

Ushering in a Brand New Future with Safe Hydrogen

# Korea's Hydrogen Economy and Safety Policy

September 19, 2023

Korea Gas Safety Corporation  
Executive Director Noh Ou-Sun

# Contents

I . Grand Transition to a Hydrogen Society

---

II . Korean Government's Hydrogen Economy Policy

---

III . Korea's Hydrogen Safety Policy

---

IV . Korea's Major Hydrogen Infrastructure

---



# I . Grand Transition to a Hydrogen Society



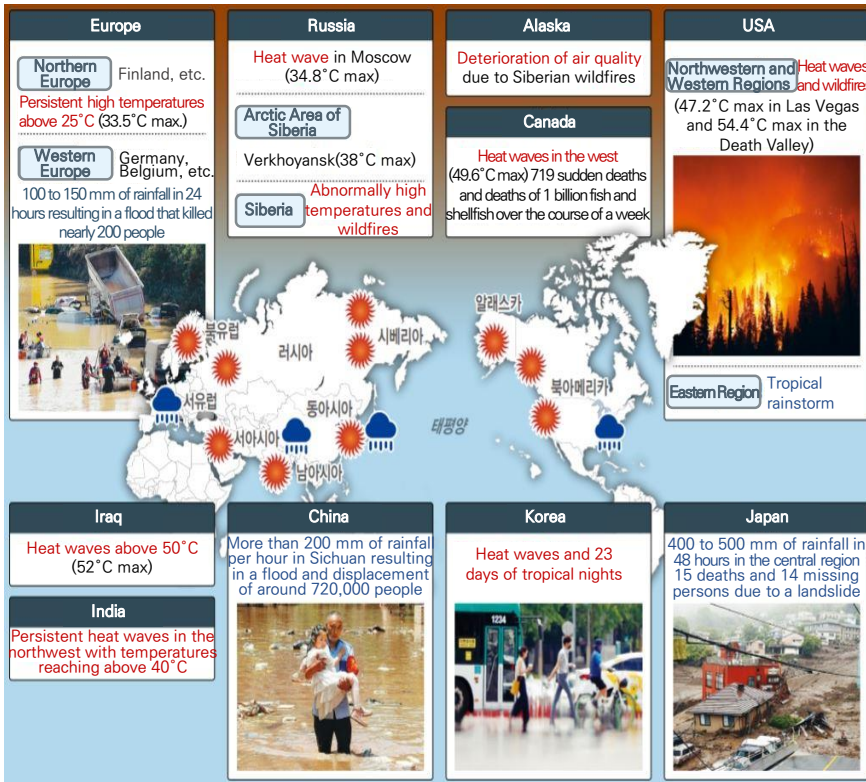


# The Severity of the Climate Crisis

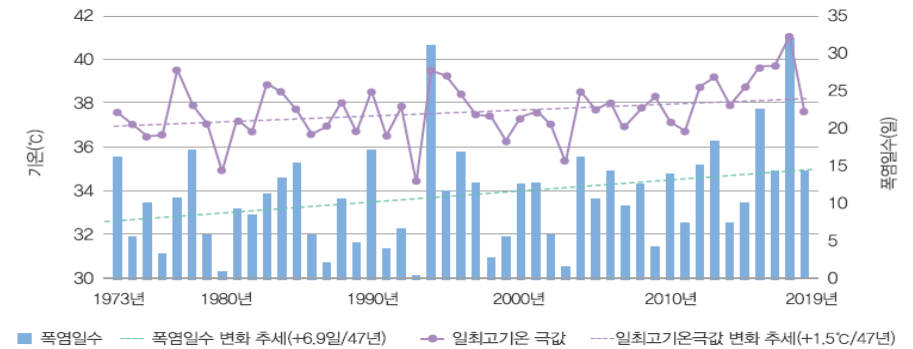
Since the 1970s, the frequency and persistence of extreme weather\* has steadily risen in Korea and around the globe.

