

ME-093

Hydrogen Technologies

Strategic Work Plan



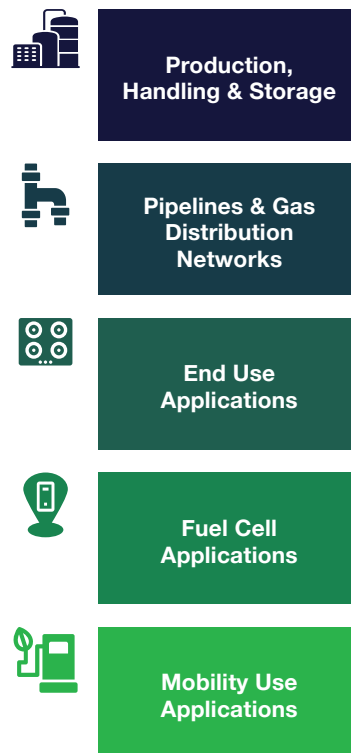
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Executive Summary

Hydrogen has the potential to play a significant role in enabling the decarbonisation of future energy systems. As promulgated by the National Hydrogen Strategy, Australia is well poised to contribute to this transition. There are many components of the hydrogen production, distribution, supply, and utilisation chain. The 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. 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, consider 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 five working groups:



Hydrogen technology is rapidly evolving. ME-093 will be agile in proactively responding to demands through the development of various documents and guiding the revision of standards that may be affected by the increased uptake of hydrogen. Given how quickly this industry is emerging, the committee will explore the use of Australian Technical Specifications and other 'speed-to-market' pathways that can be developed in shorter timeframes than traditional Australian Standards.

Purpose

This plan articulates the business, technological, safety and environmental trends in the hydrogen technologies field, and the linkages between these trends. The priority areas in the standards development work of the ME-093 Hydrogen Technologies committee are identified.

Scope

All aspects of hydrogen, across the value chain as an energy carrier are within scope. This includes the production, storage and handling, measurement, transport, transmission and distribution of hydrogen in its pure form, blended with another fuel gas or via an alternate hydrogen transport vector. 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 specification
- Hydrogen production and purification by multiple processes
- Hydrogen storage, handling and transport systems both gaseous and liquid
- Hydrogen fuelling stations and associated infrastructure
- Hydrogen “micro-grids” using pure hydrogen in a small-scale network / grid
- Hydrogen use for storage in a form of compressed gaseous, liquid and solid state such as in metal hydride, electricity generation, grid stabilisation and other electrical applications
- Hydrogen use in existing pipelines and appliances both as blends with natural gas and 100% hydrogen
- Hydrogen use in fuel cells for mobile and stationary applications
- Hydrogen export via transport vectors where not adequately covered through other standards
- Hydrogen safety systems and devices

Exclusions

- Nuclear applications
- Carbon capture, utilisation and storage (CCUS)

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.

Australian Journey

Hydrogen has recently seen strong interest because of its potential to decarbonise the economy. Australia is well-placed to produce and utilise significant quantities of hydrogen. As indicated in the Figure 1, a series of documents have outlined the potential for hydrogen.

Figure 1: Australian Hydrogen Journey



The National Hydrogen Strategy released December 2019, identified 57 joint actions that of themselves are the first steps, to realising the vision with additional actions needed over time. Actions are themed around national coordination, developing production capacity, supported by local demand; responsive regulation; international engagement; innovation and research and development (R&D); skills and workforce; and community confidence. The actions consider hydrogen in relation to exports, transport, industrial use, gas networks, electricity systems, and cross-cutting issues such as safety, skills, and environmental impacts.

The priority areas for hydrogen use in Australia have been identified as:

- Potential of new opportunities for hydrogen use e.g. clean ammonia, industrial heating, iron ore processing; steel making
- Use in remote applications e.g. microgrids for mining and remote communities; farming and marine applications
- Backup power supply e.g. mobile phone towers, hospitals and other critical infrastructure
- Blending with natural gas and eventual use of 100% hydrogen in gas networks
- Transport application, with a focus on heavy and long-range road transport, rail and shipping
- Proving technologies that reduce the cost of making, moving, storing and using hydrogen
- The use of water from sustainable sources for hydrogen production
- Developing cross-sector linkages and deriving value from sector coupling

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.

