



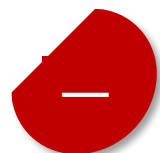
国家能源集团
CHN ENERGY

Practices for Promoting the Development of the Hydrogen Market

CHN Energy Hydrogen Innovation Technology

May 20, 2026

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Industry Background Overview



**Status of Key Hydrogen Equipment Testing
& Standard Buiding**



Future Outlook

1. Development of China's Hydrogen Energy Industry

China's hydrogen energy industry progressed from a "follower" to a "parallel runner" in global development, with the scale advantages of its industrial and supply chains becoming increasingly evident

Total scale of hydrogen production and consumption

39 million tons

Renewable energy-based hydrogen production capacity

250,000 tons/year

Pure hydrogen transmission pipeline

190 kilometers

Hydrogen fuel cell vehicles

30,000+

Hydrogen refueling station infrastructure

590+

China has formed a home-grown hydrogen energy industrial and supply chain system, and its broader hydrogen ecosystem — including policy frameworks, technological innovation, and industrial demonstration applications — continues to mature.

Renewable energy-based hydrogen production capacity



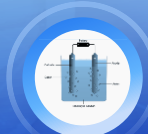
50%

Hydrogen refueling station infrastructure



40%

Electrolyzer system production capacity



60%

Fuel cell system



70%

Global share

1. Development of China's Hydrogen Energy Industry

The price of hydrogen energy in China has been steadily decreasing, with significant improvements in technological innovation capabilities and effective commercialization of research outcomes.

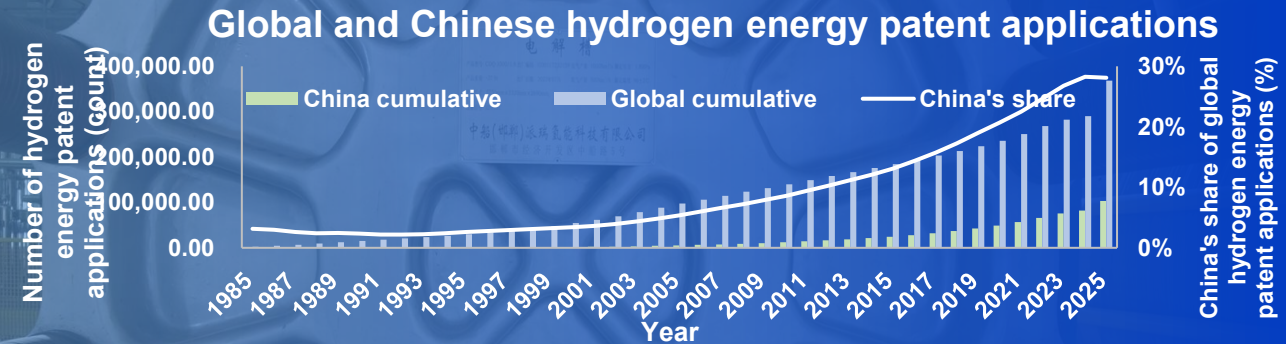
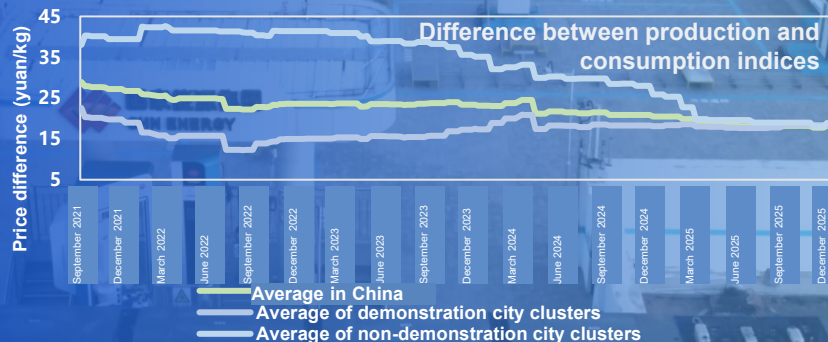
The prices of hydrogen production and consumption continue to fall, with a clear trend of narrowing price differences

From 2021 to 2025, the cost of mainstream equipment entered a rapid downward trend

