IECEx International Hydrogen Conference 2024

Singapore, May 29, 2024

Activities of ISO/TC197 Hydrogen Technologies and ISO/TC 197/SC 1 Hydrogen at Scale and Horizontal Energy Systems

Tetsufumi Ikeda

The Association of Hydrogen Supply and Utilization Technology (HySUT)

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Tetsufumi Ikeda

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Dr. Andrei V. Tchouvelev

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1. Introduction About HySUT

HySUT
The Research Association of Hydrogen Supply/Utilization Technology

Established **July 31, 2009**
End of activity March 31, 2016

HySUT
The Association of Hydrogen Supply and Utilization Technology

Established Feb 2, 2016
Start of activity **April 1, 2016**

Chairman: Tomohide Miyata, Representative Director, CEO, ENEOS Holdings, Inc.
Location: 5-4-12Akasaka Minato-ku, Tokyo 107-0052
Members: 46 companies and organizations (as of May 2024)

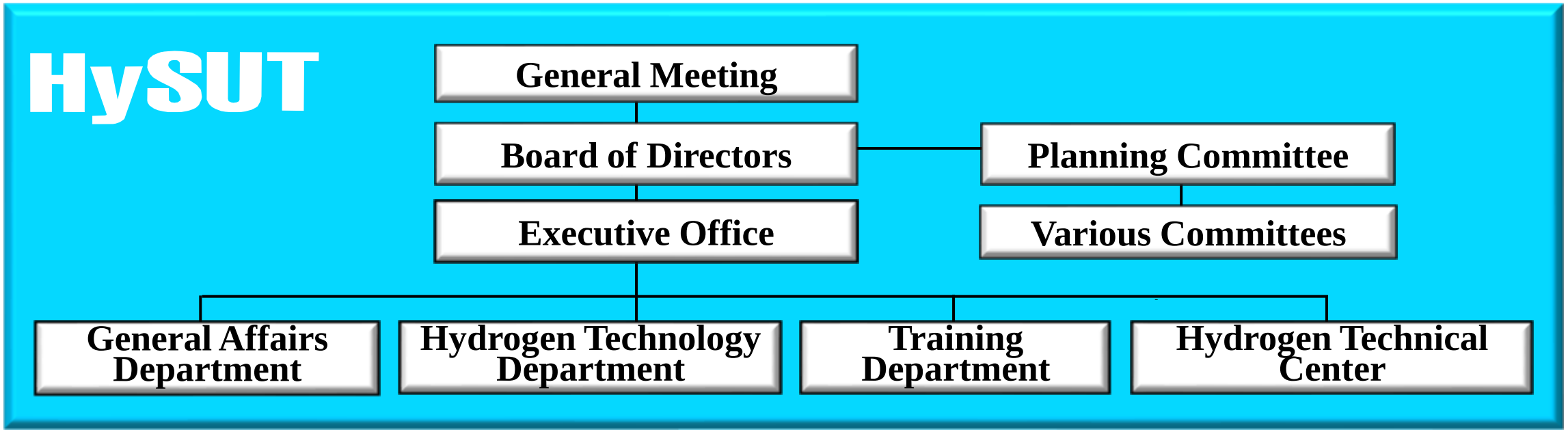
Missions: We aim to ensure the stable supply and safe distribution of hydrogen, improve user satisfaction, and contribute to the development of the hydrogen energy industry by taking a comprehensive approach and engaging in such activities as technological development, surveys and research, education and outreach on the supply and the utilization of hydrogen energy.

Industry organization specializing in hydrogen fueling infrastructure for mobility such as fuel cell vehicles

Activity Fields and Organization Chart of HySUT

1. **Technology Research and Development /** R&D for HRS (Hydrogen Refueling Stations) (NEDO's Program)
2. **International Standard Harmonization /** **Country member body of ISO/TC197 (NEDO's Program)**
3. **Support and Reliability Improvement of HRS /**
   Technical Support for Retail HRS, Safety and Security Activities, Education and training
4. **Industrial Activities /** Guidelines for HRS Technologies, Regulations Review
5. **Public Relations /** Outreach activities including exhibitions and trade shows

NEDO: The New Energy and Industrial Technology Development Organization



2. ISO/TC 197 Hydrogen Technologies

Scope:
Standardization in the field of systems and devices for the production, storage, transport, measurement and use of hydrogen