ME-093 Hydrogen Technologies Committee

A forum was held October 2018 to explore the need for a technical committee for hydrogen technologies. The ME-093 Hydrogen Technologies Committee formed in early 2019 in response to the forum outcomes.

Specific areas where ME-093 can address the needs of Australian stakeholders include:

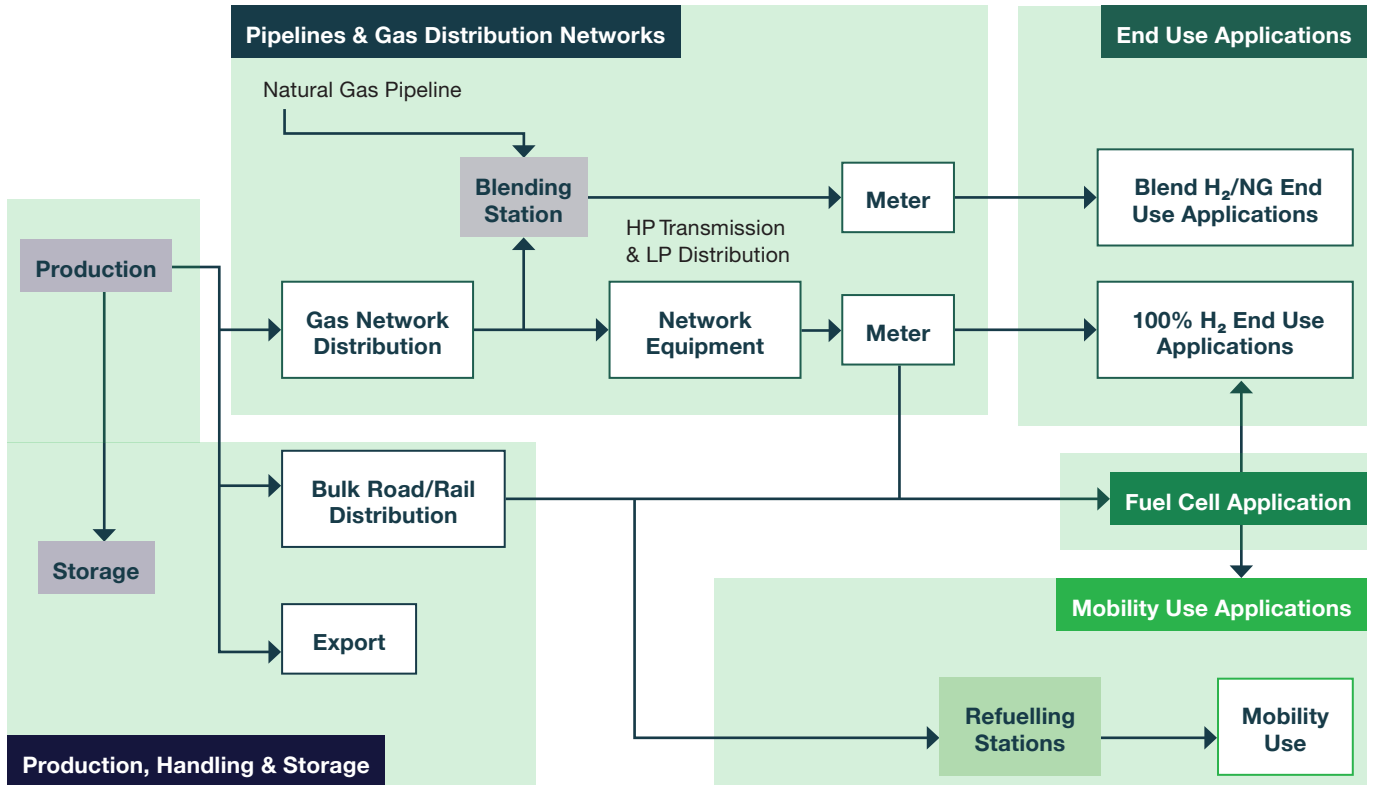
- **Safety** – Enable Australia to implement consensual rules to minimise avoidable risks to persons and goods to an acceptable level
- **Environment** – Ensure protection of the environment from unacceptable damage due to the operation and effects of products, processes and services linked to hydrogen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

ME-093 has five working groups as follows:

- Production, Handling and Storage
- Pipelines and Gas Distribution Networks
- End Use Applications
- Fuel Cell Applications
- Mobility Applications

This is also depicted in Figure 2 to show the value chain relationship.

