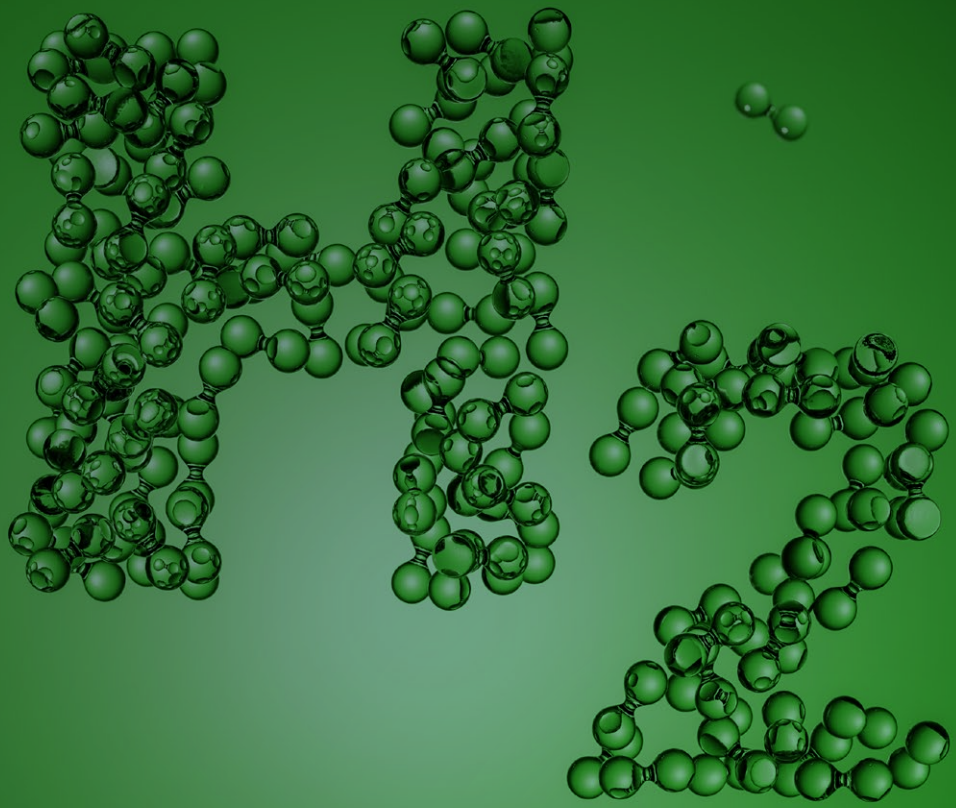
ME-093
Hydrogen Technologies
Work Plan – May 2024



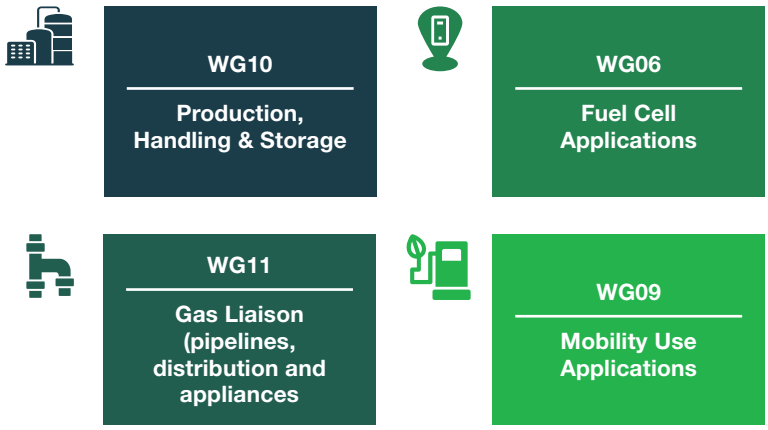
STANDARDS Australia

Contents

Executive Summary

Hydrogen has the potential to play a significant role in enabling the decarbonisation of future energy systems and Australia is well poised to contribute to this transition. There are many components of the hydrogen production, distribution, supply, and utilisation chain. The development and adoption of standards, both nationally and internationally, is critical to the success of the entire hydrogen sector. To address this need, Standards Australia's ME-093 Hydrogen Technologies Committee was constituted in 2019. This document summarises the work of the Committee and highlights its future activities.