Secretariat: SCC

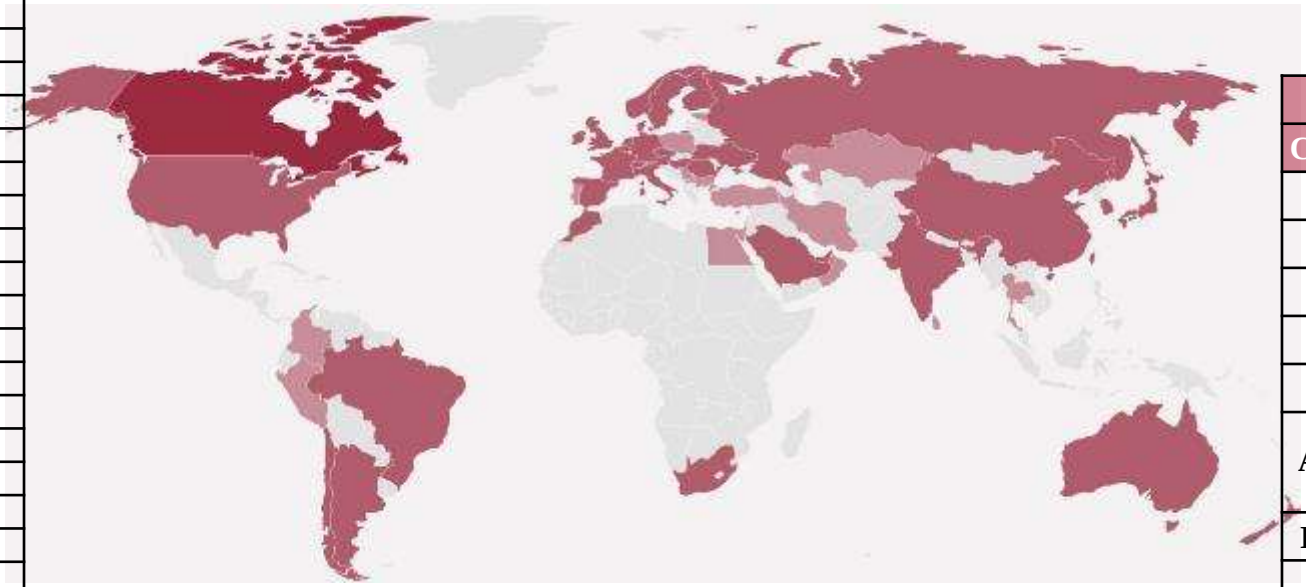
Committee Manager: Mr Siasia Morel

Chairperson (until end 2024): Mr Tetsufumi IKEDA

ISO Technical Programme Manager [TPM]:
Mrs Kirsi Silander-van Hunen
ISO Editorial Manager [EM]: Mr Arun ABY Paraecattil

ISO/TC 197 Hydrogen Technologies

PARTICIPATING MEMBERS (35)	
COUNTRY/TERRITORY	ACRONYM
Argentina	IRAM
Australia	SA
Austria	ASI
Belgium	NBN
Brazil	ABNT
Canada	SCC
Chile	INN
China	SAC
Czech Republic	UNMZ
Denmark	DS
Finland	SFS
France	AFNOR
Germany	DIN
Hungary	MSZT
India	BIS
Ireland	NSAI
Italy	UNI
Japan	JISC
Korea, Republic of	KATS
Morocco	IMANOR
Netherlands	NEN
New Zealand	NZSO
Norway	SN
Romania	ASRO
Russian Federation	GOST R
Saudi Arabia	SASO
Singapore	SSC
South Africa	SABS
Spain	UNE
Sweden	SIS
Switzerland	SNV
Ukraine	DSTU
United Arab Emirates	MoIAT-STR
United Kingdom	BSI
United States	ANSI



- Established in 1990
- 32 Plenary meetings
- Next meeting – Seoul, Dec. 2024

OBSERVING MEMBERS (18)	
COUNTRY/TERRITORY	ACRONYM
Bulgaria	BDS
Colombia	ICONTEC
Cyprus	CYS
Egypt	EOS
Estonia	EVS
Hong Kong Special Administrative Region of China	ITCHKSAR
Iran, Islamic Republic of	INSO
Israel	SII
Kazakhstan	KAZMEMST
Luxembourg	ILNAS
Oman	DGSM
Peru	INACAL
Poland	PKN
Portugal	IPQ
Serbia	ISS
Sri Lanka	SLSI
Thailand	TISI
Türkiye	TSE

ISO/TC 197 Plenary Meeting

Foshan, Guangdong Province, China / Dec. 4 - 8, 2017

Vancouver, British Columbia, Canada / Dec. 3 - 7, 2018

Grenoble, France / Dec. 9 - 13, 2019

Virtual / Dec. 9, 2020

Seoul, Korea, Hybrid → Virtual / Dec. 6 - 10, 2021

Sydney, Australia / Dec. 5 - 9, 2022

Vienna, Austria / Nov. 13 - 17, 2023

ISO/TC 197 Plenary Week
Vienna, Austria, November 13-17, 2023

Program:

- ✓ Working group meetings
- ✓ Strategic planning meeting
- ✓ Plenary meetings (TC197 & SC1)

ISO/TC 197 Scope

Standardization in the field of systems and devices for the production, storage, transport, measurement and use of hydrogen

Production

Storage

Measurement

Transport

Use

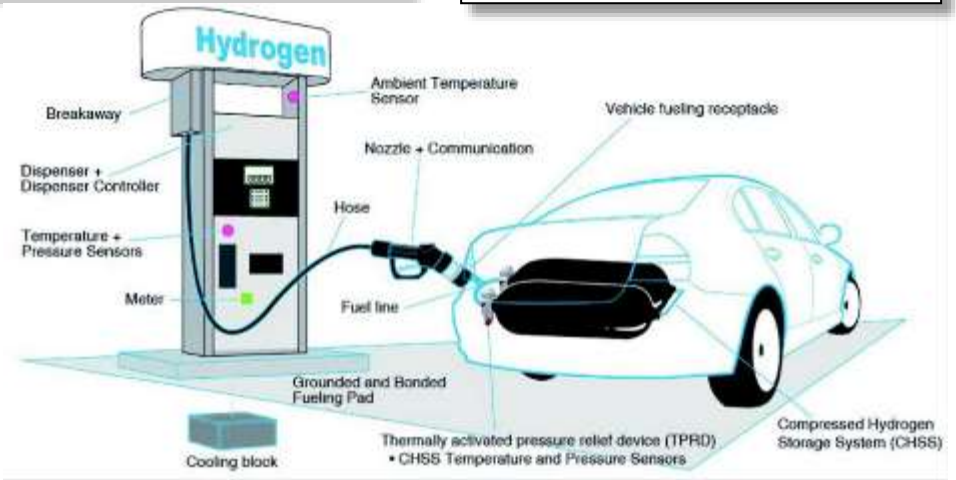
ISO/TC 197 Work Program by 2020

Fuel Quality

ISO 14687 Rev
→ Pub. 2019, cont.