\* Extreme weather : A weather event in which meteorological factors such as temperature and precipitation are significantly higher or lower than normal (1981–2010)

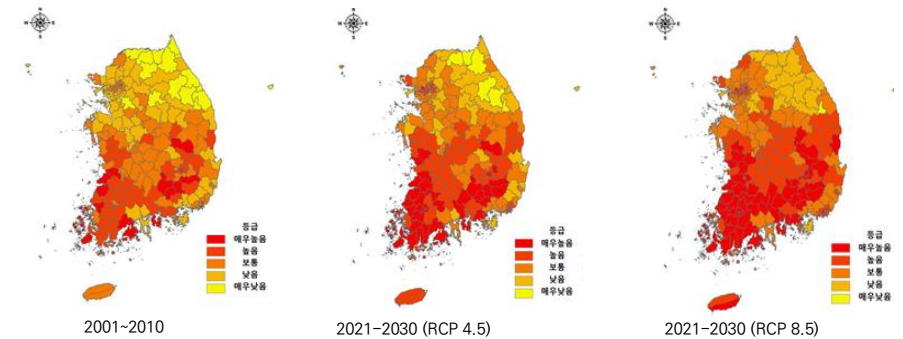
## < Extreme Weather Events Around the World >



## < Frequency and Intensity of Heat Waves by Year (1973~2019) >



## < Location Map of Heat Wave Risks in Korea >



Source : Ministry of Environment's Zero Carbon Scenario, press releases, etc.



# The Cause of the Climate Crisis – Greenhouse Gas

The **Kyoto Protocol** (effective as of February 2005) defined **six gases that cause the greenhouse effect as greenhouse gases**, Korea stipulated in the **Framework Act on Carbon Neutrality and Green Growth for Coping with Climate Crisis** (abbreviated as the Carbon Neutrality Act).

## ▶ Six Greenhouse Gases (GHGs)

GHG	Sources	Emissions (CO2 eq.)	Global warming potential*
Carbon dioxide (CO <sub>2</sub> )	Combustion of fossil fuels	88.6%	1
Methane (CH <sub>4</sub> )	Decomposition of organic matter, etc.	4.8%	21
Nitrous oxide (N <sub>2</sub> O)	Coal mining, nitrogen fertilizer	2.8%	310
Hydrofluorocarbons (HFCs)	Refrigerant in refrigerators	3.8%	1,300 ~ 23,900
Perfluorocarbons (PFCs)	Electronics, plating industry, semiconductor cleaning		
Sulfurhexafluoride (SF <sub>6</sub> )	Insulating gas for electrical appliances, transformers, etc.		

\* The global warming impact of 1 kg of the chemical released into the Earth's troposphere over a period of time, expressed in terms of CO<sub>2</sub>.



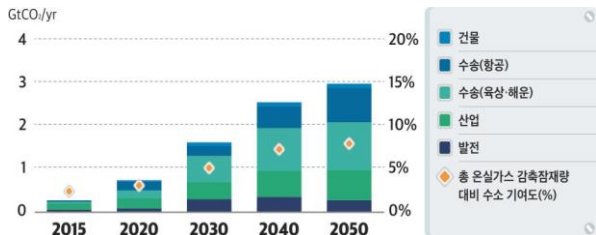
Source: Junggi Economy, Ministry of Environment, etc.



# Energy Transition to Hydrogen

## Key Carbon Neutrality Measures

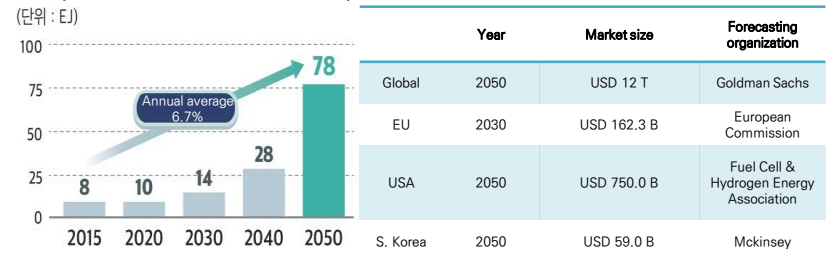
- (Hydrogen → Heat and electricity production) **Eco-friendly energy without emission of harmful substances** such as greenhouse gases
- Provision of **new means of carbon reduction** for energy-intensive industries



< Greenhouse Gas Reduction Potential of Hydrogen Energy (IEA, '20) >

## Enhancing Industrial Competitiveness

- (Utilization throughout the entire energy cycle) **Opportunity to create new industries and revitalize traditional industries**
- **Diversely utilized across industries** such as power generation, storage, transportation, and industrial processes



