Hydrogen standards Gap analysis

Green Hydrogen Taskforce: Sub working Group 4 on **Quality Infrastructure, Safety** and Legal Framework

24th April 2023

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HYDROGEN SUPPORTS DE-CARBONIZATION EFFORTS IN THE GLOBAL ECONOMY

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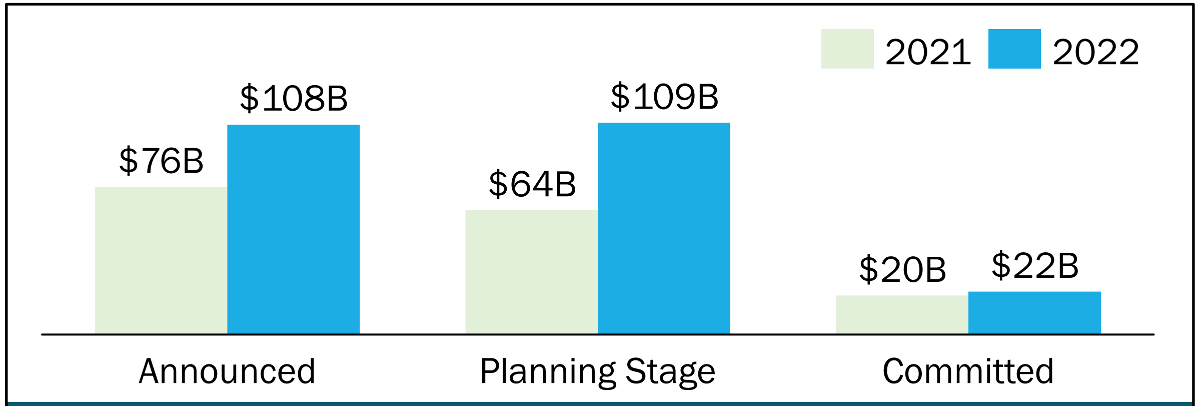
H_2

- Energy Carrier
- Reducing Agent
- Feedstock

Zero emissions possibilities



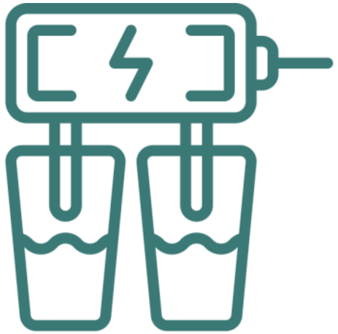
Investments in Hydrogen (Production, Infra, End-Use) [2022]

Hydrogen's Use Cases

Power	Iron & Steel	Refineries
Transport	Industry	Gas
Cement	Fertilizers	Food & Beverages

Source: IEA, Hydrogen Insights

GREEN H2 STANDARDS & POLICIES EMERGING ACROSS GEOGRAPHIES



Production

Timeline		
2019	• **Both countries have adopted the ISO 14687:2019 regulations which specify a 99.97% Hydrogen purity rating for use in fuel cell applications** and **98% in hydrogen combustion engines**	
2020	• Germany launches **National Hydrogen Strategy** • **14TWh of Green H_2 production** will be needed by 2030	• CERC notifies that H_2 is a potential energy store linked with RE projects
2023	• European Commission publishes draft rules for Green H_2 production from electrolysis • Electrolysers for H_2 must be powered by **new renewable electricity production** • "Green" H_2 criteria – GHG savings, share of RE energy needed, energy intensity needed	• India launches **National Green Hydrogen Mission** • National Green H_2 Mission empowers BIS to develop regulations & standards for upcoming Green H_2 capacity
2023-2026		• H_2 demand and capacity expansion
2030	• 90-110 TWh of H_2 demand expected	• Use-case expansion across all sectors, 5MMT of GH_2 capacity expected
2035		• Expected that NH_4 fertilizer imports will be substituted with GH_2 derivatives

Rapid deployment of Green H_2 electrolyser capacity will require knowledge-sharing & partnerships between industry & govt.

INDIAN H2 STANDARDS → COMBINATION OF INDIAN & GLOBAL STANDARDS

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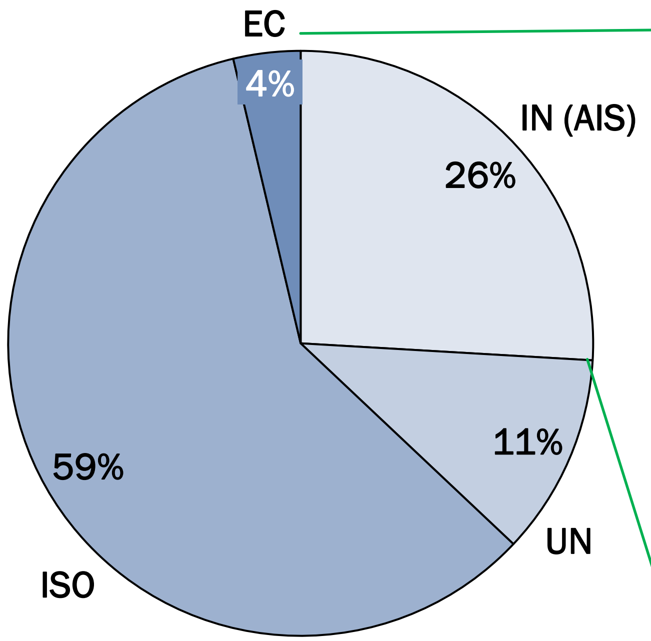