- The price of alkaline electrolyzers dropped from about 1.6 million yuan/MW to about 1.1 million yuan/MW
- The price of PEM electrolyzers dropped from about 11 million yuan/MW to about 4 million yuan/MW

Production side
26.2 yuan/kg

Consumption side
44.5 yuan/kg



- Among 59 key hydrogen energy technologies, **3** have advanced from "follower" to "parallel runner", and **6** are "leading"
- A total of **27** items of first-of-its-kind (set) technological equipment in the hydrogen energy field have been released in **4** batches
- China's hydrogen-related patent applications have climbed to over **100,000**, ranking **first** globally
- **Seven** universities have launched hydrogen energy majors, and there are over **70** hydrogen energy innovation centers, engineering technology centers, and laboratories at all levels

Efficiency in tackling key technical challenges has improved, and the scale of technology patent layout is leading

1. Development of China's Hydrogen Energy Industry

Three Core Tasks for the Development of the Hydrogen Energy Industry

Cost

Cost reduction across the entire supply chain

The core bottleneck in large-scale development
Underlying demand for full-chain commercialization

Technology

Mature and controllable technology

Address the shortcoming of being "feasible in demonstration but not scalable"
Secure supply chain stability

Supply chain

Phased establishment of interconnected infrastructure

Advance core hardware support for cross-regional resource coordination
Overcome bottlenecks such as the disconnect between production and application, mismatched scenarios, and poor storage and transportation

Create the infrastructure for the new hydrogen-based industry services

Improve the standard system for iterative innovation of core hydrogen energy technologies and enhance the governance effectiveness of hydrogen energy standardization



Build a hydrogen quality testing and hydrogen energy equipment testing system, fully covering the entire chain of production, storage, transportation and utilization, as well as core application scenarios in transportation, industry, and power generation

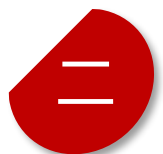
Strengthen the certification system for the green attributes of green hydrogen-based fuels and hydrogen energy equipment, and cultivate the development of the green fuel and hydrogen energy equipment market

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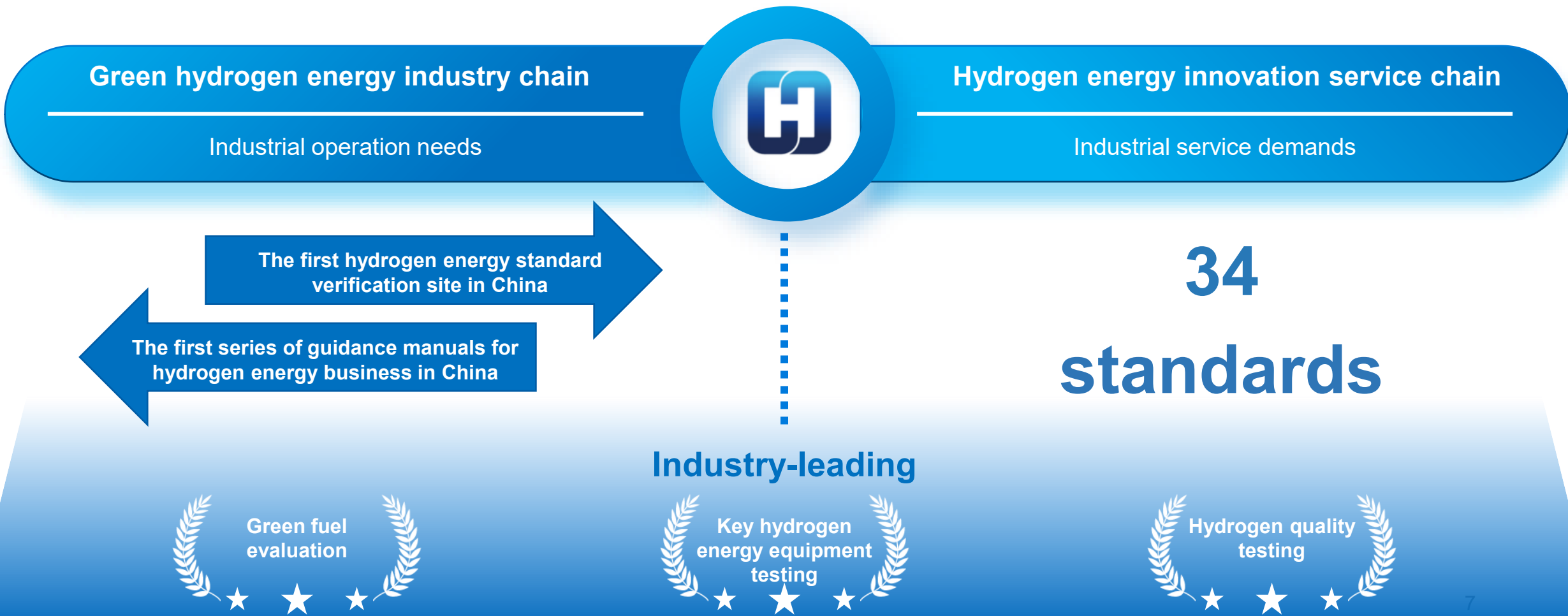
**Status of Key Hydrogen Equipment
Testing & Standard Buiding**