Electrolysers

ISO 22734 Rev
→ Pub. 2019



Vehicle Components

Fueling Connectors
ISO 17268 Rev → Pub. In 2020, cont. work on H70HF (HD)

On-board Storage
ISO 19881 → Pub. in 2018, cont. to align with GTR13 Ph2

TPRD
ISO 19882 → Pub. in 2018, cont. to align with GTR13 Ph2

Storage Technologies

GH_2 Ground Storage ISO 19884 → FDIS failed; restart in 2020 w/NWIP (WG 15 on-going)
Me-Hy Portable Storage
ISO 16111 Rev → Published in 2018

Fueling Family ISO 19880

-1: HFS General Requirements → Pub. in 2020
-2: Dispensers → DIS Restart → FDIS by end 2023
-3: Valves → Pub. in 2018
-4: Compressors → CD
-5: Hoses → Pub. in 2019, cont.
-6: Fittings → CD → DIS by early 2023
~~-7: Fueling Protocols~~ (New Project #)
-8: Fuel Quality Control → Pub. in 2019, cont.

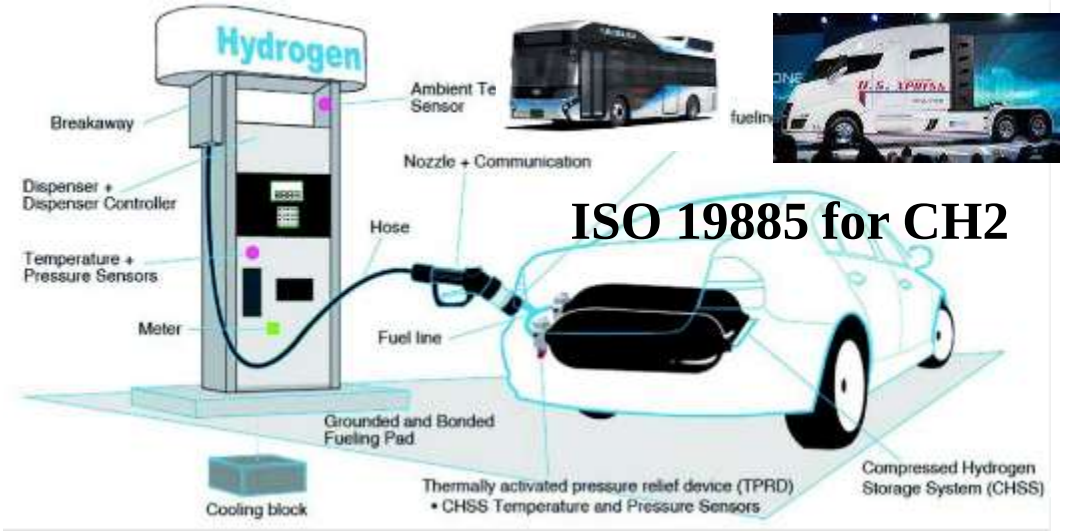
ISO/TC 197 Approved New Projects (2020 - 22)

Electrolysis ISO 22734:

Dynamic performance / safety -1
Testing for grid service -2

Fueling Family ISO 19880:

Sampling -9
O-Rings -7



Fueling Protocols for Compressed Hydrogen ISO 19885:

-1: General Req'ts
-2: Comm Req'ts
-3: HF for HD Road Vehicles

Safety:

ISO/TR 15916 Rev → Corr. Materials
Compatibility Table
New LH2 chapter

Fuel System Components for Compressed H_2 Vehicles:

ISO 19887 JWG w/TC22/SC41

ISO/TC 197 Approved New Projects (2023 -)

- LH2/sLH2 fueling protocol: Rev. ISO 13984
- LH2/sLH2 onboard tank: Rev. ISO 13985
- CcH2 connector: ISO 17268-3

- Methodology for determining the greenhouse gas emissions associated with the production and transport of hydrogen