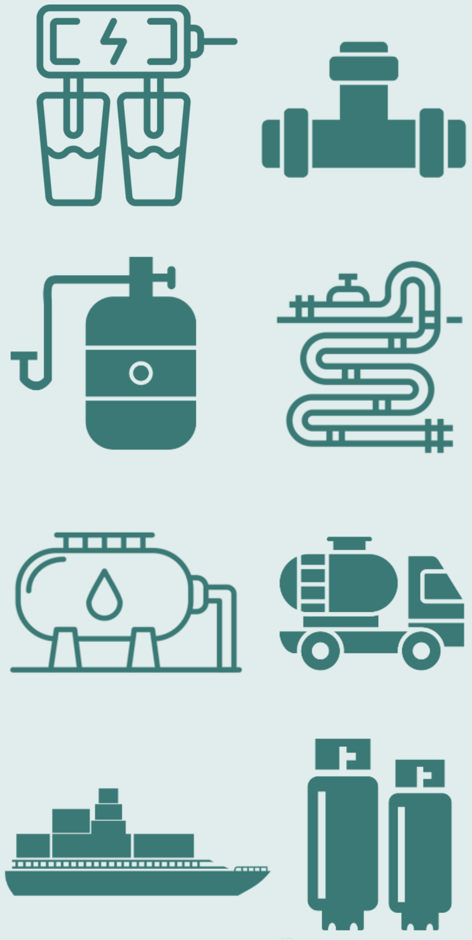
IN Std. Items	German standard	Differentiators
Compressed gaseous hydrogen cylinder/container	ISO TC58, ISO TC58/SC3	Indian climatic & road condition basis
Fitment of cylinder on vehicle	UN ECE GTR 180/13	Basis existing standards for CNG vehicle fleet
Construction and functional safety of battery operated vehicles	UN ECE GTR 180/20 UN ECE GTR 180/22	Indian climatic & road condition basis
Measurement of electric energy consumption	UN ECE GTR 180/21	Indian climatic condition basis
Measurement of vehicle range for electric power train vehicles	WLTP	Basis Indian road conditions and driving style
Measurement of net power and the maximum 30 minute power	UN ECE GTR 180/21	Indian climatic condition basis
Safety requirement of traction battery	UN ECE GTR 180/22	Indian road condition and driving style basis

Germany and India are aligned on the ISO 17268 standard for fueling and station infrastructure

Alignment with global standards will be key to fostering a dynamic H-FCEV supplier ecosystem in India and increasing market attractiveness for OEMs

GREEN H2 ADOPTION WILL REQUIRE EFFORT TO HARMONIZE STANDARDS

H_2 Value Chain



Global cooperation will be a key driven of safe and sustainable adoption of hydrogen technologies

Technology transfers and partnerships

+

Cooperation on standards development

+

Building out capacity & sharing learned experiences

=

Globally acceptable and growth-supportive standards

Harmonization pathways for Indian conditions

MNRE Created Working Group on Regulations and Standards

Working Group on Regulations compliance & Standards(RCS) on Green Hydrogen	Sub Groups identified	Sub-Groups Shared the RCS Gap Analysis

Subgroup 1
Gap Analysis: 75 Standards

Manufacturing of Electrolyser: 23 codes amd Standards
Production on Green Hydrogen 18 codes and Standards
Hydrogen Use in Industrial Application 34 Codes and standards