The ME-093 Committee develops Australian Standards, liaises with other Standards Australia committees, considers and adopts international standards, and represents Australia's national interests in hydrogen technologies to ISO and IEC. Through a broad stakeholder base, ME-093 ensures the standards it develops and adopts provide a net benefit to Australia. The scope spans the entire hydrogen value chain, with health, safety and environment (HSE) embedded in each of the four working groups. To ensure engagement with a broad range of stakeholders, ME-093 also incorporates the Hydrogen Standards Forum to facilitate open discussions and provide alternate ways to garner input from experts outside of the committee.



Purpose

The purpose of this work plan is to identify and set priority areas for the standards development work of ME-093 Hydrogen Technologies Committee. To ensure effective use of ME-093 resources, business, technological, safety and environmental trends in the hydrogen technologies field, and the linkages between these trends are identified and assessed to inform priorities.

This is the second plan released by ME-093 and shares the future focus areas of the Committee and Working Groups.

Scope

All aspects of hydrogen, across the value chain as an energy carrier and fuel are within scope. This includes the production, storage and handling, measurement, transport, transmission and distribution of hydrogen in its pure form, or blended with another fuel gas. Also included are end-use applications such as hydrogen refuelling infrastructure and mobility applications, domestic and industrial appliances and power and heat generation.

Inclusions

- Hydrogen fuel quality specification
- Hydrogen production and purification
- Hydrogen storage, handling and transport systems
- Hydrogen fuelling stations and associated infrastructure
- Hydrogen “micro-grids” using pure hydrogen in a small-scale network/grid
- Hydrogen storage in a form of:
    - Gaseous, compressed gaseous, liquid
    - Solid state (material-base), for example as metal hydride
- Hydrogen use for electricity generation, grid stabilisation and other electrical applications
- Hydrogen use in new and existing pipelines, gas distribution systems and appliances both as 100% hydrogen and blends with other fuels
- Hydrogen direct use and use in fuel cells for mobile and stationary applications, including land; marine; aviation
- New hydrogen fuel applications
- Hydrogen safety systems and devices

Note: Where standards are delivered primarily through other technical committees, for example gas pipelines and gas appliances, enablement of hydrogen will be via liaison to provide subject matter into relevant standards projects.

Exclusions

- Carbon capture, utilisation and storage (CCUS)
- Alternate chemical hydrogen transport vectors (e.g. ammonia; liquid organic hydrogen carriers (LOHC); synthetic fuels)
- Hydrogen storage by geological methods
- Deuterium, tritium and any other hydrogen isotopes

Introduction

Hydrogen has been recognised globally as having the potential to play a significant role in a future sustainable energy system as a highly versatile energy carrier. The emergence of a hydrogen society built around this clean energy represents a potential to reduce greenhouse gas emissions and the world's reliance on fossil fuels.

The role of Standards Australia will be to enable the development of technical standards for the hydrogen industry. These standards will support responsive regulation for the hydrogen sector. International standards will be adopted wherever possible.

Some examples where ME-093 can address the needs of Australian stakeholders include:

- **Safety** – Enable Australia to implement consensual rules to minimise avoidable risks to persons and goods to an acceptable level.
- **Environment** – Ensure protection of the environment from unacceptable damage due to the operation and effects of products, processes and services linked to hydrogen.
- **Elimination of barriers to trade** – Provide consistency between international jurisdictions enabling streamlined entry of hydrogen related equipment from overseas.
- **Upskilling of Australian industry** – Gain useful learnings from countries more advanced in their progress in implementing international standards and hydrogen sector development.

Benefits

The adoption of relevant international hydrogen standards and development of new Australian Standards and guidelines allows for the public health and safety risks associated with production, storage, delivery and use of hydrogen to be addressed. The introduction of standards minimises the risk to local communities and assists the Australian industry in securing the social licence to operate.

Delivery of standards will enable the introduction of hydrogen and fuel-cell technologies that deliver positive decarbonisation and air pollution outcomes, while ensuring the risks of environmental impacts from the use of hydrogen are minimised. The adoption of global practice, through mirroring international committees, will assist in the removal of barriers-to-entry for Australia and support new entrants in the marketplace. It will enable Australia to develop and grow a hydrogen economy.

Engagement in the IEC and ISO committees, which ME-093 is mirroring, enables Australia to keep abreast of progress of hydrogen and its associated technologies and monitor best operating practice. This enables safe uptake of technology in Australia without excessive compliance cost. Moreover, it also provides an avenue for Australia to contribute technical expertise at an international level.

Roles and Responsibilities

Standards Australia

Standards Australia is Australia's peak, independent, non-governmental, not-for-profit standards organisation. Standards Australia is Australia's representative to the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC).