Figure 2: Working groups value chain relationship



Roles and Responsibilities

Standards Australia

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

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

ME-093 Hydrogen Technologies Technical 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 constitution of the committee consists of a diverse range of nominating organisations across the hydrogen sector.

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.

Appendix 1 lists the ME-093 nominating organisations.



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 from impacted stakeholders. 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.

Working Group Structure

Figure 3 outlines the ME-093 working group structure and details the scope focus areas.

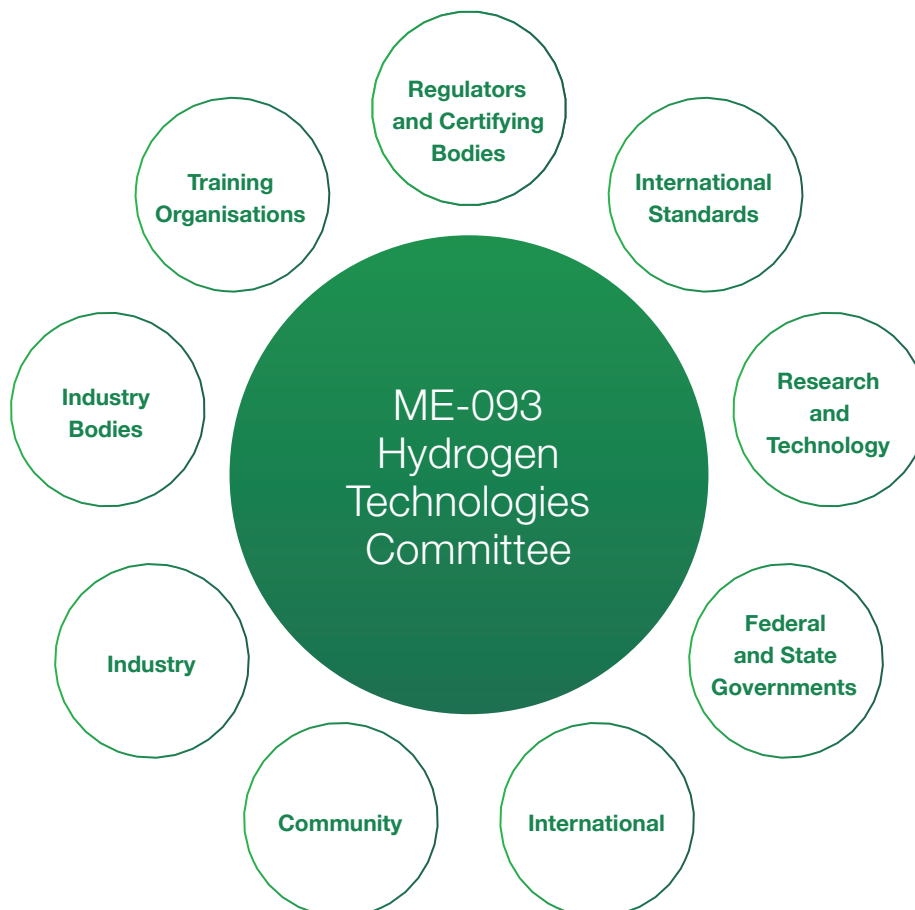
Figure 3: ME-093 Working Group Scopes

Production, Handling & Storage	Pipelines & Gas Distribution Networks	End Use Applications	Fuel Cell Applications	Mobility Use Applications
HSE				
	<ul style="list-style-type: none"> Leak and flame detection Hazardous Area Material/gas compatibility Confined space Occupational & health impact 	<ul style="list-style-type: none"> Environmental impacts Odorant & colourant Enclosed soaces Container safety Inspection requirement 		
Hydrogen Production	Gas Quality Specifications			Fuel Quality Specifications
<ul style="list-style-type: none"> Electrolysis SMR Guarantee of origin Methane pyrolysis Biogas feedstock Compression & purification System design 	<ul style="list-style-type: none"> NG:H₂ Blends 100% H₂ Sampling protocols Testing protocols 	<ul style="list-style-type: none"> NG:H₂ Blends 100% H₂ Sampling protocols Testing protocols 	<ul style="list-style-type: none"> Sampling protocols Testing protocols 	<ul style="list-style-type: none"> Sampling protocols Testing protocols
Hydrogen Storage	Pipeline Networks	Consumer Piping Network	Stationary	Refuelling Stations