  ➡ SC1 TS19870

Overview of International Standards developed by ISO/TC197

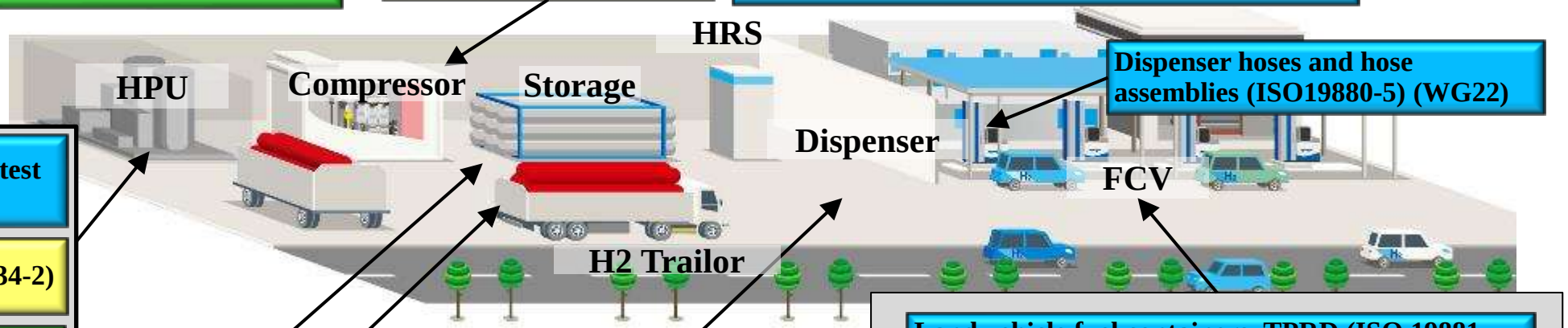
Fuelling Stations (19880-1) (WG24)

Hydrogen detection apparatus (ISO26142)

Compressors (ISO19880-4) (WG21)

Basic considerations for the safety of hydrogen systems (ISO/TR 15916) (WG29)

Fuelling protocols for hydrogen-fuelled vehicles (ISO19885) (WG24, WG38)



Dispenser hoses and hose assemblies (ISO19880-5) (WG22)

Hydrogen generators using water electrolysis, General requirements, test protocols and safety requirements (ISO22734-1) (WG34)

Testing guidance for performing electricity grid service (ISO/TR22734-2) (WG32)

Hydrogen generators using fuel processing technologies (ISO16110-1, -2)

Safety of pressure swing adsorption systems for hydrogen separation and purification (ISO/TS19883) (WG17)

Land vehicle fuel containers, TPRD (ISO 19881, ISO19882) (WG18)

Refuelling connection devices (ISO17268) (WG5)

Fuel system components for hydrogen fuelled vehicles (ISO19887) (JWG30)

Cylinders and tubes for stationary storage (ISO19884) (WG15)

Hydrogen absorbed in reversible metal hydride (ISO16111) (WG25)

Sampling for fuel quality analysis (ISO19880-9) (WG33)

Rubber O-rings (ISO19880-7) (WG31)

Dispensers and dispensing systems (ISO19880-2) (WG19)

Hydrogen fuel quality, Product specification (ISO14687) (WG27)

Fuel quality control (ISO19880-8) (WG28)

Analytical methods for hydrogen fuel (ISO21087) (TC158/JWG7)

Valves (ISO19880-3) (WG20)

Fittings (ISO19880-6) (WG23)

- Fuel Cell Vehicles (WG27 Task 1)
- Stationary Fuel Cell System (WG27 Task 2)
- Residential/commercial combustion appliances (WG27 Task 3)

Under development

Published

Under revision

International Standards developed by ISO/TC197

WG	ISO No.	Status	Classification	Title
WG27	14687	3	H2 quality	Hydrogen fuel quality - Product specification
WG29	TS15916	1	Safety	Basic considerations for the safety of hydrogen systems
WG5	17268-1	3	Fuelling devices	Gaseous hydrogen land vehicle refuelling connection devices / Part 1: Flow capacities up to and including 120 g/s
WG5	17268-2	3	Fuelling devices	Part 2: Flow capacities greater than 120 g/s
WG36	17268-3	1	Fuelling devices	Part 3: Cryo-compressed hydrogen gas
WG24	19880-1	2	Fuelling stations	Gaseous hydrogen - Fuelling stations / Part 1: General requirements
WG19	19880-2	1	Fuelling stations	Part 2: Dispensers and dispensing systems
WG20	19880-3	2	Fuelling stations	Part 3: Valves
WG21	19880-4	1	Fuelling stations	Part 4: Compressors
WG22	19880-5	1	Fuelling stations	Part 5: Dispenser hoses and hose assemblies
WG23	19880-6	1	Fuelling stations	Part 6: Fittings
WG31	19880-7	1	Fuelling stations	Part 7: Rubber O-rings
WG28	19880-8	1	Fuelling stations	Part 8: Fuel quality control
WG33	19880-9	1	Fuelling stations	Part 9: Sampling for fuel quality analysis
WG37	TS19880-10	1	Fuelling stations	Part 10: Mobile fueling stations