Sub-Group-I

Hydrogen production and use

Convener: CII

Members: BIS, Electrolyser Manufacturers, Green H2 producers

Sub-Group-II

Storage and Transportation of Hydrogen

Convener: FICCI

Members: DPIIT/PESO, BIS, GAIL, Gas handling and supply industry

Sub-Group-III

Hydrogen-fuelled mobility applications

Convener: SIAM

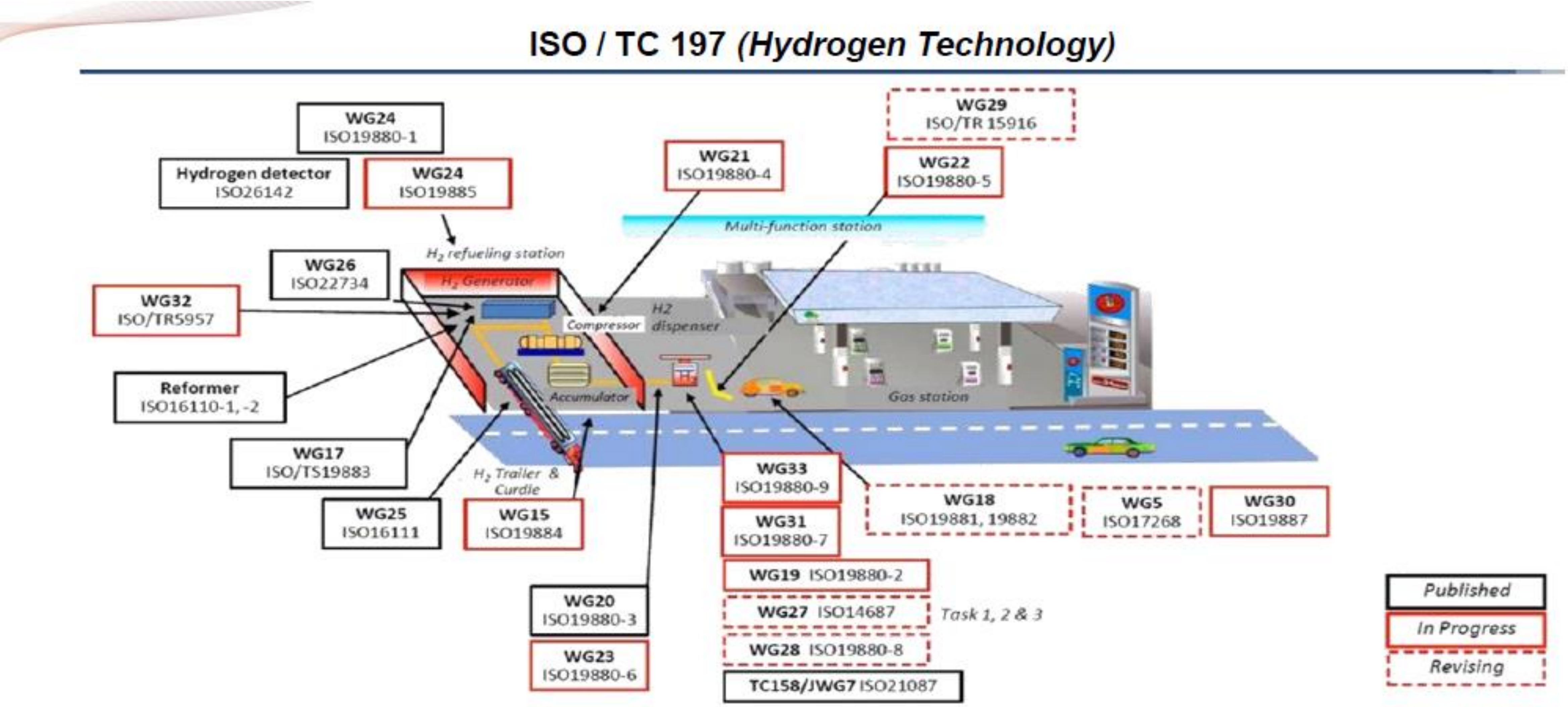
Members: MoRTH, ARAI, BIS, IOCL, NTPC, Automobile Industry

Subgroup 2
Over 150 standards have been identified during the course of action for Gap Analysis

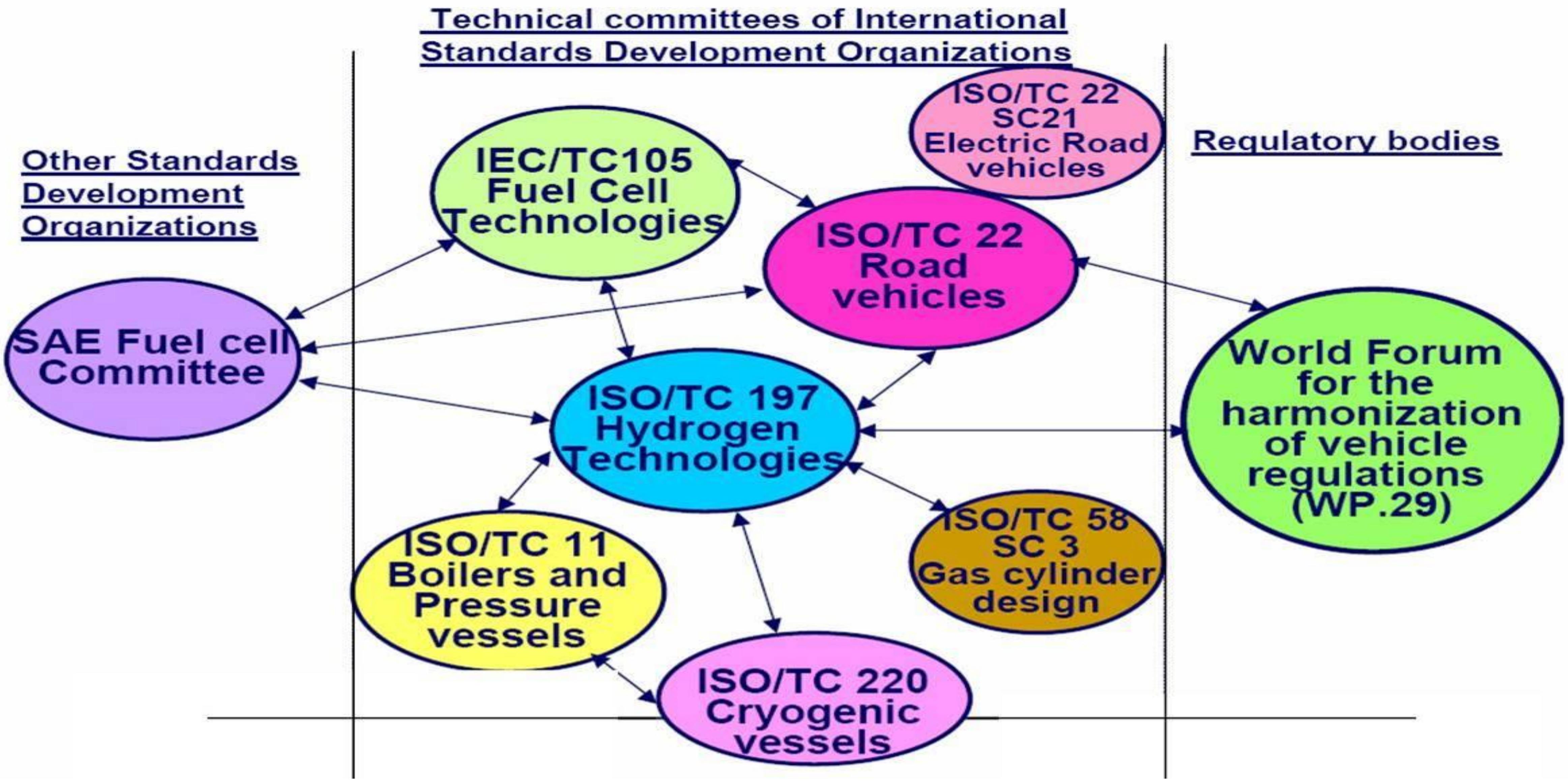
Subgroup 3
Gap Analysis: 150 RCS Analysis done
(142 Automobiles + 8 Locomotive)