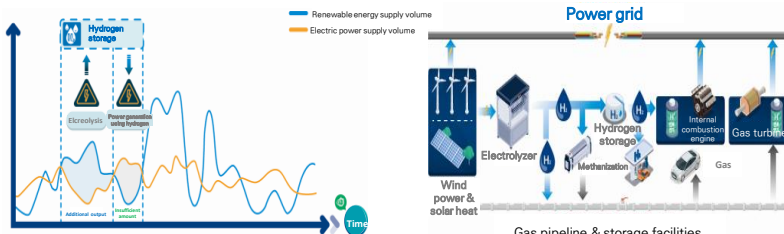
< Hydrogen Demand Forecast >

	Year	Market size	Forecasting organization
Global	2050	USD 12 T	Goldman Sachs
EU	2030	USD 162.3 B	European Commission
USA	2050	USD 750.0 B	Fuel Cell & Hydrogen Energy Association
S. Korea	2050	USD 59.0 B	Mckinsey

< Hydrogen Market Size Forecast >

## Stabilization of Power Grid

- (Energy storage and flexible power generation) **Resolve supply and demand imbalances** caused by intermittency of renewable energy
- Ensuring grid resilience and reliability through **complementary power and gas grids**

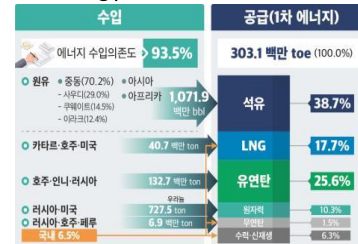


< Resolving Electricity Supply and Demand Imbalances >

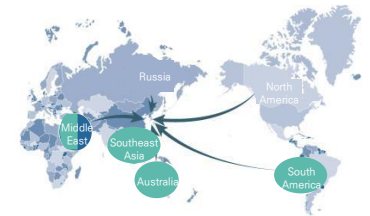
< Power-Gas Sector Coupling >

## Strengthening Energy Security

- (Securing new energy sources) **Reducing dependence on energy imports** (currently, 93.5%)
- Increase energy independence by applying the local production technology overseas and introducing hydrogen



< Energy Import Status (2019) >



< Establishment of Hydrogen Introduction Network >

# II. Korean Government's Hydrogen Economy Policy





# Announcements of Hydrogen Economy and Safety Policies

Korea's Hydrogen Policy Trends

2019

2020

2021

2022

## Roadmap to Promoting the Hydrogen Economy

(by relevant ministries, Jan. 2019)

- An interagency roadmap to become a global leader in the hydrogen economy
- 2.9 million hydrogen vehicles, 1,200 charging stations, and hydrogen price of KRW 3,000/kg (by 2040)

## Comprehensive Plan for Hydrogen Safety Management

(MOTIE, Dec. 2019)

- Laying the foundation for a safety management system across the hydrogen industry
- Prioritized management of 3 key facilities\* and creation of a safety system to promote safety and balanced industrial development

\* Hydrogen fueling stations, production bases, and fuel cell facilities

## Hydrogen Economy Promotion and Hydrogen Safety Management Act

(Feb. 2020)

### Safety Field

- Preparation of safety guidelines for hydrogen at low pressures(1MPa and under)
- Facilities using hydrogen fuel and manufacture of hydrogen appliances
- Appointment of a safety manager, registration of imported products, etc.

### Economic Field

- Establishment of the Hydrogen Economy Commission to deliberate on major policies(overseen by the Prime Minister)
- Designation of three dedicated organizations (safety, distribution, and promotion)
- Establishment of grounds for supporting companies with excellent hydrogen technology

## Strategy to Promote Carbon Neutral Technology Innovation

(by relevant ministries, Sept. 2021)

- Aimed at securing technologies for the entire life cycle of hydrogen to realize the hydrogen economy
- Established the supply price and power generation cost as key indicators

## The 1st Master Plan for the Implementation of the Hydrogen Economy

(by relevant ministries, Nov. 2021)

- Clean hydrogen self-sufficiency target : 34% (2030) and 60% (2050)
- Share of clean hydrogen: 75% (2030) and 100%(2050)
- Establishment of hydrogen distribution infrastructure (pipeline network, etc.) and industrial applications(petrochemicals, etc.)
- Establishment of safety standards, etc. for the entire life cycle of hydrogen

## Yoon Suk-yeol Administration's Tasks

- (Task 3) Focus on R&D aimed at securing technologies of the future such as NPP-linked hydrogen production
- (Tasks 20, 21, 24, and 28) Prepare a foundation for stable production and supply of clean hydrogen and pursue early commercialization of new energy industries for carbon neutrality
- (Task 75) Foster strategic technologies in the hydrogen field

## Plan for Creating a Clean Hydrogen Ecosystem

(relevant ministries, Nov. 9, 2022)

- Establish a clean hydrogen supply chain and reflect the changing global trends related to the hydrogen economy
- Set policy directions for the top three growth strategies
  - ① Growth in scale and scope
  - ② Infrastructure and institutional growth
  - ③ Industry and technology growth

