



## Views &amp; Comments

# Hydrogen Energy in Shandong: Building on the Momentum and Joining the Trend of Our Times



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## 1. Introduction

Hydrogen energy is one of the most promising clean energies in the world and can be widely used in transportation, the industrial sector, electricity, construction, and other fields. As a strategic and leading emerging industry, hydrogen energy represents an important direction in future technological revolution and energy development. Major developed countries and regions such as the United States, Japan, the Republic of Korea, and the European Union have incorporated hydrogen energy into their energy development strategies and have continuously increased their support for its research and development (R&D) and industrialization. Their enterprises have led the world in the R&D of hydrogen energy technology and the manufacturing of key materials.

The hydrogen energy industry has been recognized as a strategic emerging industry in China. Major technologies and production processes such as hydrogen energy production, storage and transportation, fuel cell system integration, and hydrogenation infrastructure have been constantly improved in China, and accelerated development has been achieved in the industry. In recent years, the province of Shandong has attached great importance to the development of the hydrogen energy industry. The province has accelerated the development of this industry as a major step toward early planning in leading industries in order to seize a strong position in the development of this new energy technology. Shandong has put forward proposals to strengthen the top-level design, rapidly develop the industrialization capacity, and explore the great horizons of hydrogen energy development in China, so as to speed up the transformation of economic growth drivers and provide strong support for high-quality development. On 17 June 2020, Shandong released the *Medium- and Long-Term Development Plan of the Hydrogen Energy Industry in Shandong Province (2020–2030)* (hereinafter referred to as “the Plan”), China’s first provincial-level official document for the hydrogen energy industry. According to the Plan, Shandong will give full play to its unique advantages in resource endowment, technological innovation, industrial foundation, and application scenarios; act quickly to undertake overall planning on hydrogen energy applications in fields such as automobiles, energy, ports, rail transit, and ships; and build a national hydrogen energy and fuel cell

demonstration area integrating innovation, R&D, equipment manufacturing, product application, and commercial operation within the next 10 years.

## 2. The main features of the Plan

### 2.1. A clear direction and path

The Plan focuses on five key aspects of the development of the hydrogen energy industry: hydrogen production, hydrogen storage and transportation, the construction of a hydrogenation infrastructure, the fuel cell system, and the promotion and application of hydrogen energy. In this way, the Plan defines the direction, priorities, specific roadmap, and agenda for developing the hydrogen energy industry in Shandong, in accordance with the principles of exerting strength, strengthening weaknesses, stressing key areas, and upgrading levels.

### 2.2. A well-established indicator system

The Plan identifies 11 specific indicators under the three categories of R&D, industrial development, and promotion and application. Moreover, it projects the expected goals for 2022, 2025, and 2030, with a special emphasis on the “14th Five-Year Plan.” The goals of the gross output value of the hydrogen energy industry, the number of hydrogenation stations, the application scale of fuel cell vehicles, and the localization rate of key components are set out on a year-by-year basis from 2020 to 2025, to ensure that such development path provide detailed guidance.

### 2.3. The instructiveness and feasibility

The focus of the Plan is on major development layouts, key innovation platforms, major infrastructure, and important applications, among other aspects. It involves planning for a number of leading industrial projects, such as the Laiwu Green Intelligent Manufacturing Industrial City in Jinan and the Sino–German Hydrogen Energy Industrial Park in Qingdao, in order to enhance the feasibility of the Plan and ensure the effective implementation of key tasks.

### 3. The implementation path of the Plan

#### 3.1. Coordinating plans

At the national level, since 2011, the central government has successively issued a series of supporting policies and outlines on strategic positioning, industrial structure, scientific and technological innovation, financing, and other aspects to guide and encourage the development of the hydrogen energy industry. Central government enterprises have actively developed the hydrogen energy business arena. The China Energy Group, State Power Investment Corporation (SPIC), PetroChina, and China State Shipbuilding Corporation (CSSC) have made forays into the hydrogen energy industry based on their respective advantages. The supporting policies of the Plan focus on coordination with the central government and give full play to Shandong's resource advantages and industrial foundation to make full use of the favorable national policies.

At the provincial level, efforts will be made to fully synergize the Plan with other plans such as the *14th Five-Year Plan of Renewable Energy Development*, the *Development Plan of the New Energy Automobile Industry*, and the specific plans of various cities. This will prevent development overlap and construction duplication so as to ensure the orderly implementation of the development plan, and will coordinate and mutually reinforce the development of the hydrogen energy industry with industrial, energy, and ecological plans.