<ul style="list-style-type: none"> Low pressure gas High pressure gas Underground Buffer storage Liquid Hydrogen storage Metal hydrides 	<ul style="list-style-type: none"> HP transmission Mid/LP distribution 	<ul style="list-style-type: none"> Downstream of Metering 	<ul style="list-style-type: none"> Distributed power generation Combined heat & power system System design Grid stabilisation 	<ul style="list-style-type: none"> Equipment specifications Metering
Bulk Product Transport	Network Equipment	Type A Appliances	Transport	Refuelling Protocols
<ul style="list-style-type: none"> Loading/unloading equipment Road & rail LH₂ shipping Transport vessels/receptacles Other export vectors 	<ul style="list-style-type: none"> Compressor stations Metering 	Type B Appliances	<ul style="list-style-type: none"> Road, rail & marine applications Range extenders Auxiliary power units 	<ul style="list-style-type: none"> Light vehicles Heavy vehicles Marine applications
	Gas Components for Networks	Gas Components for End Use	Portable	
	<ul style="list-style-type: none"> Pressure regulators Manual Shutoff valves Other equipment 	<ul style="list-style-type: none"> Pressure regulators Manual Shutoff valves Other equipment 	Micro Fuel Cells	
			Reverse Operating FC Power Systems	

Stakeholder Relationships

The stakeholders for both the emerging hydrogen sector and for ME-093 is wide. Figure 4 illustrates the type and extent of stakeholders for ME-093. It represents an indicative sample and is not a definitive list.

Figure 4: 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.
- Research and Technology – generating the knowledge needed to close gaps.
- Standards – creating the technical content to support the how.

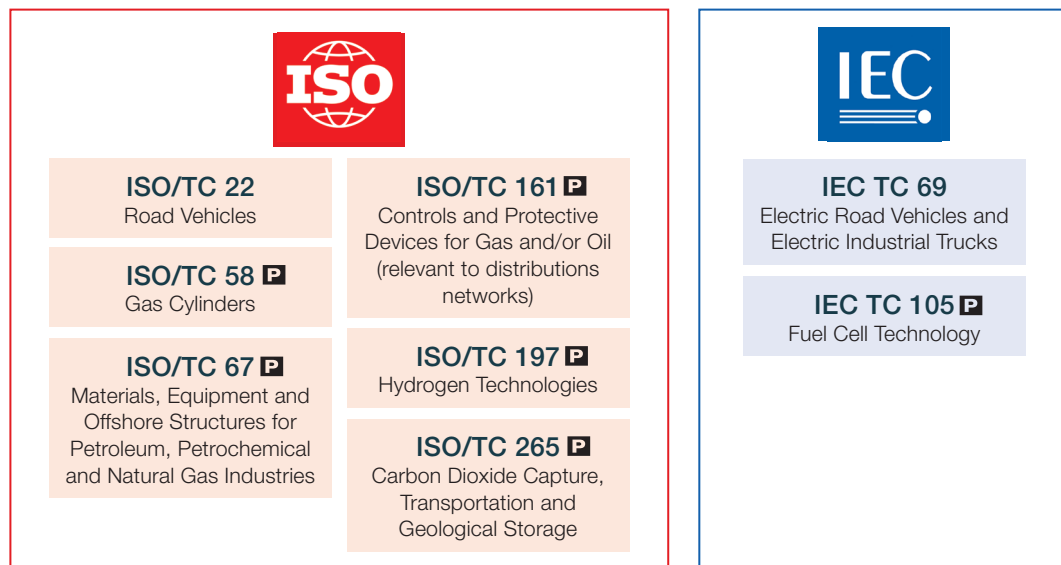
For ME-093 to be effective we need stakeholders to:

- Tell us what they need.
- Share their knowledge of what is already out there in the global landscape.
- Articulate the gaps they see where standards could support them.