Establishment of a hydrogen economy roadmap



Preparation of the basis for promoting and supporting the hydrogen economy



Securing hydrogen technology and concretizing goals and targets



Securing technologies in the hydrogen field





# Enactment of the World's First Hydrogen Law

The world's first law aimed at fostering the hydrogen industry

**Hydrogen economy promotion and policy direction:**

**Established the world's first law aimed at fostering the hydrogen industry**

### Key Details for the Economic Field

- **Establish a system to promote the hydrogen economy**
  - **(Master Plan to Implement the Hydrogen Economy)** Establishment of a master plan for effective pursuit of the hydrogen economy (MOTIE)
  - **(Hydrogen Economy Commission)** Deliberate on major policies and plans related to the implementation of the hydrogen economy (overseen by the Prime Minister)

---

- **Fostering and supporting companies specializing in hydrogen**
  - **(Companies specializing in hydrogen)** Companies with a certain percentage of sales generated in relation to the hydrogen industry
  - **(Government support)** Support for technology development, commercialization of excellent technologies, etc.

---

- **Creating a foundation for the implementation of the hydrogen economy**
  - **(Training of professionals)** Training and retraining of technical professionals and fostering excellent manpower through industry-university cooperation
  - **(Dedicated organizations)** Designation of three dedicated organizations (safety, distribution, and promotion)

### Key Details for the Safety Field

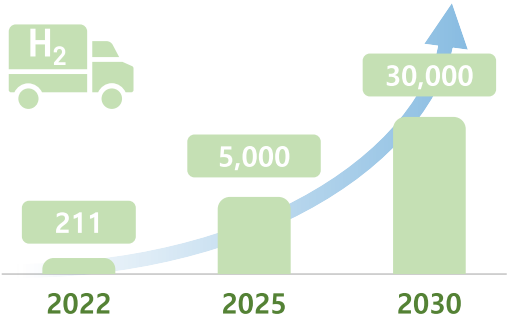
- **Preparation of manufacturing standards for hydrogen appliances**
    - **(Manufacture of hydrogen appliances)** Establishment of hydrogen appliance\* licensing and manufacturing standards
    - \*Hydrogen appliances : Fuel cells, water electrolysis equipment, hydrogen extraction equipment
    - <Procedure for Hydrogen Appliance Manufacturing Business Operations >
    - ```

graph LR
    A[Technical review] --> B[Licensing]
    B --> C[Completion inspection]
    C --> D[Commencement of business operations]
          
