processes are adhered to and employees are working in a safe environment • In addition, WHS officers will need to have a sound knowledge of the various hydrogen production techniques such as electrolysis, steam methane reforming and compressed hydrogen so they can conduct and implement relevant risk management policies and procedures.

Management: Augmentation analysis (1/2)

Job role	Qualifications, memberships & workplace experiences	Base/current job role	Expected changes to job role from hydrogen activities (i.e. how the job role will be augmented)
Engineering manager (ANZSCO code: 133211)	• Membership of Engineers Australia and registration as a Chartered Professional Engineer • Bachelor's Degree or higher in the relevant discipline (e.g. Chemical Engineering) • At least six years' work experience in related projects.	Engineering managers plan, organise, direct, control and coordinate the engineering and technical operations of organisations. They establish project schedules and budgets, and also ensure compliance with laws, regulations and safety standards.	• Engineering managers will need a base understanding of hydrogen's chemical properties and any property risks. This includes an understanding of hydrogen's lack of odour and invisibility when ignited, as well as its flammability • They will also need to understand which materials may be selected for different hydrogen processes (e.g. stainless steel as a model for transporting hydrogen) • Depending on previous experience, their skills in designing and interpreting plans for either power electronics or high pressure gas systems may need some augmentation to understand how they interact in hydrogen production plants • Safety considerations such as knowledge of hazardous areas and safety zones is paramount.
Maintenance manager (ANZSCO code: 323211)	• *Certificate IV* or higher in the relevant trade (e.g. Automotive Electrical Technology) • At least 10 years' work experience in related projects.	Maintenance managers direct, coordinate and advise team members on the maintenance and repair activities required for plant/production machinery and other pieces of mechanical equipment. They ensure that all team members follow correct and safe procedures for the servicing and maintenance of equipment.	• Depending on previous experience, additional familiarity with hydrogen's property risks will be needed. This includes an understanding of hydrogen's lack of odour and invisibility when ignited, as well as its flammability • Those working with hydrogen fuel cell vehicles will need an awareness of the high voltage systems within the vehicles and a basic understanding of how proton exchange membrane fuel cells operate • In some cases, maintenance managers may also be expected to retrofit hydrogen sub-assemblies or components into a larger system • Safety considerations such as knowledge of hazardous areas and safety zones is paramount.
Operations manager (ANZSCO code: 133512)	• *Diploma of Production Management* or higher • At least 10 years work experience in related projects.	Operations managers plan, organise, direct and coordinate the activities of an organisation, including its physical and human resources. They control plant operations through planning of operating hours and maintenance, and oversee the acquisition and installation of new plant equipment.	• Depending on previous experience, additional familiarity with hydrogen's property risks will be needed. This includes an understanding of hydrogen's lack of odour and invisibility when ignited, as well as its flammability • They will also need a general understanding of the market trends that will affect the demand and supply of hydrogen in the long term, including the progress of new technologies, potential applications and use cases of new materials, and developments in Australia's regulatory framework that will affect how hydrogen is treated and handled • Safety considerations such as knowledge of hazardous areas and safety zones is paramount.

Management: Augmentation analysis (2/2)

Job role	Qualifications, memberships & workplace experiences	Base/current job role	Expected changes to job role from hydrogen activities (i.e. how the job role will be augmented)
Planner and scheduler (ANZSCO code: 591112)	• *Certificate III in Gas Supply Industry Operations* • Electrical Equipment in Hazardous Areas certification • Confined space entry permit • Relevant licence depending on state/territory jurisdiction.	Planners and schedulers arrange the release of oil or gas into pipeline systems within their network. They analyse the storage levels available and adjust distribution levels to meet demand, report on the gas flow and ensure that distribution occurs according to schedule.	• Planners and schedulers will need to understand the basic chemical properties of hydrogen and how it differs from natural gas, most notably in its flammability, heating, calorific value and the higher pressures it is frequently transported in • In their logistical roles as schedulers, they will need an understanding of hydrogen and any associated waste products' interchangeability with other industries, such as oxygen or carbon, and how they can be supplied to chemical processing facilities.
Relationship and community manager (ANZSCO code: 131114)	• Bachelor's Degree or higher in Media and Communications, Marketing, Commerce or a related field • At least five years work experience in the relevant industry.	Relationship and community managers plan, organise, direct, control and coordinate public relations and community outreach activities within an organisation. They direct development and implementation of strategies that build a company's public image and reputation with clients, investors, regulators and the wider public.	• Relationship and community managers will need to familiarise themselves with hydrogen's chemical properties if they are new to the industry. This includes an understanding of hydrogen's lack of odour and invisibility when ignited, as well as its flammability • They will need to understand how the various hydrogen production and storage technologies function, and be able to explain their operations to government and regulatory groups (e.g. clarifying what emissions arise from operations, or how fuel cells differ from combustion engines) • They will need an awareness of the changing market architecture of hydrogen and how regulation is being developed as this will shape consumer interactions with hydrogen technologies.
Research and technology manager (ANZSCO code: 132511)	• Bachelor's Degree or higher in an Engineering discipline or field of Science • At least five years work experience in the relevant industry.	Research and technology managers plan, organise, direct, control and coordinate the research and development activities within an organisation. They lead major research operations and also monitor leading-edge developments in related disciplines to determine how they will impact the organisation.	• Research and technology managers will need to familiarise themselves with hydrogen's chemical properties if they are new to the industry. This includes developing an understanding of hydrogen's lack of odour and invisibility when ignited, as well as its flammability • They will need to understand how the various hydrogen production and storage technologies function, and what chemical properties limit their various applications (e.g. molten carbonate fuel cells have a long start-up time that makes them suitable only in some contexts) • They will need an awareness of the changing market architecture of hydrogen and how regulation is developing to shape consumer interactions with hydrogen technologies.

