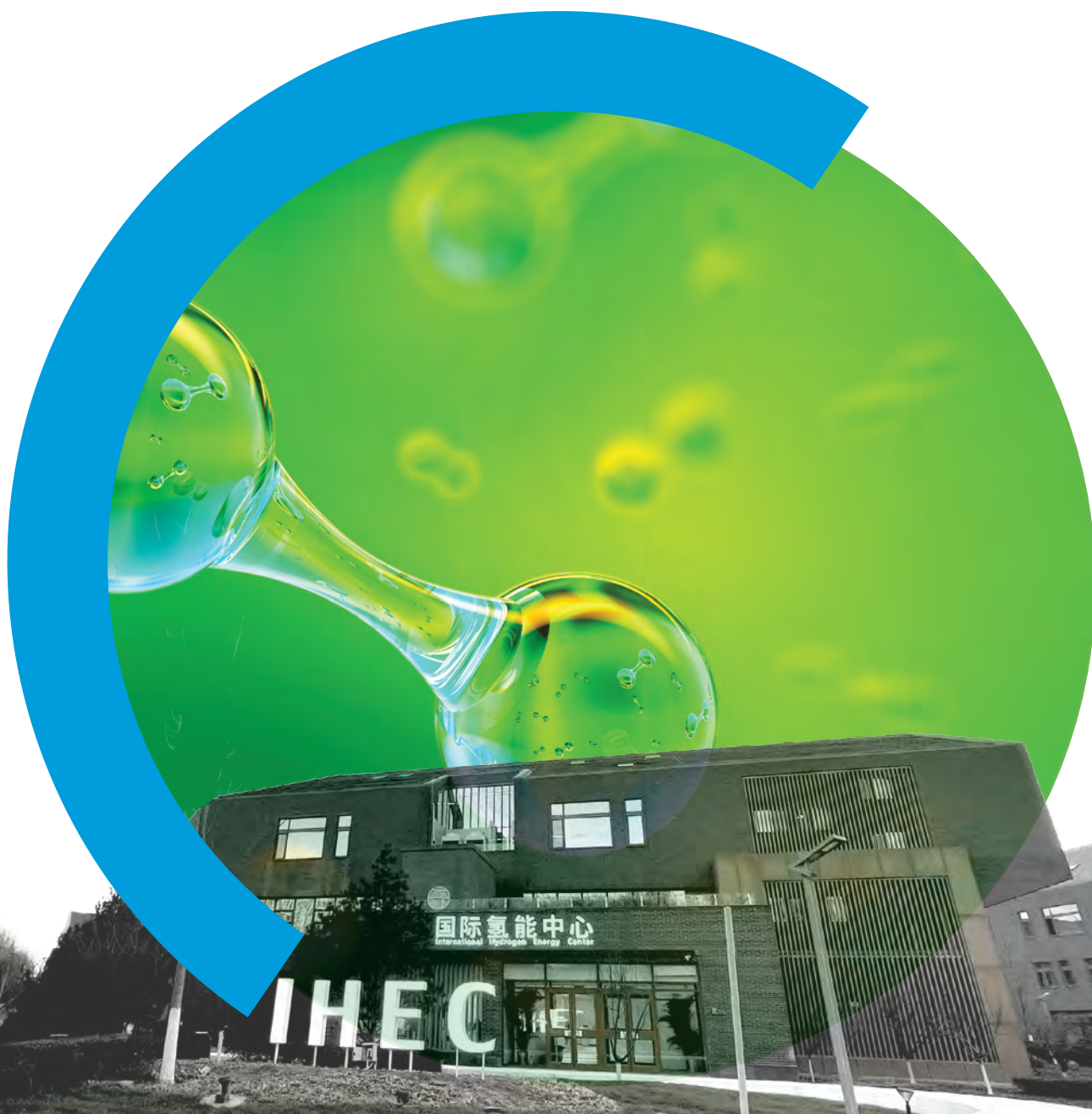




UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION



INTERNATIONAL HYDROGEN ENERGY CENTRE

Progress Report 2022

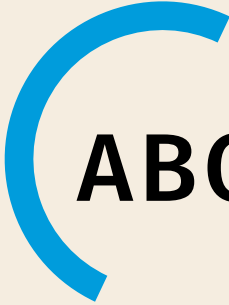
An important milestone on the road towards placing hydrogen at the heart of sustainable development