#### 3.2. Building platforms

Taking advantage of China's first hydrogen energy and fuel cell industry alliance, Shandong is building two types of platform to support the implementation of the Plan. First, it is building a development platform that covers industries and projects. A number of cities in Shandong are working as a group to strive for an official approval to establish a national urban cluster of fuel cell vehicle demonstrations. This will make it possible to integrate the upstream and downstream industrial chains; speed up the demonstration, promotion, and application of hydrogen energy; create an advanced "Shandong model" on hydrogen energy application; and enhance the leading role of Shandong's hydrogen energy industry across the country.

Second, Shandong is strengthening a functional platform for comprehensive supporting services. Major enterprises in the industrial chain are encouraged to work with key universities, scientific research institutions, and competitive enterprises—both inside and outside the province—to establish a platform for hydrogen energy technological innovation and support services, which will be enterprise-based and market-oriented, and will integrate industrial and academic research. Relying on Weichai's Provincial Fuel Cell Technology Innovation Center and Shandong Special Equipment Inspection and Testing Group's New Energy Automobile Data Detection Platform, Shandong will build a national fuel cell technology innovation center and the Shandong fuel cell vehicle big data center and ecological platform so as to vitalize the data flow of the fuel vehicle ecosystem within the province and make new advances in scientific and technological innovation in hydrogen fuel cells.

#### 3.3. Advancing technological innovation

Centering on the innovative development chain of the hydrogen energy industry, Shandong will promote collaborative innovation between the upstream and downstream of the industry and will further strengthen the development of a technological innovation system in order to underpin the implementation of the Plan with strong scientific and technological performance. The province aims to make continuous breakthroughs in key generic technologies in

hydrogen energy. With the implementation of national and provincial science and technology plans as the starting point, Shandong will intensify its efforts to pursue breakthroughs in the utilization of industrial byproduct hydrogen, hydrogen fuel cell proton-exchange membranes, fuel cell stacks, engine systems, and vehicle integration. The province will further improve the production, storage, and transportation capacity of hydrogen and related sets of equipment. It will also improve the quality of the fuel cell system, the performance of fuel cell vehicle integration and control systems, fuel cell rail transit, port machinery, and ships, and will strive to establish a sophisticated hydrogen energy technological innovation system by 2025.

Furthermore, Shandong is acting quickly to pool domestic and international innovative resources in hydrogen energy. An internationalization strategy in scientific and technological innovation will be implemented, targeting resources from the United States, Japan, the Republic of Korea, the European Union, and other countries and regions with advantages in hydrogen technology. In this way, Shandong will facilitate exchanges between local institutions, leading overseas universities, and technology enterprises in the hydrogen energy industry. It will also attract high-level science and technology talents, introduce and draw on advanced technological achievements, and integrate itself into the global innovation network of the hydrogen energy industry.

#### 3.4. Accelerating project implementation

The implementation of the Plan will be based on projects. According to the resource endowment, industrial foundation, advantages of geographical location, and policies of various areas within the province, the Plan proposes to implement seven major projects. It also includes plans for a number of key pilot demonstration projects with a focus on breakthroughs in aspects with the greatest potential and advantages. The province will focus on major development layout, key innovation platforms, major infrastructure, and important areas of application and demonstration. By doing so, Shandong will accelerate major industrial projects that have already undergone solid preliminary research and argumentation. These projects include the Laiwu Green Intelligent Manufacturing Industrial City in Jinan, the Sino-German Hydrogen Energy Industrial Park in Qingdao, fuel cell engine manufacturing in Weifang, fuel cell proton-exchange membrane industrialization in Zibo, and renewable electrolytic water hydrogen production in Dongying. Shandong will also establish a coordination and promotion mechanism, provide follow-up services in the whole process and scope of the projects, identify and solve the problems that are encountered, ensure a supply of land for leading provincial projects in line with the big picture, and promote the role of these projects in driving forward development and demonstration related to hydrogen energy.

#### 3.5. Enhancing standardization

It will be necessary to regulate the hydrogen energy industry with standards for the whole industrial chain, including hydrogen production, transportation, filling, and vehicle operation, as well as planning, design, construction, operation quality, and safety control. Shandong will optimize a local standardization system for the hydrogen energy industry, identify standardized projects that are urgently needed to speed up the R&D and release of standards, especially those that are needed for current projects. Shandong will enable enterprise-made standards to play a major role in standardization, guide enterprises and social organizations to establish standards, vigorously promote the transformation of scientific research into standards, and thereby build a solid foundation for the standardization of the hydrogen energy industry.