Status 1: Under development, 2: Published, 3: Under revision

International Standards developed by ISO/TC197 and SC1

WG	ISO No.	Status	Classification	Title
WG18	19881	3	Pressure vessels	Gaseous hydrogen - Land vehicle fuel containers
WG18	19882	3	Pressure vessels	Gaseous hydrogen - Thermally activated pressure relief devices for compressed hydrogen vehicle fuel containers
WG15	19884-1	1	Pressure vessels	Gaseous Hydrogen - Pressure vessels for stationary storage / Part 1: general requirements
WG15	TR19884-2	1	Pressure vessels	Part 2: Material test data of class A materials (steels and aluminum alloys) compatible to hydrogen service
WG15	TR19884-3	1	Pressure vessels	Part 3: Pressure cycle test data to demonstrate shallow pressure cycle estimation methods
WG24	19885-1	2	Fuelling	Gaseous hydrogen - Fuelling protocols for hydrogen-fuelled vehicles / Part 1: Design and development process for fuelling protocols
WG38	19885-2	1	Fuelling	Part 2: Communication between the vehicle and dispenser control systems
WG24	19885-3	1	Fuelling	Part 3: High flow hydrogen fuelling protocols for heavy duty road Vehicles
JWG30	19887	1	Vehicles	Gaseous Hydrogen - Fuel system components for hydrogen fuelled vehicles
WG35	13984	3	Liquid H2	Liquid Hydrogen - Land Vehicle Fueling Protocol
WG1	13985	3	Liquid H2	Liquid hydrogen - Land vehicle fuel tanks
WG34	22734-1	3	Water electrolysis	Hydrogen generators using water electrolysis / Part 1: General requirements, test protocols and safety requirements
WG32	TR22734-2	1	Water electrolysis	Part 2: Testing guidance for performing electricity grid service
SC1/WG1	TS19870	2	Sustainability	Hydrogen technologies - Methodology for determining the greenhouse gas emissions associated with the production, conditioning and transport of hydrogen to consumption gate
SC1/WG2	19888-1	1	Aerial vehicles	Hydrogen Technologies - Aerial Vehicles / Part 1: Liquid Hydrogen Fuel Storage System

Status 1: Under development, 2: Published, 3: Under revision

ISO/TC 197/SC1

Hydrogen at Scale and Horizontal Energy Systems

Scope:

Standardization of large scale hydrogen energy systems and applications including aspects of testing, certification, sustainability and placement, and coordination with other relevant standardization bodies and stakeholders

Secretariat: SCC

Committee Manager: Ms Sara Marxen

Chairperson (until end 2025): Dr Andrei Tchouvelev

ISO Technical Programme Manager [TPM]:
Mrs Kirsi Silander-van Hunen
ISO Editorial Manager [EM]: Mr Arun ABY Paraecattil

ISO/TC 197/SC 1

PARTICIPATING MEMBERS (25)	
COUNTRY/TERRITORY	ACRONYM
Argentina	IRAM
Australia	SA
Austria	ASI
Belgium	NBN
Brazil	ABNT
Canada	SCC
Chile	INN
China	SAC
Denmark	DS
Finland	SFS
France	AFNOR
Germany	DIN
Italy	UNI
Japan	JISC
Korea, Republic of	KATS
Netherlands	NEN
Norway	SN
Russian Federation	GOST R
Singapore	SSC
South Africa	SABS
Spain	UNE
Sweden	SIS
Switzerland	SNV
United Kingdom	BSI
United States	ANSI

- Established in 2022
- 2 Plenary meetings
- Next meeting – Seoul, Dec. 2024

OBSERVING MEMBERS (7)	
COUNTRY/TERRITORY	ACRONYM
Colombia	ICONTEC
Czech Republic	UNMZ
Egypt	EOS
Morocco	IMANOR
Namibia	NSI
Poland	PKN
Ukraine	SE UkrNDNC

ISO/TC 197 & SC1 Division of Scope

ISO/TC 197 Focus

- ✓ Basic Requirements for Hydrogen Technologies
  - ➢ Production
  - ➢ Storage
  - ➢ Handling
  - ➢ Built environment
  - ➢ Protocols and components including road vehicles and their fueling infrastructure

(Toyota website)

ISO/TC 197 / SC1 Focus

- ✓ Applications' requirements of Hydrogen technologies at large scale and in horizontal energy systems with H2 as a central link
- ✓ Sustainability aspects (GHG, H2GO, Cert)
- ✓ Coordination with TCs & stakeholders on:
  - ➢ Renewables and Energy Storage/Grid Balancing
  - ➢ Multi-fuel systems
  - ➢ Testing and certification of H2 components
  - ➢ Rail, maritime, aviation applications
  - ➢ Residential applications

(Toyota website)

(Toshiba website)