Standards Australia facilitates the development and adoption of internationally aligned standards in Australia. This is achieved through:

- Partnering in ISO and IEC standards development.
- Adoption of international standards, or regional where international does not exist.
- Creation of new standards where there are gaps in the international arenas or Australian specific requirements.
- Empowering other organisations/bodies to develop content.

Standards Australia is not responsible for enforcing regulations or certifying compliance with standards.

ME-093 Hydrogen Technologies Committee

ME-093 is responsible for collaborating to develop the technical standards and guidance required for the hydrogen industry to enable delivery of safety and technical performance outcomes. The objectives of the committee are met through:

- Participating in, and liaising with, relevant international committees to provide Australian input into the international standards development.
- Liaising with other Australian technical committees to ensure effective and efficient standards are available to meet blended and pure hydrogen applications.

Standards development activities occurs at three levels:

1. ME-093 Technical Committee

Role: Provide governance and lead strategic direction of workstreams, projects and standards related to hydrogen. Serves as national mirror committee to relevant ISO and IEC committees.

Composition: Mix of Nominating Organisations, WG convenors and industry experts. Refer Appendix A.

2. ME-093 Working Groups

Role: Draft and adopt technical standards for specific parts of the value chain.

Structure: ME-093 has four working groups as follows:
WG10: Production, Handling and Storage – Appendix C
WG06: Fuel Cell Applications – Appendix D
WG09: Mobility Applications – Appendix E
WG11: Gas Liaison (pipelines, distribution networks and gas installations/appliances) – Appendix F

Composition: Working groups have a small core membership of experts in the specific areas of the hydrogen value chain. When undertaking projects to develop a standard or other technical document, the workgroup will seek and engage subject matter experts for the relevant topics.

3. Hydrogen Standards Forum

Role: A community of experts and stakeholders who are interested in hydrogen standards development. The forum will contribute to the direction of standards development and priorities.

Composition: Open to members across the industry to express interest to Standards Australia to join the group, subject to signing the Committee Agreement. A pool of experts that SA can approach for project opportunities under working groups and may have an opportunity to participate on international working groups.

Working Group Structure

Figure 1 outlines the working group structure and Figure 2 details the scope of the focus areas.