```
  - **(Other)** Appointment of a safety manager, registration of imported products, etc.
- 
- **Preparation of standards for facilities using hydrogen fuel**
  - **(Facilities using hydrogen fuel)** Facilities where fuel cells are installed to use the heat or electricity generated
  - **(Safety standards)** Safety distance, installation of facilities and safety devices, etc.

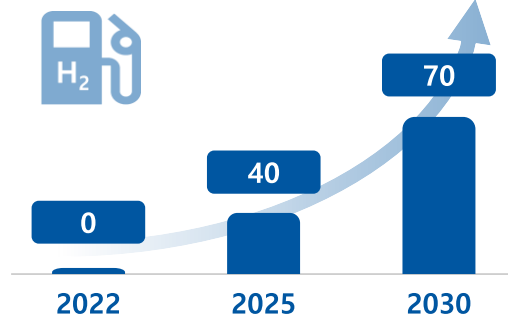


# Plan for Creating a Clean Hydrogen Ecosystem (Goals & Strategies)

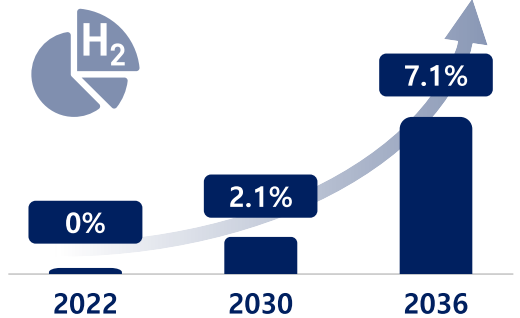
## Supply of Hydrogen Heavy Duty Vehicles



## Supply of Liquid Hydrogen Fueling Stations



## Clean Hydrogen's Share in Power Output



Drive up the demand for hydrogen



Establish a domestic and international clean hydrogen supply chain



Build hydrogen Distribution infrastructure



Prepare an institutional framework for a hydrogen market

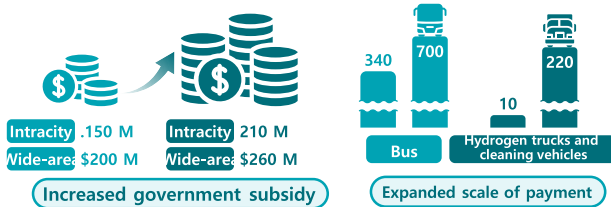




# Measures to Create a Clean Hydrogen Ecosystem(Strategies)

## 1. Actively supply heavy duty hydrogen vehicles such as hydrogen buses

- ✓ Expand subsidies for the purchase of hydrogen buses
- ✓ Replace the police buses with hydrogen buses
- ✓ Reduce the acquisition tax, etc. for hydrogen buses



Strategy 1

Drive up the demand for hydrogen

Strategy 2

Build hydrogen distribution infrastructure

4 strategies for Korea to become a global leader in clean hydrogen based on an advanced hydrogen ecosystem

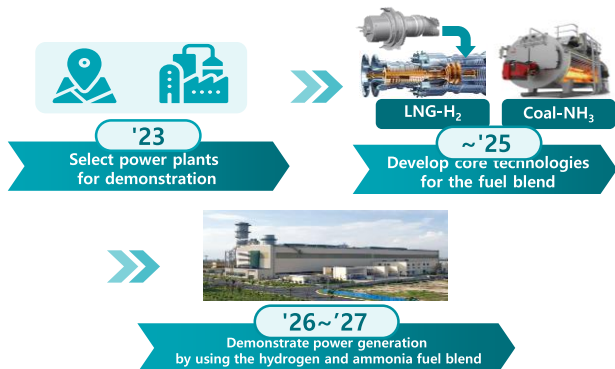
## 1. Create a liquid hydrogen ecosystem

- ✓ Build the world's largest liquid hydrogen plant (40,000 tons) by 2023
- ✓ Increase subsidies to build liquid hydrogen fueling stations and prepare measures to support the transition of gas fueling stations



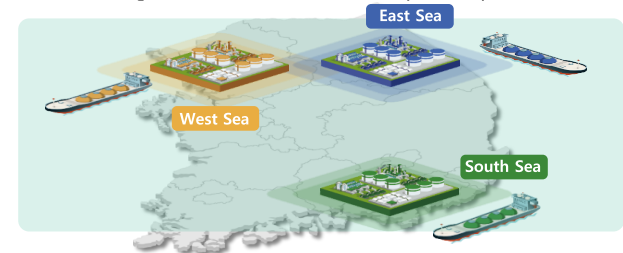
## 2. Fuel transition of coal-fired and LNG power plants

- ✓ Seek to develop and demonstrate the technology for 50% hydrogen and 20% ammonia fuel blend by 2027
- ✓ Expand the application of the fuel blend starting in 2028



## 2. Build infrastructure for generating power with hydrogen and ammonia

- ✓ Designate three regions (West Sea, East Sea, and South Sea) with clusters of coal-fired power plants as the bases and establish large-scale acquisition and storage facilities(approx. 1.1 million tons in 2027 and 4 million tons in 2030)
- ✓ Build an approximately 100,000-ton storage facility and supply hydrogen to the Seoul metropolitan area, where there is a high concentration of LNG power plants





# Measures to Create a Clean Hydrogen Ecosystem(Strategies)

## 1. Domestic production of clean hydrogen

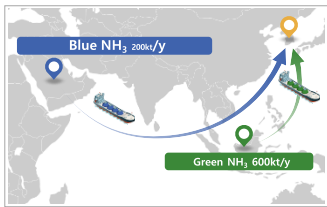
- ✓ Secure the technology to produce green hydrogen in a highly efficient way on a large scale and build a domestic supply chain
- ✓ Establish a blue hydrogen production base by supporting overseas transport of CO2
- ✓ Demonstrate hydrogen production in connection with nuclear power plants in operation

## 2. Overseas production of clean hydrogen

- ✓ Initiate a pilot project for building clean hydrogen production facilities overseas based on public-private partnerships (2023-2026)
- ✓ Establish a hydrogen support system to achieve energy security (financing, etc.)

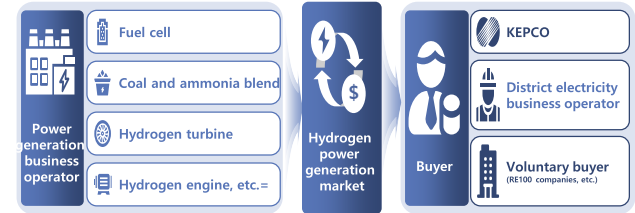
## 3. Develop the ability to build ammonia-powered ship/carrier and liquid hydrogen carrier

- ✓ (~2026) Build an ammonia-powered ship/carrier
- ✓ (~2029) Build a liquid hydrogen carrier



## 1. Open a hydrogen power generation bidding market in 2023

- ✓ Set the annual hydrogen power generation volume in consideration of basic power supply plan, national greenhouse gas reduction target, etc.