142 Regulations, Codes & Standards

Emission	5 nos
Performance	83 nos
Component	30 nos
Fuel	39 nos
Terminology	15 nos
Safety	20 nos


ISO / TC 197 (Hydrogen Technology)
WG24 ISO19880-1
Hydrogen detector ISO26142
WG24 ISO19885
WG21 ISO19880-4
WG29 ISO/TR 15916
WG22 ISO19880-5
Multi-function station
H2 refueling station
H2 Generator
WG26 ISO22734
WG32 ISO/TR5957
Compressor
H2 dispenser
Reformer ISO16110-1, -2
Accumulator
Gas station
WG17 ISO/TS19883
H2 Trailer & Curdle
WG25 ISO16111
WG15 ISO19884
WG33 ISO19880-9
WG31 ISO19880-7
WG18 ISO19881, 19882
WG5 ISO17268
WG30 ISO19887
WG20 ISO19880-3
WG23 ISO19880-6
WG19 ISO19880-2
WG27 ISO14687
Task 1, 2 & 3
WG28 ISO19880-8
TC158/JWG7 ISO21087
Published
In Progress
Revising

INTERNATIONAL STANDARDS TECHNICAL COMMITTEES ON HYDROGEN



ISO 197 HYDROGEN STANDARDS COMMITTEE STRUCTURE

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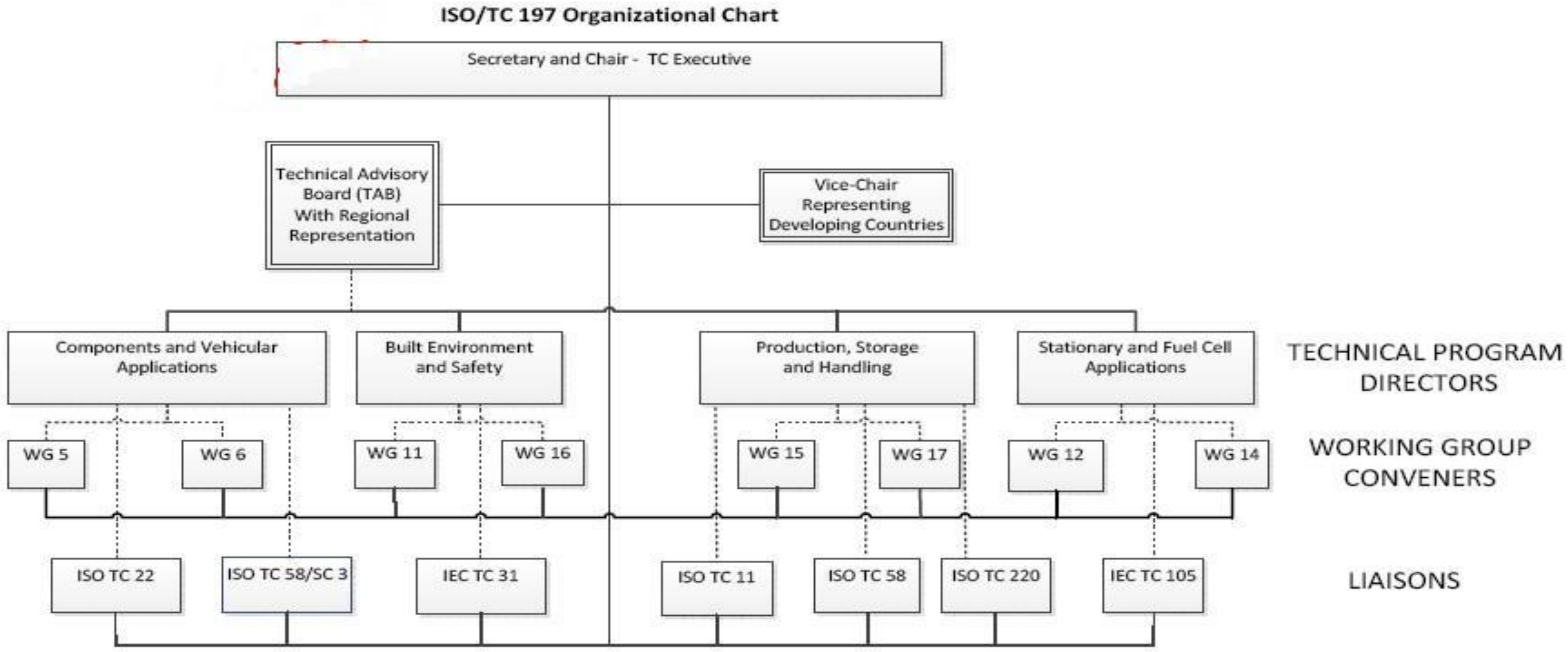
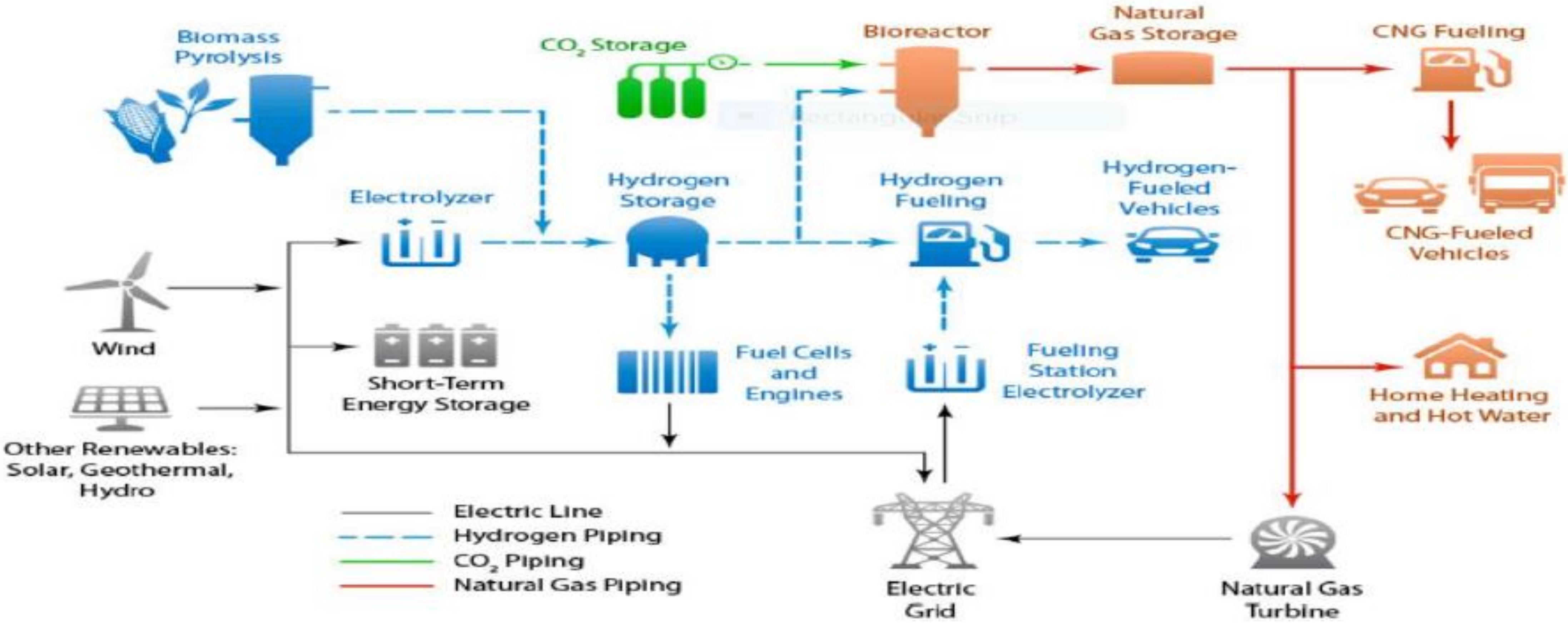