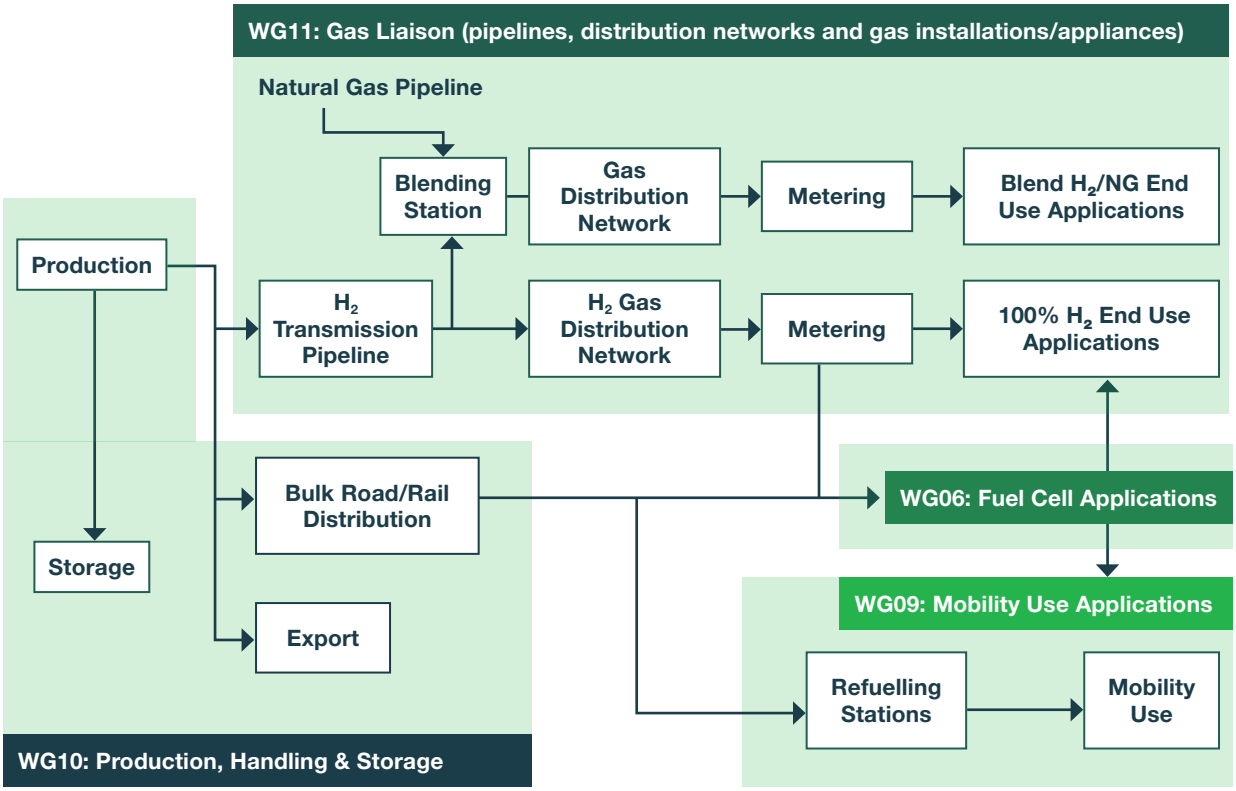


Figure 1: Example of working groups value chain relationship

<table>
<tr><th>WG10: Production, Handling & Storage</th><th>WG11: Gas Liaison (pipelines, distribution networks and gas installations/ appliances)</th><th>WG06: Fuel Cell Applications</th><th>WG09: Mobility Use Applications</th></tr>
<tr><td>Hydrogen Storage</td><td>Pipelines</td><td>Stationary</td><td>Refuelling Stations</td></tr>
<tr><td>• Low pressure gas
• High pressure gas
• Underground tank storage
• Buffer storage
• Liquid Hydrogen storage
• Metal hydrides</td><td>• HP transmission
• Compressor stations
• Metering
• Other equipment
• Underground / aboveground
• Integration with AS 2885 series
• Blending
• Existing and New pipelines</td><td>• Distributed power generation
• Combined heat & power system
• System design
• Grid stabilisation
• Energy storage systems
• Fuel cell modules in reverse mode</td><td>• Equipment specifications
• Metering</td></tr>
<tr><td>Bulk Product Transport</td><td>Networks and Network Equipment</td><td>Transport</td><td>Refuelling Protocols</td></tr>
<tr><td>• Loading/unloading equipment
• Road & rail
• LH_2 shipping
• Transport vessels/ receptacles
• Other export vectors</td><td>• Mid/LP distribution
• Compressor stations
• Metering
• Pressure regulators
• Manual Shutoff valves
• Other equipment
• Blending
• Integration with AS/NZS 4645 series
Appliances
• Gas appliances
• Gas equipment standards
• Integration with appliance standards</td><td>• Road, rail & marine applications
• Aviation
• Industrial trucks
• Range extenders
• Auxiliary power units
Portable
• Portable power systems
• Micro Fuel Cells</td><td>• Light vehicles
• Heavy vehicles
• Marine applications</td></tr>
<tr><td>Hydrogen Production</td><td colspan="2">Gas Quality Specifications</td><td>Fuel Quality Specifications</td></tr>
<tr><td>• Electrolysis
• SMR
• Guarantee of origin
• Methane pyrolysis
• Biogas feedstock
• Compression & purification
• System design
• Gas quality</td><td>• NG:H_2 Blends
• 100% H_2
• Sampling protocols
• Testing protocols</td><td>• Sampling protocols
• Testing protocols</td><td>• Sampling protocols
• Testing protocols</td></tr>
<tr><td colspan="4">HSE</td></tr>
<tr><td></td><td>• Leak and flame detection
• Hazardous Area
• Material/gas compatibility
• Confined space</td><td colspan="2">• Occupational & health impact
• Safety in Design
• Environmental impacts
• Odorant & colourant
• Enclosed spaces
• Inspection requirement</td></tr>
</table>

Figure 2: ME-093 Working Group Scopes

Stakeholder Relationships

The stakeholder groups for both the emerging hydrogen sector and for ME-093 is wide.

Figure 3 illustrates the type and extent of stakeholders for ME-093. It represents an indicative sample and is not a definitive list.

Figure 3: ME-093 External Stakeholder Map

Key to the success of the hydrogen economy in Australia, is understanding the need to develop a range of skills and capabilities including:

- Training – developing training material and competency programs to educate and skill people on the “how”.
- Industry – putting the “how” into practice.
- Government – regulating what is put into practice, ensuring public safety and environmental safety.
- Research and Technology – generating the knowledge needed to close gaps.
- Standards – creating the technical content to support the how.