4 strategies for Korea to become a global leader in clean hydrogen based on an advanced hydrogen ecosystem

Strategy 3

Establish a domestic and international

Strategy 4

Prepare an institutional framework

## 2. Establish a legal framework for hydrogen businesses through the enactment of the Hydrogen Business Act

- ✓ Define businesses for each stage of distribution such as production, import and export as well as compulsory matters such as licensing standards, supply obligations, facility and safety management, etc.
- ✓ Establish supply plans for each sector, report on production and consumption volumes by businesses, introduce verification systems, impose stockpiling obligations, etc.

## 3. Prepare a clean hydrogen certification and operation system

- ✓ Establish clean hydrogen standards and incentive programs
- ✓ Review the operations and management systems, including designation of certification authorities and certificate trading

# III . Korea's Hydrogen Safety Policy





To emerge as a hydrogen powerhouse with balanced development of hydrogen safety and industry, The **Comprehensive Plan for Hydrogen Safety Management (Sept. 2019)** that includes 3 strategies and 12 tasks was announced



## Background

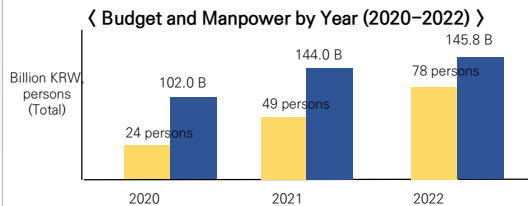
**Urgent need to prepare a safety management law and institutions** for the construction of hydrogen fueling stations, production bases, and other related facilities following the announcement the roadmap to promoting the hydrogen economy

### Achievement 1.

Increased budget and manpower for building the foundation for hydrogen safety

- **Project budget: 110 million dollars**
  - Budget for **building infrastructure** and **operating a hydrogen safety system** in promoting the hydrogen economy

#### ➤ Increase in hydrogen professionals



### Achievement 2.

Successful implementation of the government's hydrogen policy

- **Laying the groundwork for the hydrogen economy and safety**
  - ① Enactment and enforcement of the world's first hydrogen law (Feb. 5, 2021)
  - ② Designation of hydrogen safety agencies (July 1, 2020, MOTIE)
  - ③ Preparation of detailed safety standards (6 types), etc.
- **Implementation of the government's safety management policy tasks**
  - Operate and oversee the task according to the **Comprehensive Plan for Hydrogen Safety Management** and ensure successful implementation

### Achievement 3.

Ensuring the safety of hydrogen facilities and appliances

- **Preparation of safety standards for hydrogen appliances**
  - **Establish inspection standards and measures for hydrogen appliances** in accordance with the Hydrogen Act
  - Prepare inspection standards for facilities that use low-pressure hydrogen fuel
- **Preparation and operation of liquid hydrogen testbed standards**
  - Proactively **ensure hydrogen safety** with new hydrogen storage and transport measures



**Establishment of Hydrogen Safety Management Roadmap 2.0(3 strategies and 10 fields) centering on clean hydrogen** to replace the Comprehensive Plan for Hydrogen Safety Management(Dec. 2019) in reflection of the related changes such as government policy, safety management, technical development, etc.

### Government policy

#### Announcement of a new direction for hydrogen economy policies

- ✓ **Creation of a clean hydrogen ecosystem(MOTIE)**
    - Prepare the necessary framework with the Hydrogen Business Act, clean hydrogen certification system, etc.
    - Establish goals to build blue and green hydrogen production bases