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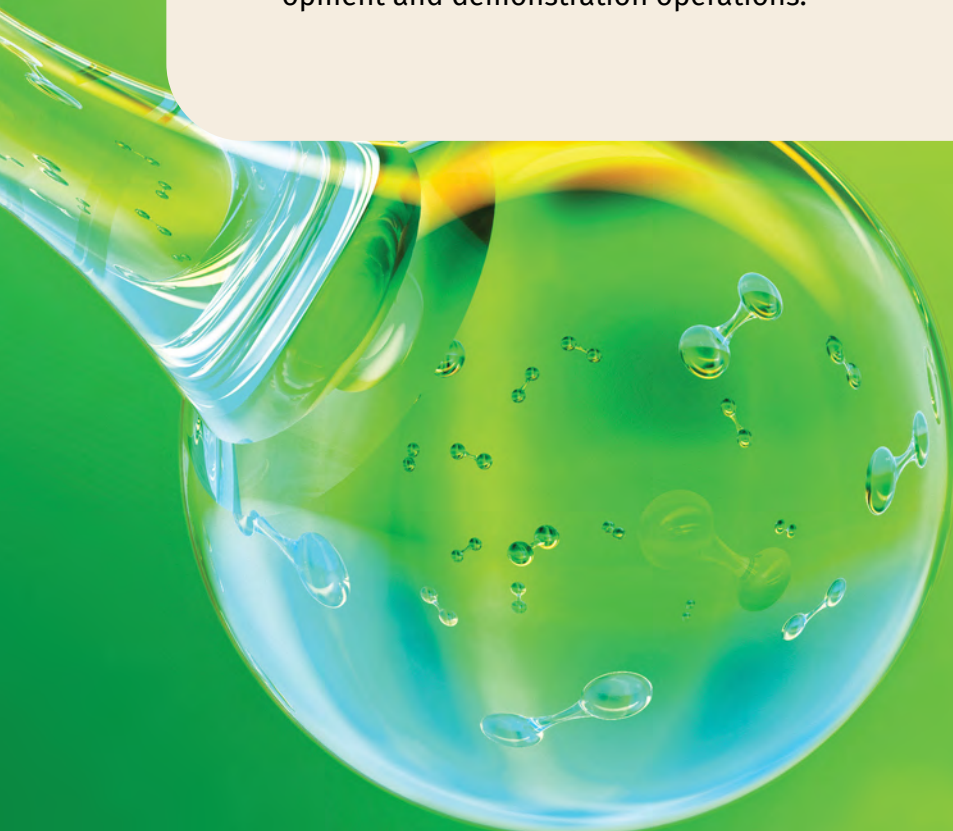
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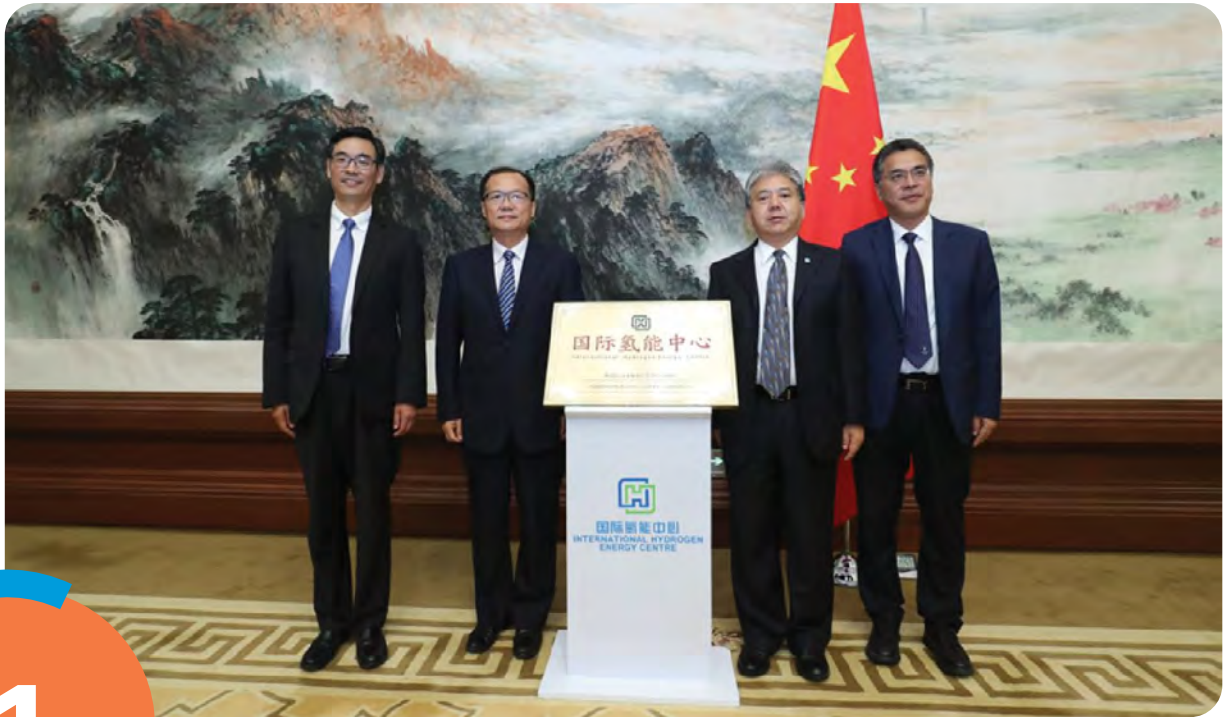