Future Outlook

2. Cornerstone for the Healthy Development of Hydrogen Market - New Infrastructure Construction

“ Leveraging its standards verification platform, the China Hydrogen Alliance has efficiently advanced the development of China’s hydrogen standards demonstration pilots. It has played a leading role in green fuel assessment, testing of key hydrogen equipment and hydrogen quality, while providing strong support for standards development and contributing to global standards governance.



2. Cornerstone for the Healthy Development of Hydrogen Market - New Infrastructure Construction

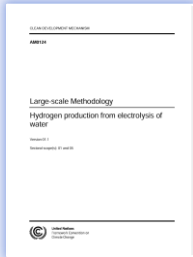


Construction of a carbon-hydrogen synergy standard system: advancing the establishment of a dual standards system covering carbon footprint quantification and grading methodologies for hydrogen products, as well as carbon reduction methodologies, to enable the green value of hydrogen products to become measurable, priceable, and monetizable.

Carbon footprint quantification and grading		Carbon emission reduction methodology
Key functions	Establish a life-cycle carbon footprint accounting method and classify hydrogen into three categories (low-carbon hydrogen, clean hydrogen, and renewable hydrogen) to provide the industry with a unified and verifiable green attribute certification.	Establish emission reduction accounting rules to convert the reduction benefits of renewable hydrogen production projects into carbon assets tradable in China's carbon market, thereby monetizing the value of emission reductions.
Policy tools	Industry standard: Evaluation Standard for Clean and Low-Carbon Hydrogen (DL/T 3015-2025)	CCER methodology: <i>Methodology for Voluntary Greenhouse Gas Emission Reduction Projects - Hydrogen Production from Water Electrolysis Using Renewable Energy (CCER-01-004-V01)</i>
Core value	Clarify the green attributes of products to meet the differentiated demands of downstream users for clean, low-carbon hydrogen	Monetize project emission reductions to obtain direct economic benefits
Market-oriented	Focus on China's market to lay the groundwork for promoting green certification and aligning with international standards	Carbon trading market in China
Project opportunities	Obtain authoritative green identity certification in China, laying the foundation for meeting future policy requirements related to green consumption and certification, and accumulating technical experience for future integration with the international market.	By creating additional revenue streams from carbon assets, projects can improve their economic viability and help drive the hydrogen industry's transition from policy-driven to market-driven development.



2020: The group standard "Standard and Evaluation of Low-Carbon Hydrogen, Clean Hydrogen and Renewable Hydrogen" was released



2023: The first CDM emission reduction methodology for the hydrogen energy industry was released



2023: The group standard "Evaluation Methods and Requirements of Hydrogen-based Green Fuel" was released



2025: The CCER methodology for hydrogen production from renewable energy was released



2026: The industry standard "Evaluation Standard for Clean and Low-Carbon Hydrogen" is about to be implemented