IEA TCP Hydrogen and ISO/TC 197

Connecting PNR with Standards

IEA TCP Hydrogen Task 43 on Hydrogen Safety

Safety and RCS of Large-Scale Hydrogen Energy Applications

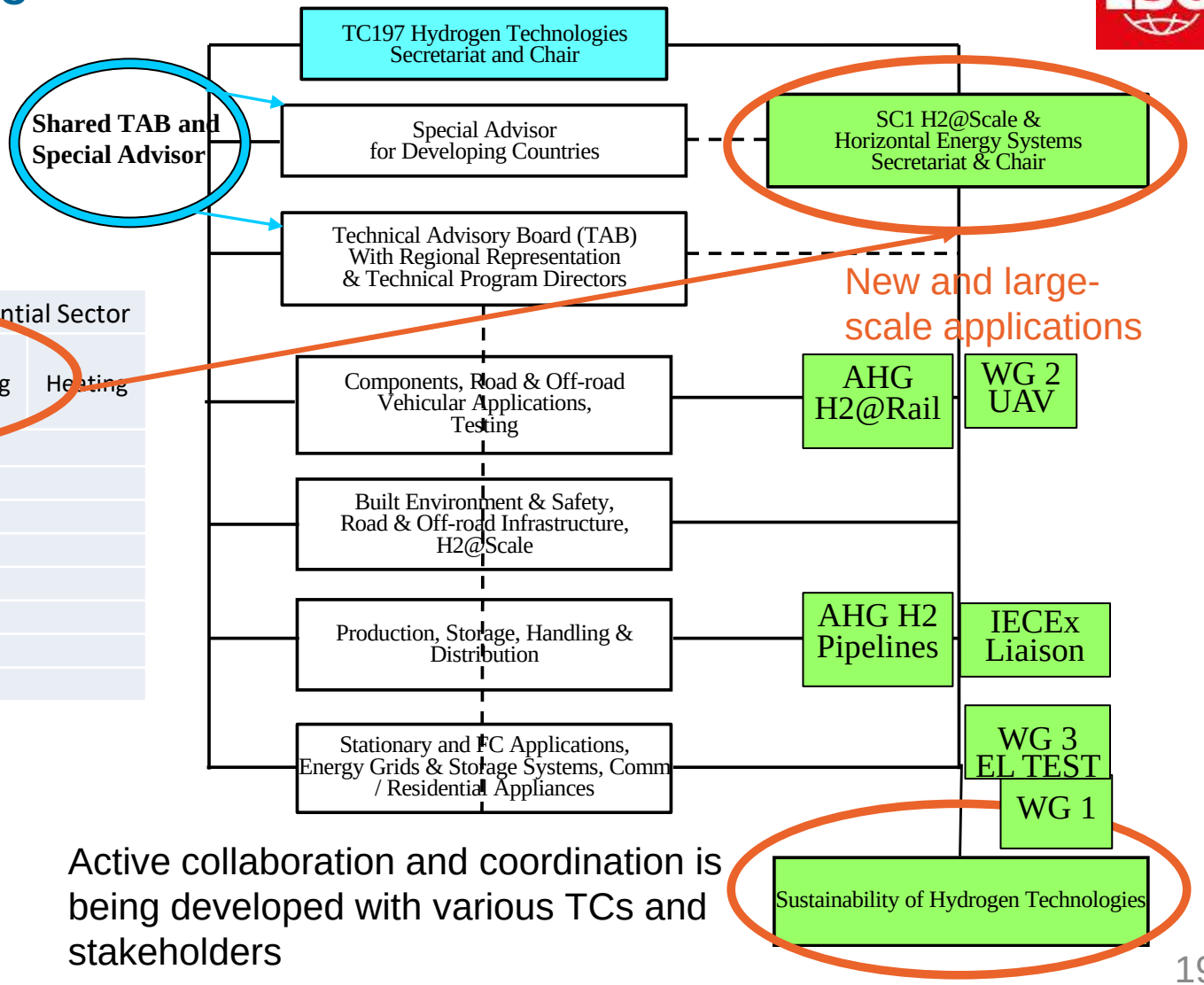
Focus on Common "Large Scale" and "Horizontal" Safety and Regulatory Aspects

Mobility Infrastructure					P2H with RES		Residential Sector	
Heavy duty road vehicles	Multifuel stations	Rail	Maritime	Aviation	Electrolysis	Energy Storage	Cooking	Heating
Common horizontal topics:								
Social (comprehensive) risk								
Safety culture and management system								
Safety distances								
Hazardous areas								
Confined environment: Enclosures, buildings, structures								
Hydrogen system safety								
Liquid and compressed hydrogen								

Kick off meeting – June 27, 2022
1st in-person meeting – October 17-21, 2022
2nd in-person meeting – February 27-March 3, 2023
3rd in-person meeting – September 18, 2023
4th in-person meeting – April 8-12, 2024

Hydrogen TCP

Program Level ISO/TC197 Organization Chart



Active collaboration and coordination is being developed with various TCs and stakeholders

ISO/TS 19870:2023 Published!

TECHNICAL SPECIFICATION

ISO/TS 19870

First edition
2023-11

Hydrogen technologies — Methodology for determining the greenhouse gas emissions associated with the production, conditioning and transport of hydrogen to consumption gate

Technologies de l'hydrogène — Méthodologie pour déterminer les émissions de gaz à effet de serre associées à la production, au conditionnement et au transport de l'hydrogène jusqu'au point de consommation

Reference number
ISO/TS 19870:2023(E)

New ISO standard on hydrogen unveiled at COP28

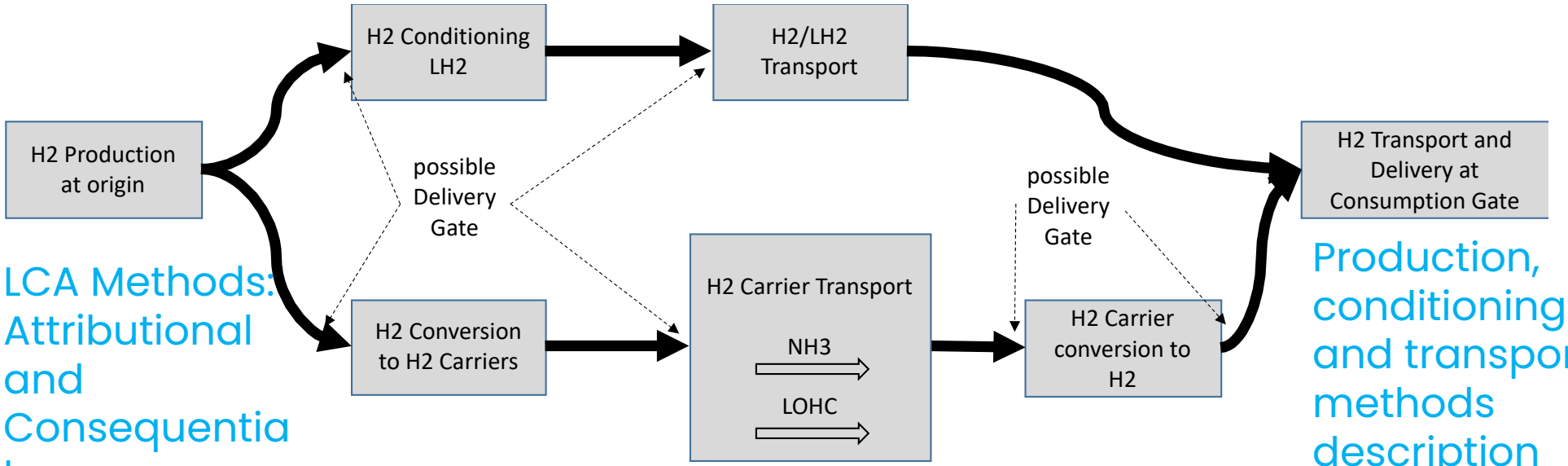
During COP28 in Dubai, the International Organization for Standardization (ISO) unveiled a new technical specification (ISO/TS 19870) as a foundation for harmonisation, safety, interoperability and sustainability across the hydrogen value chain.