To facilitate stakeholder engagement beyond the nominating organisations represented on the ME-093 technical committee, the Hydrogen Standards Forum provides an opportunity for interested parties to directly provide input, and hear updates, about the work of ME-093. This two-way engagement is an important avenue for stakeholders to say what they need, to share their knowledge, and articulate the gaps where new standards could support them.

Participation in International Standardisation

The ME-093 technical committee mirrors and participates in the following international committees:

- ISO/TC 197, Hydrogen Technologies – participating member
- IEC TC 105, Fuel Cell Technology – participating member
- ISO/TC 8/SC 2, Ships and Marine Technology – Marine environment protection – observing member (Membership is to facilitate development and adoption of a liquid hydrogen loading arm ISO standard)

In addition to the committees that ME-093 is directly engaged with, Figure 4 below identifies the current relevant ISO and IEC committees for hydrogen standards. For the committees that ME-093 does not mirror, a liaison is in place via other Standards Australia technical committees.

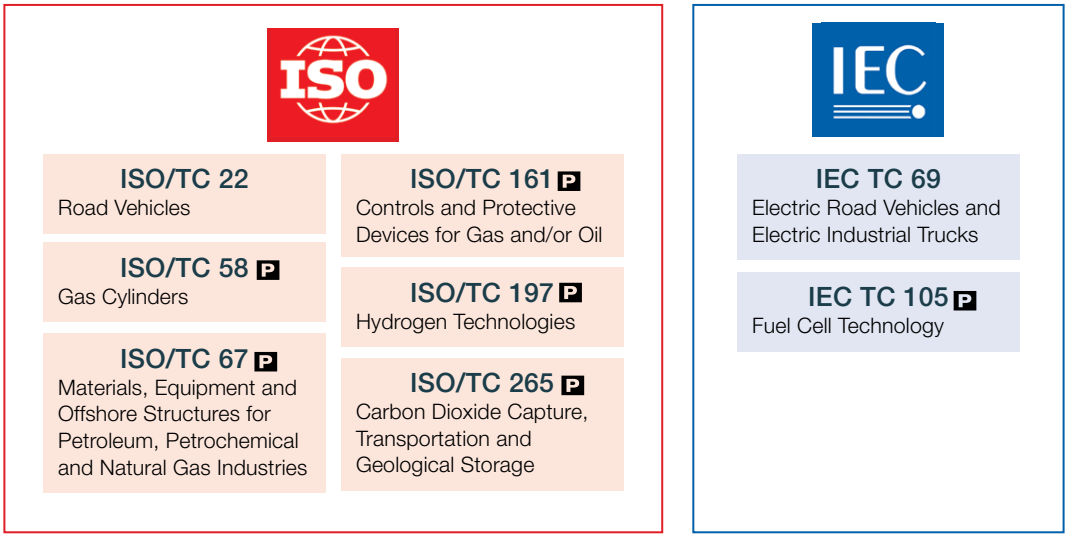


Figure 4: Relevant International Standards Technical Committees

Standards Australia Technical Committee Liaisons

In addition to external stakeholders and the Hydrogen Standards Forum, ME-093 maintains a formal liaison with other relevant Standards Australia technical committees. The list in Appendix B are the current liaisons to ME-093 and their alignment with the working groups.

Appendix A: Nominating Organisations

ME-093 technical committee nominating organisations:

- Australian Gas Association
- Australian Hydrogen Council
- Australian Industry Group
- Chemistry Australia
- Department of Climate Change, Energy, the Environment and Water
- Energy Networks Australia
- Engineers Australia
- Gas Energy Australia
- Gas Technical Regulators Committee
- Institute of Electrical Inspectors
- National Association of Testing Authorities Australia
- National Energy Resources Australia
- The University of Adelaide

Appendix B: Standards Australia Liaison Committees

ME-093 has a liaison arrangement from this committee to:

- AG-001, Gas Appliances
- AG-006, Gas Installation
- AG-008, Gas Distribution
- AG-010, Natural Gas Quality Specifications
- AG-011, Industrial and Commercial Gas-Fired Appliances
- AG-013, Components used for Gas Appliances and Equipment
- CH-038, Liquefied Petroleum Gas - Composition
- EL-014, Equipment for Explosive Atmospheres
- ME-002, Gas Cylinders
- ME-038, Petroleum Pipelines
- ME-070, Liquefied Natural Gas Storage and Handling
- ME-092, Oil and gas industries including lower carbon energy
- MS-011, Classification of hazardous areas due to explosive atmospheres

ME-093 has a liaison arrangement to this committee from:

- AG-006, Gas Installation
- AG-010, Natural Gas Quality Specifications
- EL-014, Equipment for Explosive Atmospheres
- EL-048, Wind energy generation systems
- ME-038, Petroleum Pipelines
- ME-092, Oil and gas industries including lower carbon energy

Figure 5 identifies how each ME-093 working group aligns with the liaisons, in addition to the parent ISO/TC 197 mirror.