2. Cornerstone for the Healthy Development of Hydrogen Market - New Infrastructure Construction

Hydrogen supply evaluation for fuel cell vehicle city clusters

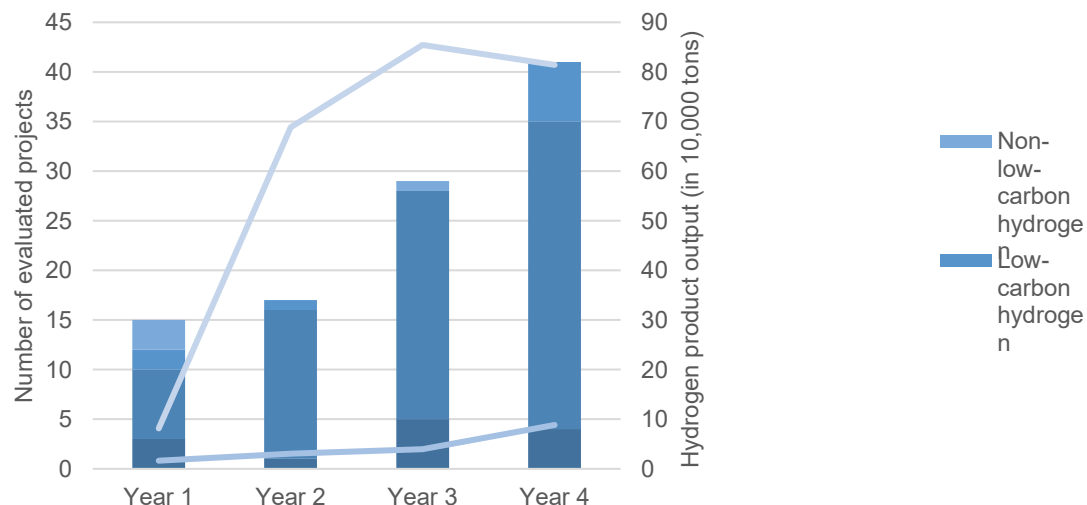
- **Practical application:** support the hydrogen supply evaluation for fuel cell vehicle demonstration city clusters for four consecutive years, creating a demonstration effect covering the entire industry chain and multiple process paths

102 projects
Cumulatively
evaluated
projects

16 types
Covering hydrogen
production
processes

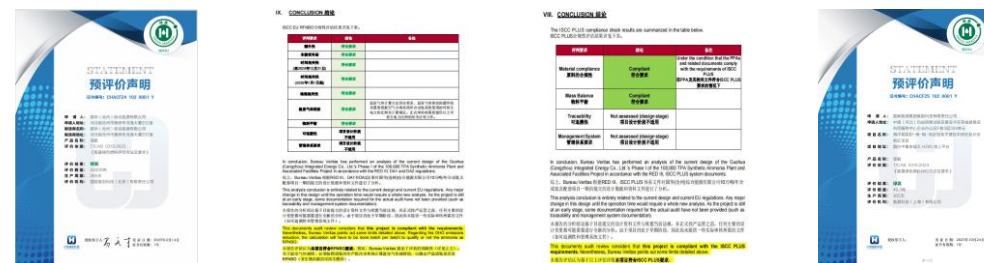
175,000 tons
Evaluated hydrogen quantity

Hydrogen supply evaluation projects for fuel cell vehicle city clusters



Hydrogen-based green fuel evaluation and certification

- **"Cangzhou Green Port Hydrogen City" project: completed China's green ammonia assessment, as well as pre-certification under ISCC EU RFNBO and ISCC PLUS.**
- **Marine Hydrogen Production-Storage-Transportation-Utilization Full-chain Key Technology Research and Demonstration Project: completed green ammonia pre-evaluation**



Impact assessment of renewable hydrogen CCER methodology on projects

- **Example: The total investment of a wind-solar hydrogen production project in Inner Mongolia is about one billion yuan, with an annual hydrogen production of over 7,000 tons. Without considering CCER income, the project's investment payback period is about 9.21 years, with an internal rate of return of about 4.34%. Calculated at the current CCER market price, the project's emission reduction benefits can reach about 20 million yuan per year. With CCER income, the project's investment payback period can be shortened to about 8.77 years.**

2. Cornerstone for the Healthy Development of Hydrogen Market - New Infrastructure Construction

“Hydrogen Top Runner Program for electrolyzers: 28 sets of alkaline electrolyzers have been tested, with a "one test, mutual recognition" model established to promote international mutual recognition of test results.