Scope of ISO Methodology ISO/TS 19870:2023

To establish CFP (Carbon Footprint of Product) of Hydrogen along its supply chain: from Well to any Delivery gate up to Consumption gate.

Key ISO standards: 14044 (on LCA) and 14067 (on CFP)

Considered hydrogen supply chain



LCA Methods: Attributional and Consequential

Production, conditioning and transport methods description

ISO/TS 19870 Pub. Nov 30, 2023

ISO 19870-1, -2, -3, -4: 2024-26

Started, DIS Nov 2024

NOT in the Scope of the ISO Methodology

ISO/TS 19870:2023 is **NOT** defining what is acceptable in a given jurisdiction or for the purpose of a specific public policy!

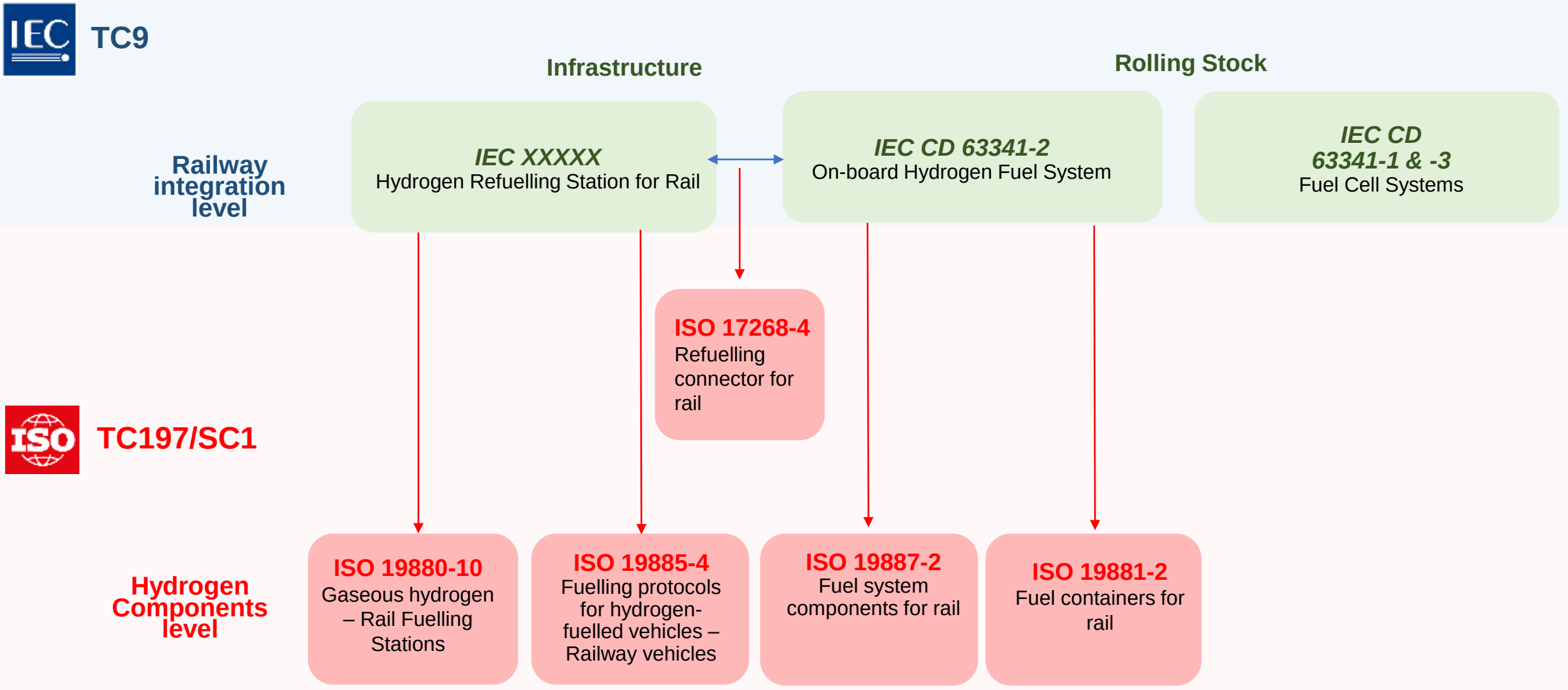
Thresholds, Labels (Colors) are defined by public policies or by the market