  - ✓ **Fostering the domestic hydrogen industry into the world's No. 1(MOTIE)**
    - Conduct deregulation to attract private investment
    - Select seven hydrogen sectors\* for concentrated support
- \* ① Water electrolysis, ② Liquid hydrogen carrier, ③ Trailer, ④ Hydrogen fueling stations, ⑤⑥ Fuel cells (mobility/power generation), ⑦ Hydrogen turbine

### Technical development

#### Emergence of products and equipment incorporated with new hydrogen technology

- ✓ **Introduction of diverse clean hydrogen production equipment**
  - Demonstration of new hydrogen production equipment for water electrolysis, ammonia breakdown, etc.
  - Development of water electrolysis equipment such as SOEC and PCEC
- ✓ **Sharp increases in hydrogen production and demand**
  - Evident demand for hydrogen for hydrogen power generation, hydrogen reduction steelmaking, commercial vehicle refueling, etc.
  - Establishment of a pipeline network for large-scale hydrogen distribution

### Safety management

#### Need for safety management due to the emergence of new industries

- ✓ **Comprehensive Plan for Hydrogen Safety Management**
  - Prioritization of safety management of hydrogen fueling stations and fuel cells, which are key infrastructure in the early days of the hydrogen economy
  - Ensuring safety for utilization of high-pressure gaseous hydrogen
- ✓ **Ensuring safety for new hydrogen fields**
  - Need to ensure the safety of liquid hydrogen equipment (valves, vaporizers, etc.) that has yet to be used in Korea
  - Manage the safety of hydrogen mobility other than hydrogen vehicles



# Hydrogen Safety Management Roadmap 2.0 (Vision & Strategies)



## Vision

A global leader in the hydrogen economy that keeps the public safe and allows enterprises to freely use hydrogen



## Key Details

- ✓ (Clean hydrogen) Commercialization and safety management of full-cycle facilities including production, distribution, and utilization
- ✓ (Regulatory innovation) Improvement of the safety management system considering the characteristics of new industries
- ✓ (Safety Management) Pursue zero hydrogen accidents through the safety management of hydrogen facilities, etc.

## 3 strategies, 10 fields, 64 tasks

### Strategy 1.

Proactively create a safe ecosystem for clean hydrogen

- Hydrogen mobility & hydrogen power generation equipment
- Clean hydrogen production equipment
- Full-cycle products and equipment for liquid hydrogen
- Ammonia transport and storage equipment

### Strategy 2.

Innovate regulations to foster the domestic industry into the world's No. 1

- Inspection system for newly developed technologies
- Rationalization of regulations on self-fueling, urban fueling stations, etc.
- Support for the commercialization of new technologies related to fuel cells for hydrogen mobility

### Strategy 3.

Perform safety management for balanced development of hydrogen safety and industry

- Safety management tailored to each hydrogen facility
- Capacity building of agencies dedicated to hydrogen safety, etc.
- Ensuring the public's acceptance of hydrogen energy



# V. Korea's Major Hydrogen Infrastructure





# Korea's Major Hydrogen Infrastructure

Designation of **14 key infrastructure facilities** for testing & certification, education & PR, and R&D related to hydrogen and **11 pilot hydrogen cities**

FCEV:32,896  
HRS:185

Chungnam (3 locations)  
Green Hydrogen Testbed & Research Center (Daejeon)  
Full-Cycle Hydrogen Product Safety Support Center (Daejeon)  
Hydrogen Gas Turbine Test and Research Center (Boryeong)