Testing Reports

Evaluation Certificates

Applicants

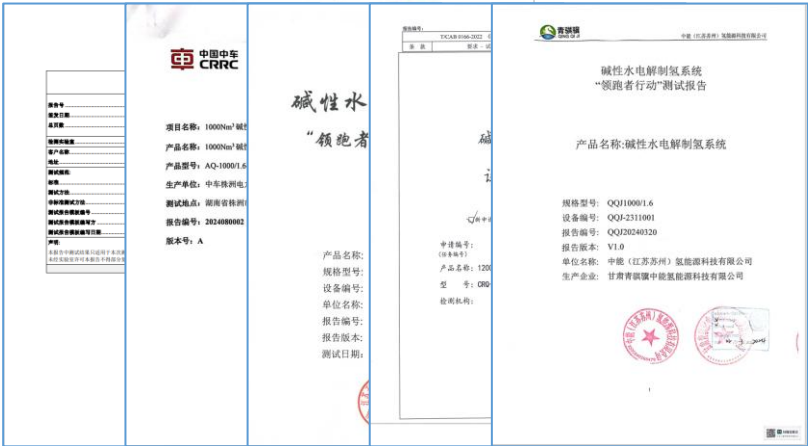
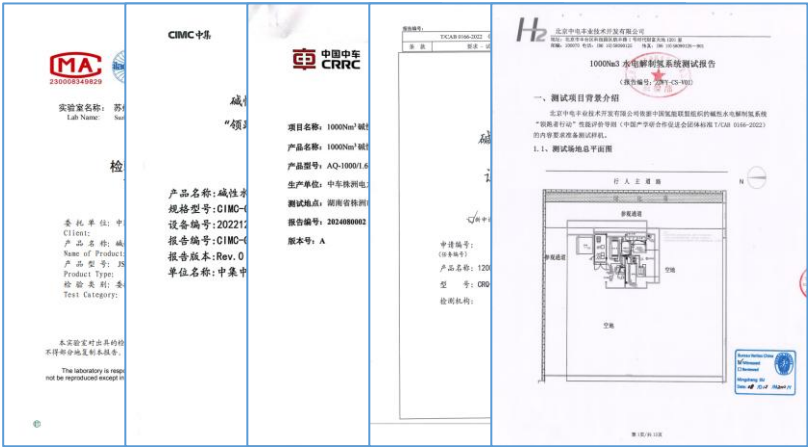
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Pending evaluation

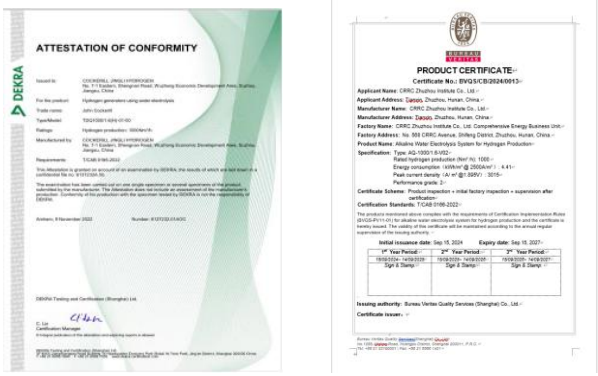
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Evaluation completed