Standards for Hydrogen Fuel, Components, Cylinders and Vehicles

CII: STANDARD GAP ANALYSIS

Regulations, Codes & Standards (RCS) for Largescale Hydrogen Systems (Production & Use)

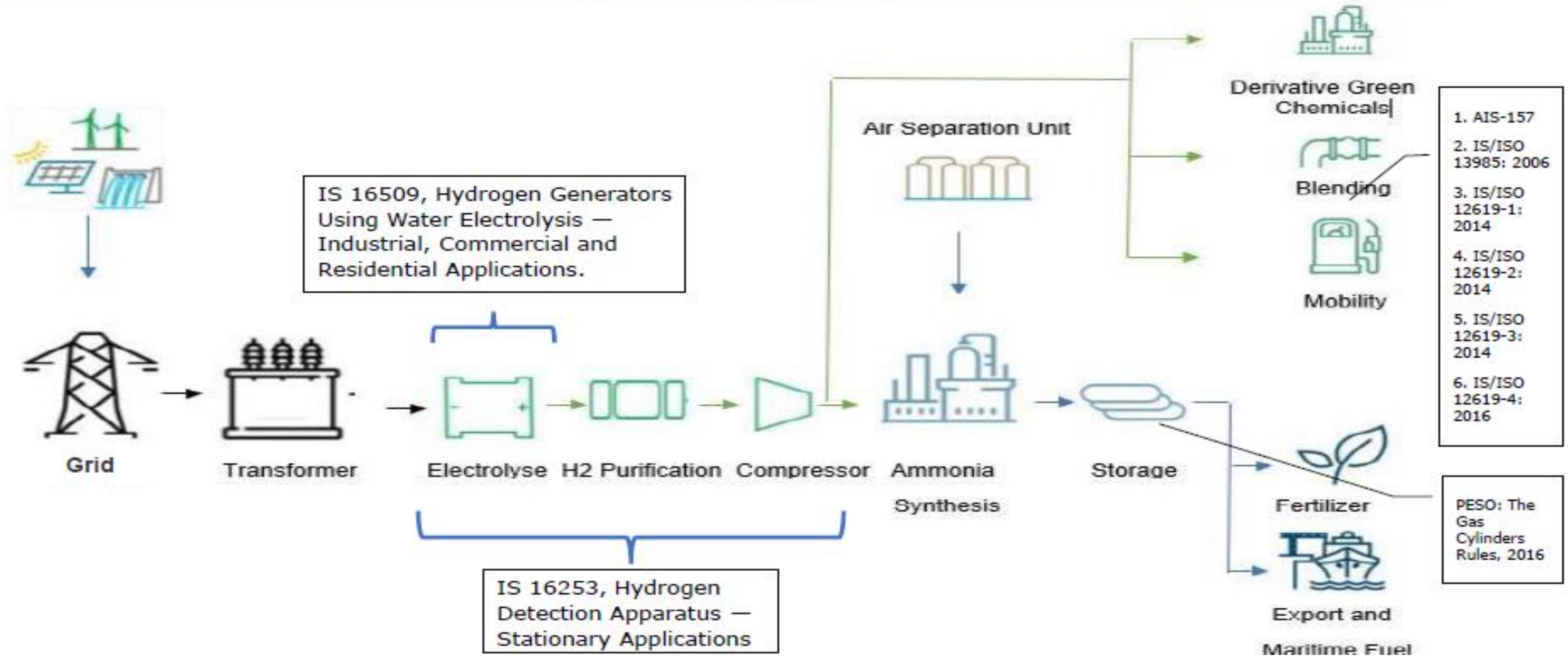
Hydrogen production through renewable energy / green forms