Participation in International Standardisation

Figure 5 below identifies the current relevant ISO and IEC committees for hydrogen standards and Australia's membership status as an observing (O) or participating (P) member.

Figure 5: Hydrogen relevant International Standards Committees Status



The following are the international mirror committees for ME-093:

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

The remaining ISO and IEC memberships are through other Standards Australia committees with whom ME-093 has a liaison.

Standards Australia Technical Committee Liaisons

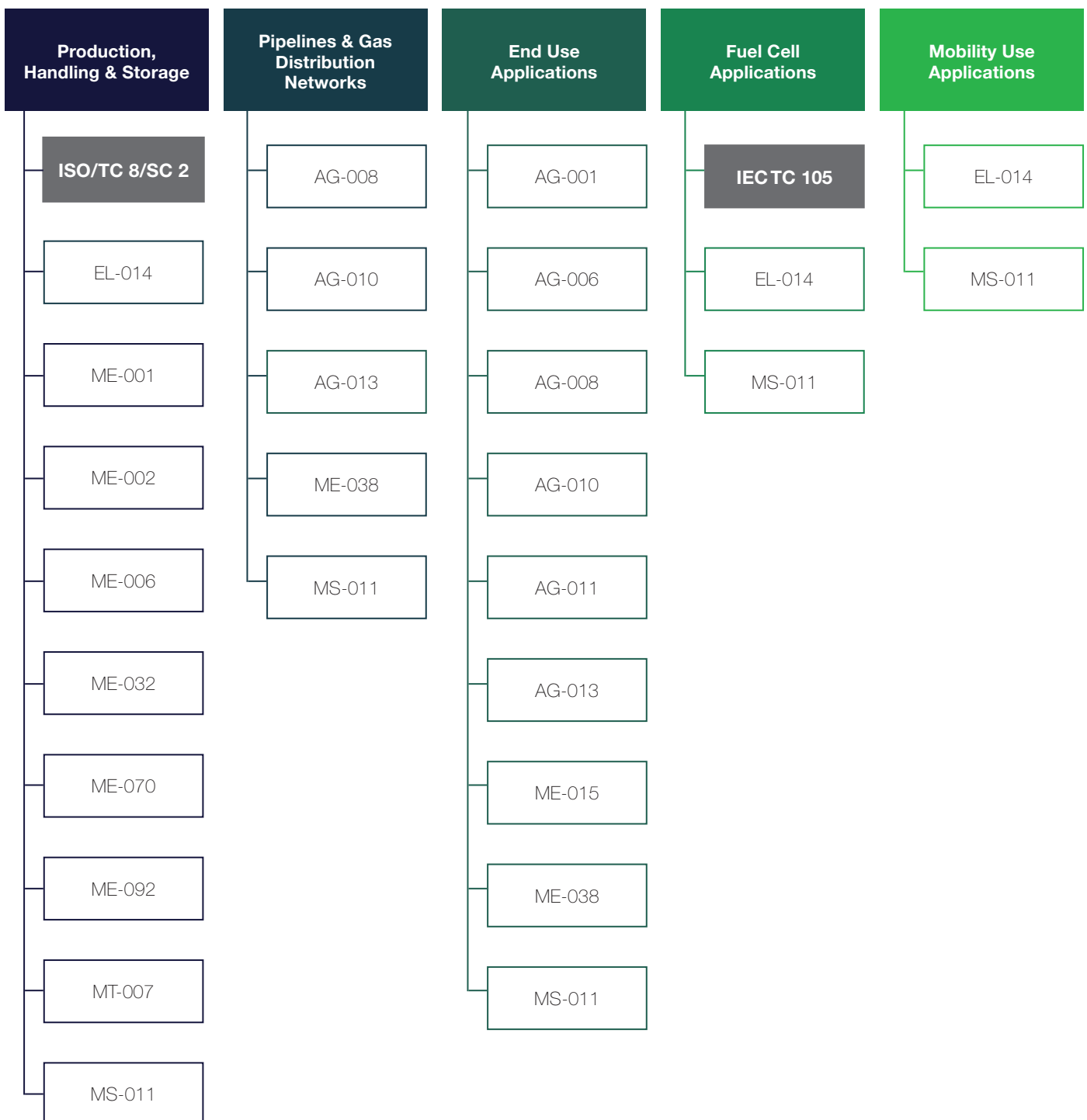
In addition to external stakeholders, the following are the Standards Australia technical committee who form the internal stakeholders and where appropriate formal liaisons for ME-093:

- AG-001, Gas Appliances (Type A)
- AG-006, Gas Installation
- AG-008, Gas Distribution
- AG-010, Natural Gas Quality Specifications
- AG-011, Industrial and Commercial Gas-Fired Appliances (Type B)
- AG-013, Components used for Gas Appliances and Equipment
- CH-038, Liquefied Petroleum Gas – Composition
- EL-014, Equipment for Explosive Atmospheres
- ME-001, Pressure Equipment
- ME-002, Gas Cylinders (ISO/TC 58 mirror committee)
- ME-006, Refrigeration

- ME-015, Storage and Handling of LPG
- ME-032, Anhydrous Ammonia Storage and Handling
- ME-038, Petroleum Pipelines
- ME-070, Liquefied Natural Gas Storage and Handling
- ME-092, Materials, Equipment, Structures and Related Services for Petroleum, Petrochemical and Natural Gas Industries (ISO/TC 67: Mirror Committee)
- MS-011, Classification of Hazardous Areas Due to Explosive Atmospheres
- MT-007, Non-Destructive Testing of Metals and Materials

Figure 6 below identifies how each ME-093 working group aligns to the liaisons in addition to the parent ISO/TC 197 mirror.

Figure 6: ME-093 working group internal stakeholder map



Working Group Summaries

Production, Handling and Storage

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

2020 – 2023 Focus areas:

- Development of a new Australian Technical Specification – Hydrogen: Storage and Handling (in progress).
- Development of a standard for liquid hydrogen (LH₂) 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.

Pipelines and Gas Distribution Networks

The Pipelines and Gas Distribution Networks 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 network. The scope ends at the outlet of the gas meter where the consumer piping commences which is the handover point to the End Use Applications working group.

The topics that will be addressed within these boundaries includes:

- HSE elements such as leak detection, hazardous areas and material compatibility
- Gas quality specifications for the gas network
- Transmission and distribution pipelines
- Network equipment

This working group will liaise with existing pipeline and gas network committees to ensure adequate coverage for the use of hydrogen as a blend with natural gas, or as

pure hydrogen, in Australian Standards for gas network. The working group will also develop new content where necessary to close identified standards gaps.

2020 – 2023 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 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.

End Use Applications

The End Use Applications Working Group will monitor developments relating to end use applications using hydrogen or hydrogen/ natural gas blends and liaise with relevant standards committees to facilitate the development of Australian Standards for these applications.

The scope boundaries are the gas equipment installed downstream of the outlet of the consumer billing meter installation including but not limited to:

- Consumer piping
- Gas components
- Type A gas appliances
- Type B gas appliances

In addition, gas quality and HSE aspects including odorant and flame/leak detection will be addressed.

2020 – 2023 Focus areas:

- Review of current Standards Australia 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 work programs through liaisons.
- Review of published international standards or guides related to 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.

Fuel Cell Applications

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
- 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.

2020 – 2023 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.

Mobility Applications

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.

2020 – 2023 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.

Appendix I

ME-093 nominating organisations:

- Association of Accredited Certification Bodies
- Australasian Fire and Emergency Service Authorities Council
- Australia New Zealand Industrial Gas Association
- Australian Energy Market Operator
- Australian Hydrogen Council
- Australian Industry Group
- Australian Pipelines and Gas Association Limited
- Chemistry Australia
- CSIRO
- Department of Infrastructure, Transport, Regional Development and Communications
- Energy Networks Australia
- Engineers Australia
- Future Fuels Cooperative Research Centre
- Gas Appliance Manufacturers Association of Australia
- Gas Energy Australia
- Gas Technical Regulators Committee
- Institute of Chemical Engineers
- Institute of Electrical Inspectors
- National Energy Resources Australia
- The Australian Gas Association
- The University of Adelaide