28



"Hydrogen Top Runner Program" evaluation certificates

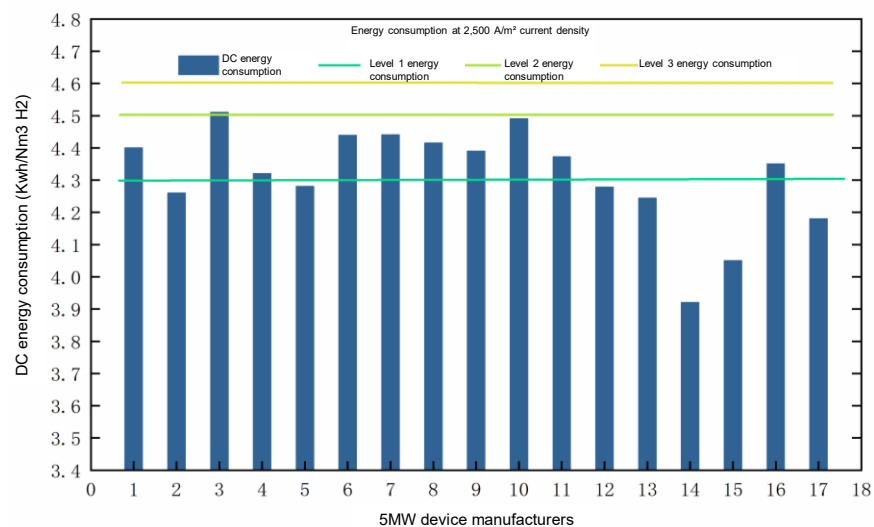
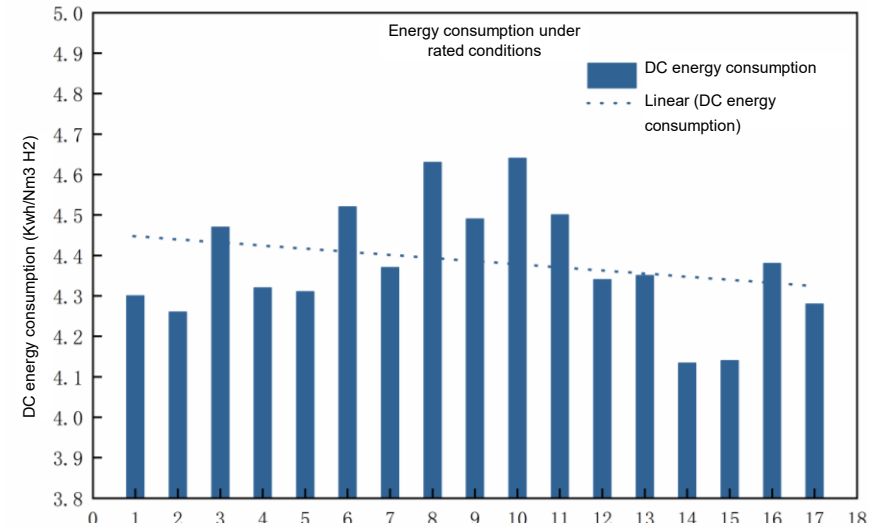
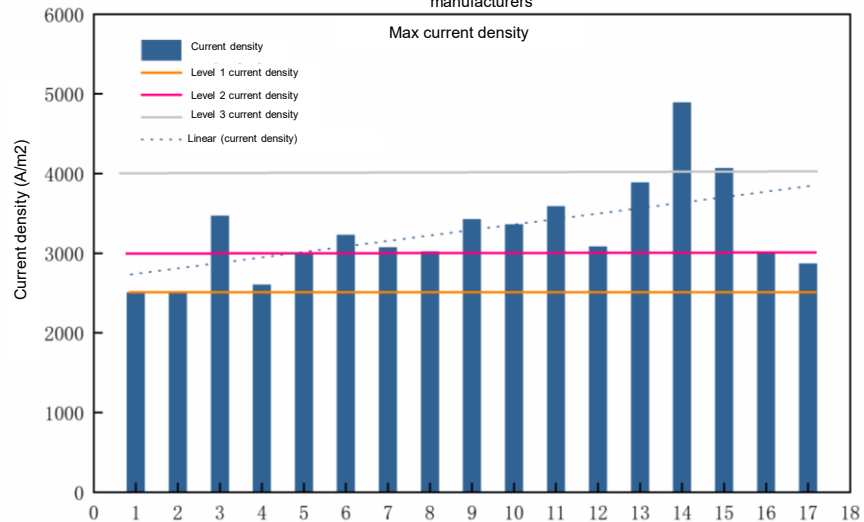
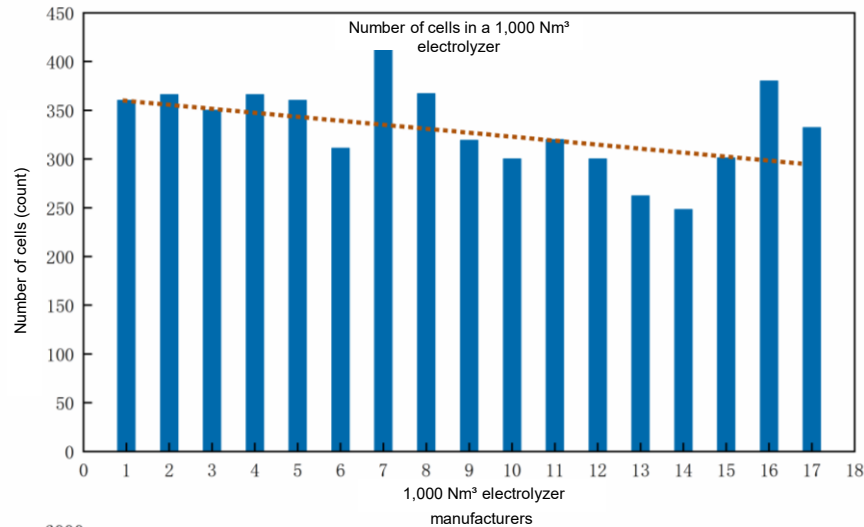