Subgroup 1

CII: STANDARD GAP ANALYSIS

Regulations associated with various areas of Hydrogen Generation and Use



CII: STANDARD GAP ANALYSIS SUMMARY

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Summary of the Study

Manufacturing of Electrolyser

- 1 existing Code: IS 16509-2020 (ISO 22734-2019)
- 22 Recommendations made

Production on Green Hydrogen

- 2 existing Code: IS 16509-2020 (ISO 22734-2019) and NFPA – 2 (on safety)
- 16 Recommendations made

Hydrogen Use in Industrial Application

- 12 existing Codes and Standards identified
- 22 Recommendations made

CII: STANDARD GAP ANALYSIS RECOMMENDATIONS

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Subgroup 1

Priority Recommendations

Sl.no	Key interventions			Indian Standard		International Standard		Gap	Recommendation	Reasoning
				Name	No.	Name	No.			
1)	AWE | H2 Purity	After separation unit	99.8 %	Compressed hydrogen Specification	IS 1090:2002	Hydrogen fuel quality	ISO 14687-2:2019	The Chinese (GB) and ISO standards have a more detailed classification of applications and grade of purity	Both AWE and PEM can achieve ultra-high pure hydrogen purity. Purity of hydrogen should be defined as per the application.	1. The level of purity is application and material specific. 2. Achieving higher purity of hydrogen is expensive and energy intensive
		After Deoxo unit	99.95 %							
		After Dryer unit	99.999%							
1)	AWE | System Efficiency	58-60% (complete system including: electrical system, Electrolyser stack, Separation unit, Deoxygenation, dryer and chiller) based on LHV		No standard available		No standard available		Efficiency of the system may vary based on the purity and pressure output of hydrogen. Efficiency of electrolyser stack must also be a parameter	Widely 3 methods of efficiency calculation are used namely, 1) Lower heating value 2) Higher Heating Value 3) Voltage efficiency A suitable method should be finalized for uniformity	To help ease of comparison and maintain uniformity
1)	AWE | H2 Pressure	Max 16 barg		Hydrogen Generators Using Water Electrolysis — Industrial, Commercial And Residential Applications	IS 16509 : 2020	Hydrogen Generators Using Water Electrolysis — Industrial, Commercial And Residential Applications	ISO 22734 : 2019	Both the Indian IS 16509 : 2020 and International ISO 22734 : 2019 standards have given the definitions of MAWP (Maximum allowable working pressure) and MOP (Maximum operating pressure) and testing procedures but haven't mentioned a value	Values may be mentioned for the use of electrolysers in specific applications keeping in mind safety and technical requirements	This will help in setting a benchmark

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S u b g r o u p 1

Priority Recommendations

S.No	Key interventions		Indian Standard Name	Indian Standard No.	International Standard Name	International Standard No.	Gap	Recommendation	Reasoning
1)	PEM | H2 Purity	Refer 1							
1)	PEM | System Efficiency	Refer 2							
1)	PEM | H2 Pressure	Maximum pressure of 40 barg	Hydrogen Generators Using Water Electrolysis — Industrial, Commercial And Residential Applications	IS 16509 : 2020	Hydrogen Generators Using Water Electrolysis — Industrial, Commercial And Residential Applications	ISO 22734 : 2019	Both the Indian IS 16509 : 2020 and International ISO 22734 : 2019 standards have given the definitions of MAWP (Maximum allowable working pressure) and MOP (Maximum operating pressure) and testing procedures but haven't mentioned a value.	Values may be mentioned for the use of electrolysers in specific applications keeping in mind safety and technical requirements	This will help in setting a benchmark

Subgroup 2

FICCI: STANDARD GAP ANALYSIS & RECOMMENDATIONS

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Gap Analysis (Type-wise) and Recommendations

- **3 Types of categories identified for the gap analysis.**

Type 1

Analysis of **International standards that are missing in the Indian norms**.

And mapping done to ensure the adoption of relevant standards in the Indian system.

Type 2

Standards **available in both Indian as well as international standards.**

The gaps were then identified to understand further scope for improvement.

Type 3

National and International codes not available or Partially available.