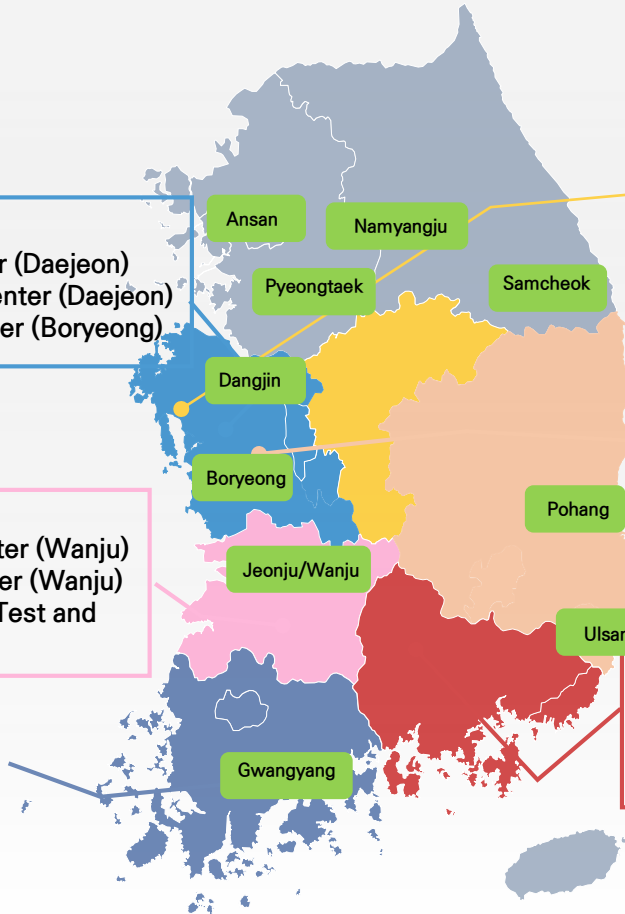
Jeonbuk (3 locations)  
Hydrogen Appliance Inspection Support Center (Wanju)  
Hydrogen Secondary Battery Research Center (Wanju)  
High-Molecular-Weight Clean Hydrogen Test and Evaluation Center (Buan)

Jeonnam (1 location)  
Hydrogen House (Jeonnam)

Chungbuk (3 locations\_ Eumseong)  
Hydrogen Bus Fueling Station Component Test and Evaluation Center  
Liquid Hydrogen Inspection Support Center  
Hydrogen Safety Museum

Gyeongbuk (1 location, Daegu)  
Hydrogen Fuel Cell Certification Center (Pohang)

Gyeongnam (3 locations, Busan & Ulsan)  
Corporate Support Center for Hydrogen Environment Materials and Parts (Miryang)  
Hydrogen Ship Technology Center (Busan)  
Hydrogen Electric Vehicle Inspection Center (Ulsan)





# Hydrogen Safety Experience and Education Center

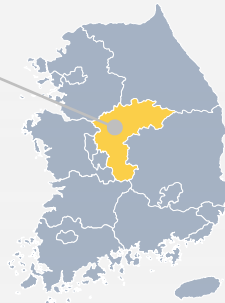
Promotes hydrogen policies on and offline, invites the public to participate in events, and operates an experience center to **provide experiential learning activities**

## ➤ Hydrogen Safety Experience and Education Center

Chungbuk

- (Size) Lot size: 10,698m<sup>2</sup>, gross floor area: 2,154m<sup>2</sup>
- (Budget) 12 million dollars
- (Location) Eumseong-gun, Chungcheongbuk-do
- (Function) Offers education and experiential activities related to hydrogen energy and gas safety
- (Composition) Hydrogen Safety PR Hall, Gas Safety Experience Hall, 4D Theater, and Hydrogen Professional Education Hall
- (Opening) Dec. 2022

Complete





**Establishment of a test and evaluation center** in line with the growing size of hydrogen vehicles and expanded scope of certifications for high-pressure parts and components of fueling stations

## ➤ Hydrogen Bus and Fueling Station Parts Test and Evaluation Center

Chungbuk

- (Size) Lot size: 20,000m<sup>2</sup>, gross floor area: 2,274m<sup>2</sup>
- (Budget) 19 million dollars
- (Location) Eumseong-gun, Chungcheongbuk-do (inside an industrial complex)
- (Function) Testing and certification of containers, parts, and components for hydrogen buses and parts and components for fueling stations
- (Equipment) 25 types of testing equipment, etc. such as cooling gas valve
- (Opening) 2024 Scheduled





# Liquid Hydrogen Inspection Support Center

Construction of a test building where **performance tests, evaluations, and inspections of liquid hydrogen parts and components** can be performed to ensure the safety of liquid hydrogen products

## ➤ Liquid Hydrogen Inspection Support Center

Chung buk

- (Size) Lot size: 8,099m<sup>2</sup>, gross floor area: 2,011m<sup>2</sup>
- (Budget) 23 million dollars
- (Location) Eumseong-gun, Chungcheongbuk-do
- (Function) Inspection of products such as containers and specific equipment related to liquid hydrogen
- (Equipment) Liquid hydrogen supply equipment (2 types, 3 pieces) and testing equipment (23 types, 27 pieces)
- (Opening) 2025

Scheduled





# Hydrogen Appliance Inspection Support Center

Establishment of the Hydrogen Appliance Inspection Support Center to **perform inspections on hydrogen appliances** in accordance with the **Hydrogen Act**

## ➤ Hydrogen Appliance Inspection Support Center

Jeonbuk

- (Size) Lot size: 7,535m<sup>2</sup>, gross floor area: 30,276m<sup>2</sup>
- (Budget) 36 million dollars
- (Location) Wanju-gun, Jeollabuk-do
- (Function) Conduct inspections on hydrogen appliances (4types) in accordance with the Hydrogen Act
- (Equipment) 48 types (94 pieces) (KRW 11.2 B) of performance evaluation devices, etc.
- (Opening) 2023

Scheduled



# Q & A

Thank you for your attention.