Evaluation certificates from foreign testing institutions

2. Cornerstone for the Healthy Development of Hydrogen Market - New Infrastructure Construction



Test results: electrolyzers show a trend of increasing current density, decreasing energy consumption at rated operating conditions, and miniaturization of equipment.



- Rapid increase in rated current density
- The number of electrolysis cells is gradually decreasing, and the volume of a single stack is miniaturizing
- Enterprises' focus shifts from current density and energy consumption to lifespan, cost and new energy accommodation capacity

2. Cornerstone for the Healthy Development of Hydrogen Market - New Infrastructure Construction

📌 The quality requirements for hydrogen in traditional industries emphasize "high purity, low impurities," while hydrogen for fuel cells focuses on "low purity, high impurity control." Standards such as ISO 14687-2, and GB/T 37244 specify the types and content limits of 13 impurities in hydrogen for proton exchange membrane fuel cell vehicles.

	GB/T 3634.2-2025			GB/T 37244-2018	ISO 14687:2025
	Pure Hydrogen	High Pure Hydrogen	ultra Pure Hydrogen		
Hydrogen fuel index	99.99%	99.999%	99.9999%	99.97%	99.97%
Total non-hydrogen gases	100 ppm	10 ppm	1 ppm	300 ppm	300 ppm
H ₂ O	10 ppm	3 ppm	0.5 ppm	5 ppm	5 ppm
*Total hydrocarbons (C1 equivalent)				2 ppm	
*Hydrocarbons except methane (C1 equivalent)					2 ppm
CH ₄	10 ppm	1 ppm	0.2 ppm		100 ppm
O ₂	5 ppm	1 ppm	0.2 ppm	5 ppm	5 ppm
He				300 ppm	300 ppm
N ₂	60 ppm	5 ppm	0.4 ppm		300 ppm
Ar	—	—	0.2 ppm	100	300 ppm
CO ₂	5 ppm	1 ppm	0.1 ppm	2 ppm	2 ppm
CO	5 ppm	1 ppm	0.1 ppm	0.2 ppm	0.2 ppm
Total sulfur(S1 equivalent)				0.004 ppm	0.004 ppm
HCHO				0.01 ppm	0.2 ppm
HCOOH				0.2 ppm	/
NH ₃				0.1 ppm	0.1 ppm
Total halogens(Halogen equivalent)				0.05 ppm	0.05 ppm
Particulate matter				1 mg/kg	1 mg/kg

2. Cornerstone for the Healthy Development of Hydrogen Market - New Infrastructure Construction

Fully covers the detection items for 13 gaseous impurities and particulate matter specified in ISO 14687 and GB/T 37244-2018. Adopts a "mobile + platform + service" multi-integration model to achieve one-stop, full-chain analysis and testing for the hydrogen energy industry.