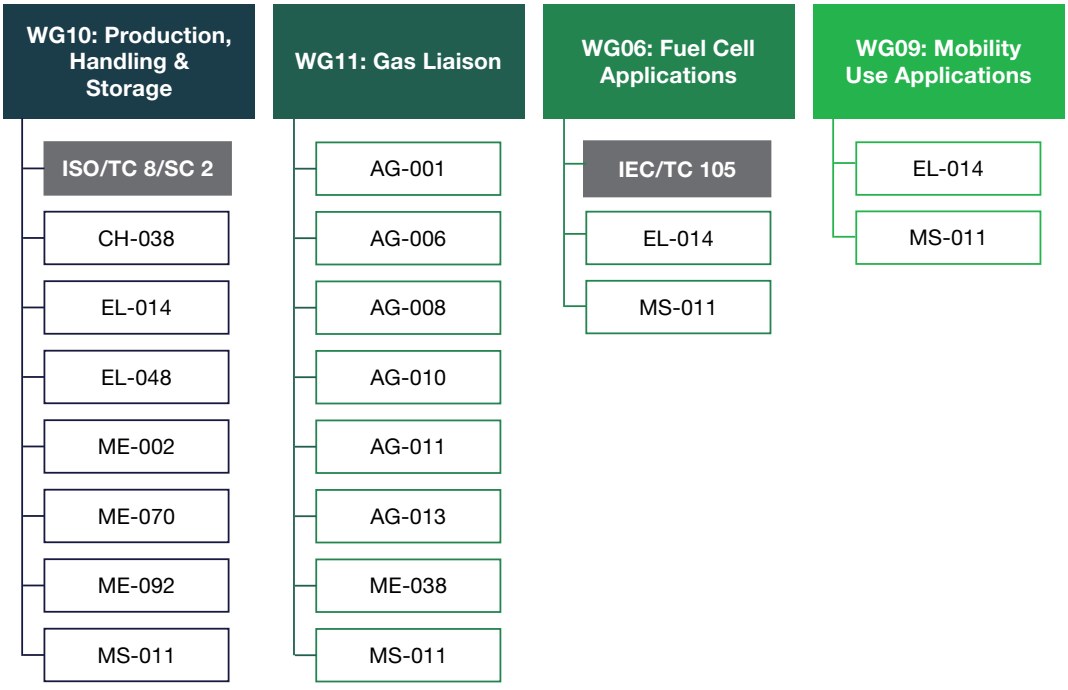


Figure 5: ME-093 working group liaison map.
Note: That international participation in ISO/TC 197 spans all working groups.

Appendix C: Production, Handling and Storage Working Group (WG10)

Scope

The scope of the Production, Handling and Storage Working Group includes the facilities used in production and purification by various processes and the storage, handling and transport systems of both gaseous and liquid hydrogen. Storage can be in the form of compressed gaseous hydrogen or liquid and solid state such as in metal hydride. The working group also covers hydrogen export via transport vectors not adequately covered in other standards. Within these scope boundaries, equipment design and performance criteria, installation and operational requirements, as well as HSE and emergency management will be addressed.

Scope exclusion are:

- Production by nuclear and biological pathways
- Storage by geological methods, such as underground salt caverns
- Transport in pipelines (Pipelines and Gas Distribution Networks working group)
- Large-scale marine transportation

2024 – 2026 Focus areas

- Upgrading a new Australian Technical Specification to first tier publication Australian Standard – Hydrogen: Storage and Handling (in progress).
- Development of a standard for liquid hydrogen (LH_2) marine loading in conjunction with ISO/TC 8/SC2 (in progress).
- High-pressure gas and liquid hydrogen storage for bulk transport and stationary applications. This will include consideration of design, operation and re-qualification through the service life.
- Review and determine the standards requirements for reduction technologies (e.g. steam-methane reforming; methane pyrolysis).
- Review opportunity to establish a framework for risk assessment methods for both small- and large-scale production facilities.
- Monitor and influence the testing and certification standards for hydrogen, specifically around components that are difficult to measure.
- Provide input into the requirements for training and accreditation of the next generation of competent technicians, operators for hydrogen equipment, noting that training material development or delivery is outside scope.