Henceforth, this analysis includes extracting out recommendations (experience based)

- **Summary**

FICCI(Convenor of Subgroup-II) consolidated comprehensive inputs for the framework on RCS to enable work for **storage and transportation for green hydrogen** within the country:

- **More than 150 R, C, S mapped against respective topics**
- **Recommendations to adopt International C&S - ~ 60 nos.**
- **Recommendations related to update of existing R, C, S and / or new C&S - ~ 22 nos.**

SIAM SUBGROUP III: SCOPE OF WORK

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Subgroup 3

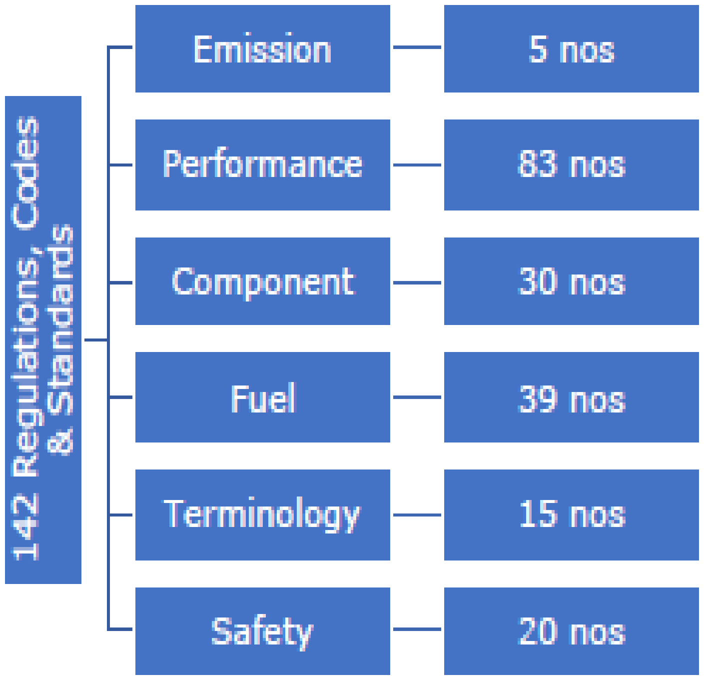
- Fuel Cell Vehicles including components, sub-components: Framework for system design/testing, vehicle safety, performance, terminology, hydrogen sensors and fuel system.
- Fuel Cell: Design considerations on thermal management, performance, and recyclability.
- IC Engine vehicles fuelled by pure Hydrogen and Hydrogen-blended fuels
- Refuelling Infrastructure, process, and equipment
- Hydrogen/Hydrogen derivative fuelled marine propulsion systems
- Hydrogen/Hydrogen derivative locomotive for rail transportation.
- Hydrogen/Hydrogen derivative gensets application.
- Hydrogen/Hydrogen derivative construction equipment vehicles application.
- Testing infrastructure readiness.
- Fuel quality and specifications
- Emission norms

Subgroup 3

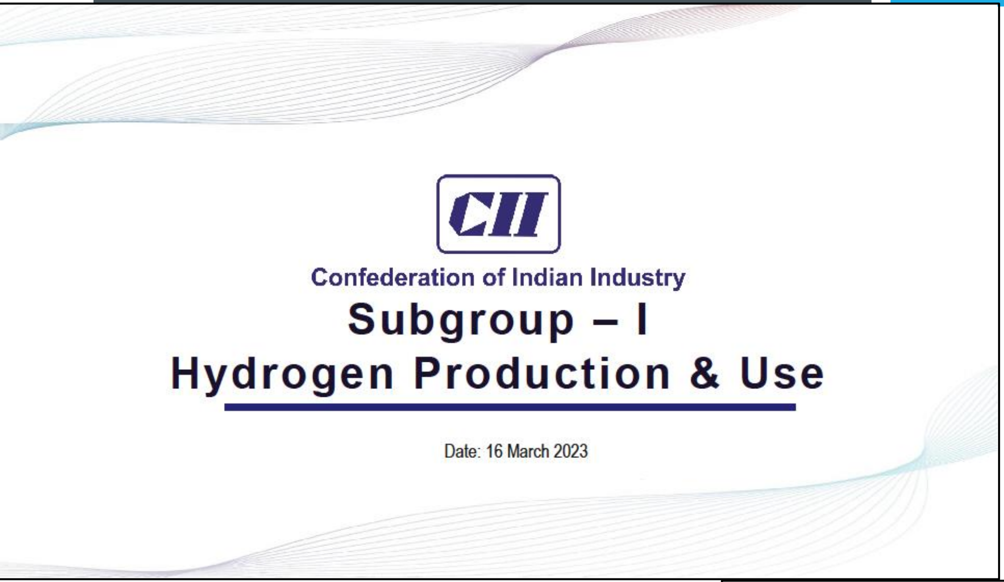
SIAM- STANDARD GAP ANALYSIS

- **Milestone I: 150 relevant RCS identified & covered**
- **Milestone II: Gap Analysis carried out**
  - At product, system & component levels with priority
  - To facilitate unhindered development of applications
  - Keeping safety as paramount criteria, feasibility of design, development, testing, validation & certification ensured
  - Identified amendments required in the existing RCS
  - For all new RCS, a short scope prepared
- **Milestone III: Drafting of Standards, Amendments & Recommendations carried out**
  - New standard drafted for hydrogen powered L category vehicles
  - Amendments being recommended in AIS 157 – Safety regulation for H2 FC vehicles (M&N Category)
  - New standard drafted AIS 195 for hydrogen powered ICE vehicles(M & N Category)