Online testing solution



Laboratory solution



Mobile hydrogen quality testing vehicle

Full-cycle digital hydrogen quality control platform



- Provide one-stop, full-chain analysis, testing, and solution services for the hydrogen energy industry

- Supported by multiple major key R&D programs and group science and technology projects
- Demonstration of integrated application of NQI key technologies for hydrogen refueling stations
- Research and application demonstration of key equipment testing technologies for green hydrogen

2. Cornerstone for the Healthy Development of Hydrogen Market - New Infrastructure Construction

As of now, quality testing for the entire lifecycle of hydrogen has been carried out at 32 hydrogen production plants and refueling stations across 20 cities in 12 provinces, including Shanghai, Zhejiang, Jiangsu, Shandong, Tianjin, Beijing, Hebei, Henan, Shanxi, Shaanxi, Ningxia, and Inner Mongolia, covering a distance of 6,900 kilometers. Over 100 sets of test data have been collected, covering hydrogen sources such as coal-based hydrogen, natural gas reforming hydrogen, coke oven gas industrial by-product hydrogen, and alkaline water electrolysis hydrogen.



Shandong



Tianjin



Shanghai



Hebei



Beijing



Zhejiang

Hyd

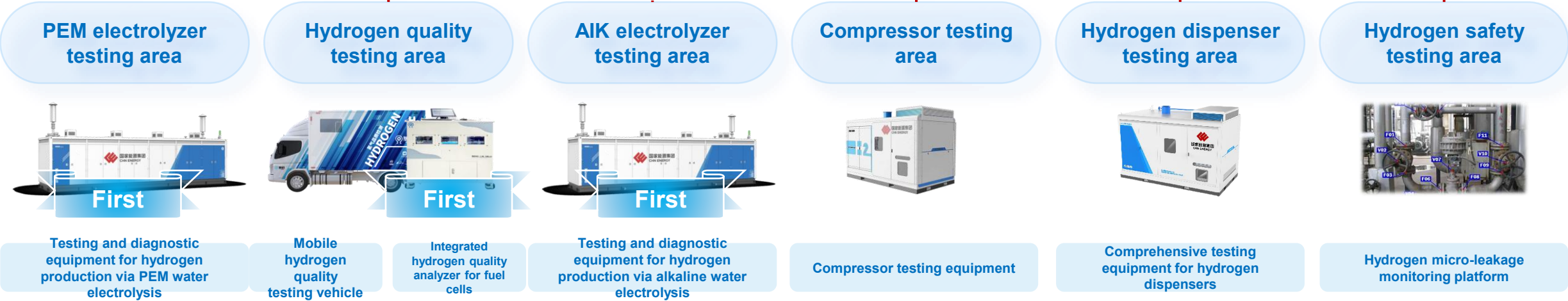


2. Cornerstone for the Healthy Development of Hydrogen Market - New Infrastructure Construction

No. 1 Test Site of the Industrial-Scale Green Hydrogen Equipment Testing and Validation Research Center



Equipped with a hydrogen quality control platform, hydrogen storage equipment testing system, hydrogen refueling station equipment testing platform, and hydrogen leak monitoring, warning and control platform, **it provides testing and validation services for hydrogen storage and transportation facilities and equipment.**



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Future Outlook

3.Future Outlook

Build the functions of "demonstration, testing & certification, and hands-on training", and create an open innovation collaboration mechanism to actively serve new hydrogen energy technologies, new products, new models, and new business formats.

Demonstration Function



Green Hydrogen Demonstration and Verification Platform

Carry out real-world condition verification for key hydrogen energy equipment such as electrolyzers, hydrogen dispensers, and fuel cells. Conduct comparative benchmarking with equipment manufacturers and laboratory data. Build a real-world performance database to support industry standard development and validation.

Hands-on Training Function

Hydrogen Industry Talent Training Base

Based on the industry-education integration concept and cooperation with Xi'an Jiaotong University and other partners, build a talent training platform for universities and key industry enterprises, as well as an industrial application talent training base.



Green Hydrogen Demonstration and Verification Platform

Testing Function



Testing and inspection of full-chain technical equipment/products/processes

Carry out testing of key green hydrogen technology equipment, products, and processes for the industry. Accelerate the development of enterprise self-procurement/submitted testing, long-term testing, and government/industry-specified testing capabilities.

Certification Function

Explore an international "one test, multiple certificates" mechanism

Provide one-stop testing and certification for Chinese and international hydrogen equipment suppliers. Innovatively implement "one test, multiple certificates" to promote mutual recognition and alignment of hydrogen technology standards internationally, creating an internationally trusted quality chain from product R&D and manufacturing to operation.





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THANKS!