Appendix D: Gas Liaison Working Group (WG11)

Scope

The Gas Liaison Working Group scope begins at the outlet of a production or storage facility that is putting hydrogen into a pipeline that forms any part of the gas transmission or distribution network and ends when the hydrogen is used in a stationary application excluding fuel cells. Hydrogen use in fuel cells is the responsibility of Fuel Cell Applications Working Group (WG06).

It is recognised that the existing suite of standards for traditional fuel gases is generally able to cater for inclusion of hydrogen as a new fuel type in pipelines, gas distribution systems and appliances. To ensure efficient and effective integration of hydrogen into Australian Gas Standards the Gas Liaison Working Group will monitor developments relating to pipelines, distribution systems and end use applications using hydrogen or hydrogen/ natural gas blends and liaise with relevant standards committees to facilitate the inclusion of hydrogen in these standards, or where necessary, the development of hydrogen specific Australian Standards, technical specifications or guidelines for these applications.

The topics that will be addressed within these boundaries include:

- HSE elements such as leak detection, hazardous areas, flame detection and material compatibility
- Gas quality specifications for the gas network and combustion applications
- Transmission and distribution pipelines
- Network equipment
- Blending facilities
- Consumer piping
- Gas components
- Type A gas appliances
- Type B gas appliances
- New gas appliances
- Stationary fuel cell power systems for distributed power generation; and combined heat and power systems (liaison with WG-06 as required)

2024 – 2026 Focus Areas

- Conduct a literature review of existing Australian Standards to determine gaps for use of hydrogen in the gas network.
- Develop material or guidance where existing standards do not, or will not, adequately cover areas of higher safety risk (e.g. leak management, personal gas detectors).
- Develop liaison relationships with Standards Australia AG-008, Gas distribution and ME-038, Petroleum pipelines, AG-001, Gas appliances (Type A), AG- 006 Gas Installation, AG-011, Industrial and Commercial Gas-Fired Appliances (Type B) and AG-013, Components used for Gas Appliances and Equipment committees to determine the best approach for including hydrogen and relevant safety topics in existing standards.
- In conjunction with other ME-093 working groups, develop external liaisons such as UK HSE, IGEM and Northern Gas Network in the UK for network related issues.
- Monitor Australian (e.g. Future Fuels CRC) and global research relevant to gas networks.

- Review of published international standards or guides related to pipelines, distribution systems, appliances, components and installations for potential use in Australia.
- Monitor Australian and global research relevant to End Use Applications specifically for:
    - Testing of Type A appliances with natural gas/hydrogen blends and 100% hydrogen
    - Testing of Type B appliances used for steel, glass and cement manufacturing in the mid term
- Obtain updates of Australian based projects and review progress for input to standards work.

Appendix E: Fuel Cell Applications Working Group (WG06)

Scope

The scope of the Fuel Cell Applications Working Group covers fuel cell technologies for all fuel cell types and various associated applications; and includes:

- Stationary fuel cell power systems for distributed power generation; and combined heat and power systems (liaison with WG-11 as required)
- Fuel cells for transportation, such as propulsion systems (e.g. all-electric systems for ground vehicles, ships and aircrafts)
- Auxiliary power units
- Portable fuel cell power systems
- Micro fuel cell power systems
- Reverse operating fuel cell power systems.

The scope of the working group also covers technical input to IEC TC 105, Fuel Cell Technologies to enable ME-093 fulfill its role as the Australian National Mirror Committee and participating member of IEC TC 105.

In line with the scope of IEC TC 105, the scope of the working group will remain flexible enough to include new trends and technologies both in Australia and internationally; and take into consideration the market demand of:

- Component, sub-system and fuel cell suppliers
- Fuel cell and system installers
- Fuel cell and system manufacturers
- Testing and certification bodies
- Regulators, authorities and approval organisations
- Original equipment manufacturers.

2024 – 2026 Focus areas

- Review standards associated with fuel cell technologies and their associated applications; and recommend the adoption of IEC TC 105 standards as Australian Standards, with modifications where applicable that take into consideration Australian needs and existing compliance requirements.
- Provide technical input into IEC TC 105's international standards development, on behalf of ME-093, to enable Australia to participate actively and contribute to the development of associated international standards; adopt global practice in fuel cell applications; keep abreast of developments in fuel cell technologies; and accelerate technology uptake within Australia with minimal barriers-to-entry.
- Work with Australian State and Territory technical regulators on proposed regulatory requirements for fuel cell applications.
- Liaise with other relevant Standards Australia Committees, starting with EL-014, Equipment for Explosive Atmospheres and MS-011, Classification of Hazardous Areas due to Explosive Atmospheres and developing other liaison relationships over time as the need arises.
- Monitor and assess the need for Australia to establish National Mirror Committees to other international standards committees that will interface with IEC TC 105 (e.g. IEC TC 120, Electrical Energy Storage (EES) Systems; ISO/TC 22/SC 37, Electrically Propelled Vehicles; and ISO/TC 110, Industrial Trucks), as the fuel cell sector develops in Australia.