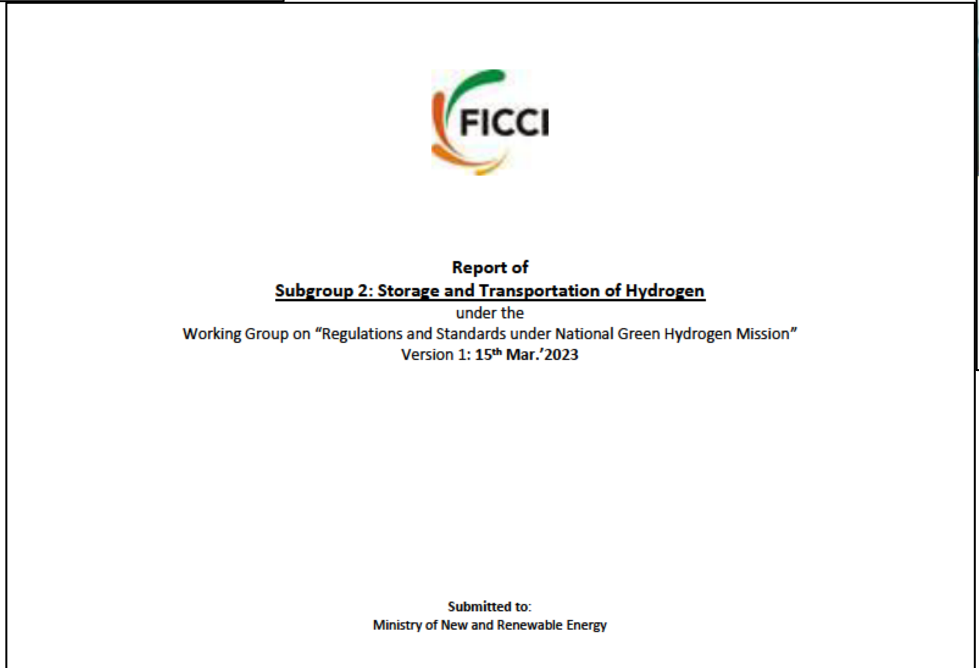
150 RCS Analysis done
(142 Automobiles + 8 Locomotive)



SUB-GROUP RECOMMENDATIONS || REPORTS


CII
Confederation of Indian Industry
Subgroup – I
Hydrogen Production & Use
Date: 16 March 2023

CII- Subgroup 1


FICCI

Report of
Subgroup 2: Storage and Transportation of Hydrogen
under the
Working Group on "Regulations and Standards under National Green Hydrogen Mission"
Version 1: 15th Mar.'2023

Submitted to:
Ministry of New and Renewable Energy

FICCI- Subgroup 2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REPORT ON STANDARDS & REGULATORY FRAMEWORK
Hydrogen Fuelled Mobility Applications

Submitted by
PRASHANT K BANERJEE
Convenor, Subgroup III
Hydrogen Fuelled Mobility Applications
under National Green Hydrogen Mission

SIAM- Subgroup 3

NEXT ACTION PLAN- INDO GERMAN ENERGY FORUM

Next Action Plan

1. Work Closely with Indo-German Energy Forum to ensure India and Germany are closely aligned in the formation and implementation of policies and Rules

2. Participate Actively in International Organization for Standardization
Technical Committee 197 (ISO/TC 197)

   i. WG1: Hydrogen Production
   ii. WG2: Hydrogen Storage
   iii. WG3: Hydrogen Systems and Infrastructure
   iv. WG4: Fuel Cells and Other Hydrogen Utilization Devices
   v. WG5: Safety and Environmental Aspects of Hydrogen Technologies

3. International Electrotechnical Commission (IEC)
-Technical Committee 105 (TC105) - Fuel cell technologies:
-Technical Committee 108 (TC108) safety of electronic equipment in Hydrogen Tech

4. Active participation in UNECE Working Party on Pollution and Energy **(GRPE) Subgroup on Hydrogen Fuel Cell Vehicle Task Force**

SYNCHRONIZING OUR STRENGTHS & OBJECTIVES || INDIA-GERMANY

INDIA

National Green Hydrogen Mission INDIA

The overarching objective of the Mission is to make India the Global Hub for **production, usage and**

Export of Green Hydrogen

and its derivatives.

- Infrastructure Development
- Mutual Recognition of Safety Standards
- Unified Market Development
- Creation of FTA and inflow of Foreign Direct Investment (FDI)
- Creation of Single Portal for Indo-German Hydrogen Standards

GERMANY

Objectives of GERMANY's National Hydrogen Strategy

To wean Away from Fossils with Renewable Energies and Green Hydrogen

Develop a home market for Imports

Establish international markets and cooperation for hydrogen to **bring down the cost globally**

Develop a "home market" with focus on hard to abate sectors ready for **imports**

Source: Guidehouse 2022 based on BMWK 2022 & BMWK 2020

EU ENERGY MINISTER (Feb. 2022)
"End dependence on Russia"
In view of the Ukraine conflict, EU energy ministers decided to reduce the dependence on Russia's energy supplies and the associated security of supply.

Deutscher Wasserstoff- und Brennstoffzellen-Verband: Der DWV

Gazprom (14.06.2022)
Reduction of gas delivery about 40%.

USA (14.06.2022)
Explosion in LNG-Terminal – less export to Germany

Renewable Energies and GREEN HYDROGEN is the best answer to the energy dictate.

THANKS

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