Public authorities: Thresholds and labels. What is acceptable

Standards: How to measure

Harmonizing labels and thresholds should only be done through **negotiations between governments**

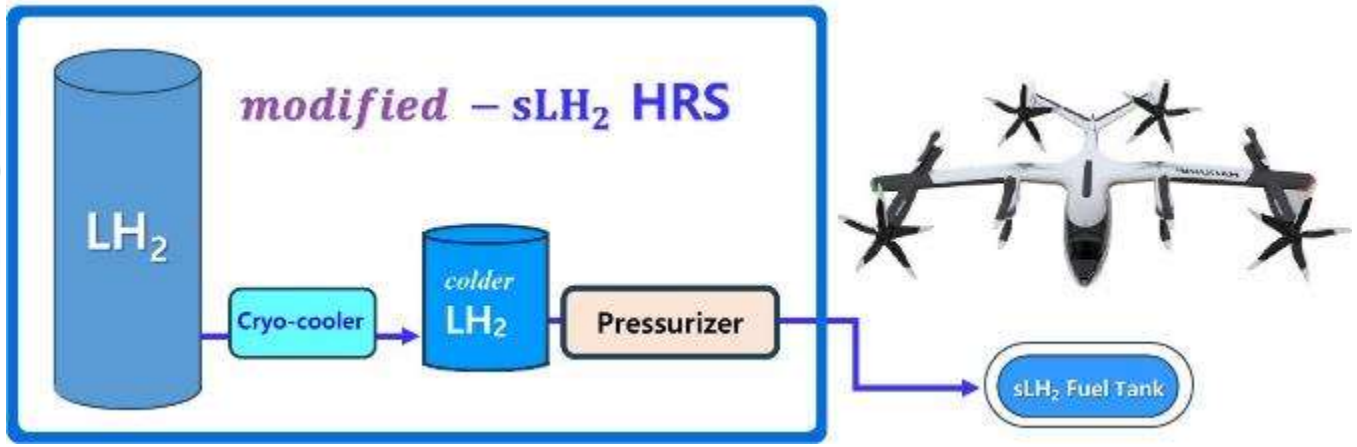
Hydrogen technologies for Railway – International standardization mapping

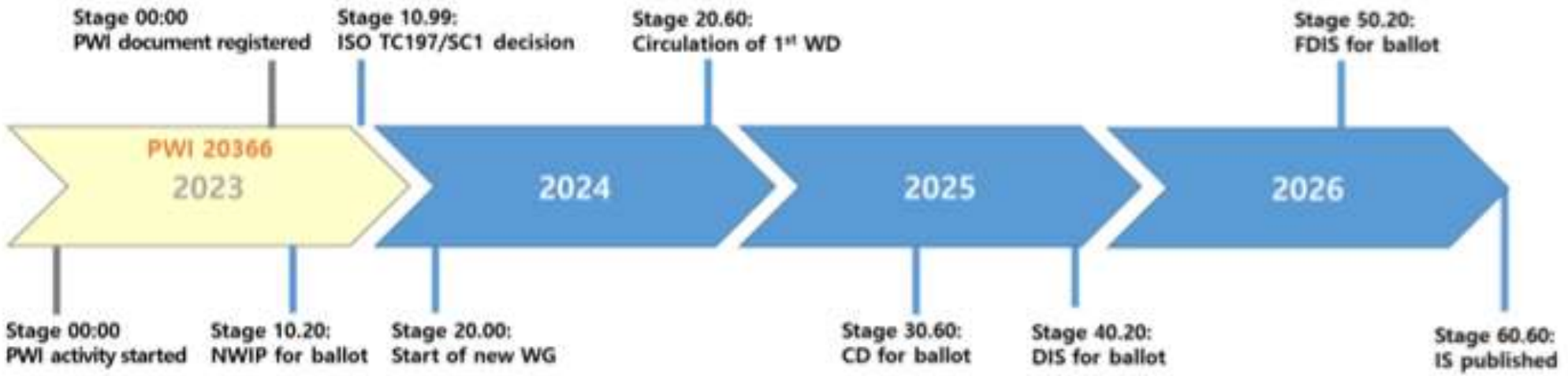


Hydrogen technologies for Aerial vehicles

ISO/AWI 19888-1 Hydrogen Technologies – Aerial Vehicles – Part 1: Liquid Hydrogen Fuel Storage System

Convener	Yong Nam CHOI (Korea Atomic Energy Research Institute)
Project Leader	Cheol Woo PARK (Hyundai Motor Company)





ISO/TC97/SC1/AHG2

ISO/TC97/SC1/AHG2 was activated to promote coordination of standardization on H_2 and high H_2 content blends pipelines.

Title: H_2 and high H_2 content blends pipelines.

Convenor: Prof. Jinyang ZHENG（until the end of 2026).

Terms of Reference:

(1) Discuss and research on patents, literatures, technologies, and standards for hydrogen and high content hydrogen blended natural gas pipelines, develop a report on state of the art and research priorities in hydrogen pipeline

(2) Develop a roadmap for future hydrogen pipeline standards development

Thank you very much for your attention!

This report contains the results of the programs supported by the New Energy and Industrial Technology Development Organization (NEDO).