Appendix F: Mobility Applications Working Group (WG09)

Scope

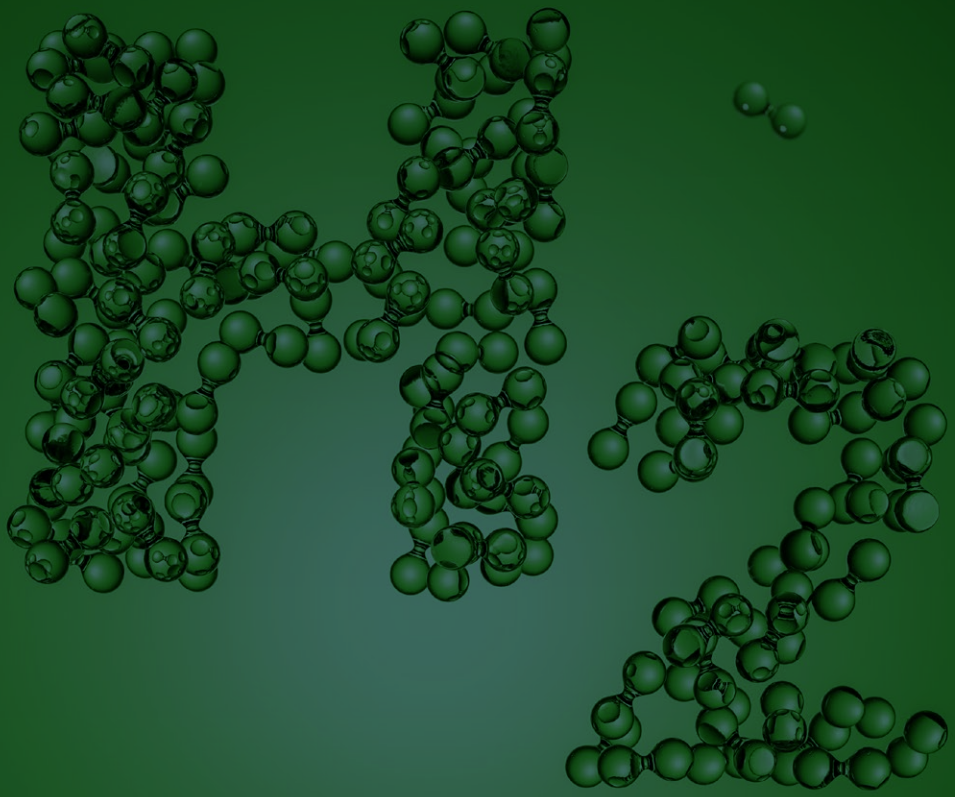
The scope of the Mobility Applications Working Group covers refuelling stations and mobility use and includes:

- Hydrogen fuel specification including sampling and testing protocols
- Hydrogen fuelling stations and associated infrastructure
- Refuelling protocols for light, heavy and marine applications
- Hydrogen safety systems and devices

This working group has an interface with the Fuel Cell Applications Working Group where fuel cells are used within the mobility application; for example, in light vehicles. The working groups will actively liaise to ensure seamless coverage of the interfaces.

2024 – 2026 Focus areas

- Participation in ISO/TC 197 active projects related to mobility applications, specifically in the areas of:
  - refuelling protocols, specifically new protocols for fast refuelling of buses and trucks.
  - refuelling station equipment design performance criteria.
- Review and adopt (as appropriate) of ISO 19880, *Gaseous hydrogen — Fuelling Stations Series.*
- Monitor and assess the need for Australia to establish National Mirror Committees to ISO/TC 22, Road Vehicles and ISO/TC 110, Industrial Trucks and/or relevant sub-committees to facilitate hydrogen use in these sectors. Develop a proposal for membership in conjunction with the Fuel Cell Applications Working Group if appropriate.
- Review published international standards or guidance related to hydrogen refuelling facilities, both gaseous and liquid, including the impact of hazardous areas for potential use in Australia and development of content where gaps exist.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