Logistics: Augmentation analysis (1/2)

Job role	Qualifications, memberships & workplace experiences	Base/current job role	Expected changes to job role from hydrogen activities (i.e. how the job role will be augmented)
Heavy vehicle operator (ANZSCO code: 7331) Note: No ANZSCO code is currently available for this job role. The best match is a 4-digit ANZSCO code 7331 – Truck Drivers, which encompasses multiple job roles holding the responsibilities described in this entry.	• Various Certificate III qualifications depending on field (e.g. *Certificate III in Surface Extraction Operations* or *Certificate III in Driving Operations*) • Dangerous goods drivers' licence.	Heavy vehicle operators are logistics workers who handle and operate large vehicles needed to transport goods and materials between destinations. For instance, on mining sites where mineral extraction takes place, or in road freight applications where trucks are needed to carry goods.	• Heavy vehicle operators will need an understanding of fuel cell systems to enable the safe and proper handling of the vehicle • They will need to understand factors that can cause a lack of hydrogen containment and prepare the proper evacuation and safety procedures in the event of a incident, such as a fire • They may also need to recognise the signs of cracking or leakage in vessels storing hydrogen • Safety considerations such as knowledge of hazardous areas and safety zones is paramount.
Marine master/operator (ANZSCO code: 231213) **Note: We have also used this ANZSCO code for the Marine engineer job role**	• A Master certificate of competency from the Australian Maritime Safety Authority • Valid certificate of medical fitness as specified by the Australian Maritime Safety Authority • Any other relevant international seafarer certificates.	Marine master/operators are those workers who control and manage the operations of a ship, which includes navigating a ship's course. They also control and direct shipping operations in order to ensure goods are shipped and transported safely.	• A familiarity with hydrogen's property risks is needed. This includes an understanding of hydrogen's lack of odour and invisibility when ignited, as well as its flammability • They will also need to recognise the signs of cracking or leakage in vessels storing hydrogen in order to address containment issues • In some cases where liquefied hydrogen is being transported, there needs to be an understanding of the cryogenics systems required to store these materials at the required low temperatures • Safety considerations such as knowledge of hazardous areas and safety zones is paramount.
Plant machinery operator (ANZSCO code: 721211)	• *Certificate III in Mobile Plant Technology* or a combination of relevant units of competency • Relevant licence depending on state/territory jurisdiction.	Plant machinery operators are logistics workers who operate mobile plant machinery such as excavators, cranes and forklifts, often to physically move or shift materials between locations. They also monitor and report on the condition of the plant to ensure it is operating as intended.	• Plant machinery operators will need an understanding of fuel cell systems to enable the safe and proper handling of the vehicle • They will need to understand factors that can cause a lack of hydrogen containment and prepare the proper evacuation and safety procedures in the event of an incident, such as a fire • They may also need to recognise the signs of cracking or leakage in vessels storing hydrogen • Safety considerations such as knowledge of hazardous areas and safety zones is paramount.

Logistics: Augmentation analysis (2/2)

Job role	Qualifications, memberships & workplace experiences	Base/current job role	Expected changes to job role from hydrogen activities (i.e. how the job role will be augmented)
Stevedore (ANZSCO code: 891113)	• *Certificate III in Stevedoring* • Relevant licence depending on state/territory jurisdiction.	Stevedores are logistics workers who undertake the activities needed in marine terminals to secure and anchor a ship to transfer goods on and off the ship.	• A familiarity with hydrogen's property risks is needed. This includes an understanding of hydrogen's lack of odour and invisibility when ignited, as well as its flammability • They will also need to recognise the signs of cracking or leakage in vessels storing hydrogen in order to address containment issues • In some cases where liquefied hydrogen is being transported, there needs to be an understanding of the cryogenics systems required to store these materials at the required low temperatures • Safety considerations such as knowledge of hazardous areas and safety zones is paramount.
Truck driver (ANZSCO code: 733111) **Note: It is assumed that this job role does not have any prior experience or skills required to work on a hydrogen project relative to their current job role.**	• *Certificate III in Driving Operations, Certificate IV in Specialist Driving Operations* or a higher-level qualification • Dangerous goods drivers' licence.	Truck drivers can transport hydrogen in a compressed gaseous form in high pressure tubes between different locations. They will need certification to be a dangerous goods driver and will need to observe safety requirements when loading or unloading their vehicles.	• A familiarity with hydrogen's property risks is needed. This includes an understanding of hydrogen's lack of odour and invisibility when ignited, as well as its flammability • Truck drivers will also need to have general awareness of the high pressure gas systems that pipes hydrogen • They will also need to recognise the signs of cracking or leakage in transported tubes to address containment issues • Safety considerations such as knowledge of hazardous areas and safety zones is paramount.