ABOUT IHEC

The International Hydrogen Energy Centre (IHEC) is a globally influential technology innovation hub for hydrogen energy. The centre was established by the Tsinghua Industrial R&D Institute (TIDRI) under the auspices of the Beijing Municipal Bureau of Economy and Information Technology (BEIT) and China International Center for Economic and Technical Exchanges (CICETE), and supported by the United Nations Industrial Development Organization (UNIDO).

The IHEC was officially inaugurated by the People's Government of Beijing Municipality on 7 July 2021, and its headquarters completed on 15 November 2021. Since the IHEC fully started its operations in 2021, it has carried out hydrogen-related application research, technology R&D, scenario demonstrations and international cooperation in collaboration with research institutions, enterprises and local governments. It also operates the Beijing Yitong Hydrogen Energy and Fuel Cell Technology Innovation Research Institute (BYJT Hydrogen Institute), a private non-enterprise unit initiated by TIDRI. A scientific advisory committee was established to make suggestions on IHEC's research direction, product development and demonstration operations.





Establishment of the International Hydrogen Energy Centre

On 25 April 2019, Beijing Mayor Chen Jining and Vice Mayor Yin Yong met with former UNIDO Director-General Li Yong to discuss establishing the International Hydrogen Energy Centre. Organized by the Beijing Municipality, TIDRI, BEIT and UNIDO jointly completed the centre's construction plan, which was formally approved in December 2019. In April 2020, the Beijing Municipality wrote to the Ministry of Commerce of the People's Republic of China (MOFCOM) to express support for the founding of the centre. With the help of MOFCOM, the IHEC project was completed through CICETE and UNIDO in July 2020. Supported by BEIT, the centre officially signed the project cooperation agreement and project task letter with CICETE and UNIDO in May 2021.

On 7 July 2021, IHEC held its inauguration ceremony, which was attended by Tareq Emtairah, Director of UNIDO's Energy Division; Zhang Yi, Deputy Director of CICETE of the Ministry of Commerce; Jiang Guangzhi, Deputy Director of the Beijing Municipal Bureau of Economy and Information Technology; and Jin Qinxian, President of the

Tsinghua Industrial R&D Institute. At the ceremony, Ma Jian, Deputy Representative of UNIDO in China, together with Zhang Yi, Jiang Guangzhi and Jin Qinxian, inaugurated the IHEC, which marked its official establishment.

Inauguration ceremony





Organizational Development

2.1. Establishment of the Board and Scientific Advisory Committee

Once the IHEC was running, it set up a Board and a Scientific Advisory Committee:

The IHEC Board:

Director: Jin Qinxian, Vice Secretary-General of Tsinghua University and Director of the Tsinghua Industrial R&D Institute.

The Board Members:

- Zhu Dequan and Fu Xiaolong, Vice Presidents of the Tsinghua Industrial R&D Institute;
- Zhang Guoqiang, Chairman of Beijing SinoHytec;
- Zha Zhiwei, Chairman of Beijing Hypor Hydrogen Energy Technology.

The IHEC Scientific Advisory Committee:

Chairman: Ouyang Minggao, Tsinghua University Professor and Member of the Chinese Academy of Sciences.

The Committee Members:

- Yi Baolian, Member of the Chinese Academy of Engineering and Researcher at the Dalian Institute of Chemical Physics of the Chinese Academy of Sciences;
- Li Jianqiu, Yang Fuyuan and Wang Hewu, Professors from Tsinghua University;
- Li Junhua, Director of the 718th Research Institute of China State Shipbuilding Corporation.

2.2. Setting up the Operation and Management Team and Subsidiary Departments

The IHEC's management team consists of 15 people. Jin Qinxian is the Director, and Zhu Dequan and Fu Xiaolong serve as Vice Directors. Wang Yanyan is Assistant Director in charge of daily operations, with a full-time team of six (Chen Chen, Liang Zheng, He Huan, Hu Jing, Wang Jiahui and Wang Hui). The IHEC also has four subsidiaries: Headquarters R&D Division, Application Research Division, Scenario Demonstration Division, and International Cooperation Division.

The Headquarters R&D Division is responsible for conducting exchanges and cooperation with domestic and foreign leading enterprises in hydrogen energy and fostering innovative and entrepreneurial entities in this field, with Wang Yanyan as Chief. The Application Research Division cooperates with domestic and foreign research institutions to carry out technology development and equipment design, with Dr. Wang Xue as Director. The Scenario Demonstration Division, directed by Zhang Chengbin, liaises with local governments to conduct local hydrogen energy industry planning and promote local hydrogen energy application demonstration. The International Cooperation Division, headed by Qian Jingbin, connects with UNIDO and foreign embassies in China to carry out international exchanges and hold international seminars.

2.3. Establishment of the IHEC Headquarters

The IHEC headquarters, which covers 2,200 square meters, was built on the first floor of Building Seven (7) of Zhongguancun International Science Park in the Haidian District, Beijing. Inside the offices, there is a modern international hydrogen energy exhibition hall with a panoramic view of the 20-year journey of China's hydrogen energy industry, as well as its development in the United Nations, the United Kingdom, Denmark, Norway, the Netherlands, Germany, Australia, Japan and South Korea. A 2,000-square-meter working space is open to governments, scientific research institutions, leading enterprises, innovative and entrepreneurial corporates that are involved in the global hydrogen energy industry.

2.4. Daily Operation of IHEC

On 10 November 2021, UNIDO held a special expert meeting on supporting the capability building of the IHEC, where global experts in the field of hydrogen energy discussed development goals and priorities. The IHEC also invited leaders from UNIDO in China and representatives from the embassies of the United Kingdom, Denmark, Australia, Japan and South Korea to visit the centre to advance cooperation. The IHEC has also cooperated with the Haidian District of Beijing, Jiuyuan District of Baotou City of Inner Mongolia and Qiaodong District of Zhangjiakou City of Hebei Province to build regional innovation centres in the IHEC headquarters, and three innovative enterprises in the field of hydrogen energy have been stationed at the headquarters. The three enterprises cover the three key areas of hydrogen energy: Shuimu Mingtuo Hydrogen Energy Technology (renewable energy); Beijing Jituo Chuangneng Technology (hydrogen production by water electrolysis); and Beijing Leidong Zhichuang Technology (instrument equipment of the hydrogen production area). The IHEC also opened a WeChat public account and published several news articles, which have been read by more than 2,000 people.





Extensive International Exchanges and Cooperation

3.1. First International Hydrogen Energy Industry Development Forum

On 15 November 2021, the IHEC held the first International Hydrogen Energy Industry Development Forum. Top scholars and representatives from enterprises from various countries in the field of hydrogen energy gave presentations and held in-depth discussions on global hydrogen energy development trends. The event was hosted by Jin Qinxian, Deputy Secretary-General of Tsinghua University and President of the Beijing Tsinghua Institute of Industrial Development, and addressed by Li Yong, then-Director-General of UNIDO, Zhang Yi, Deputy Director of the China Center for International Economic and Technical Exchanges, Yang Xiuling, Director of the Beijing Municipal Bureau of Economic and Information Technology, Lin Jianhua, Vice Mayor of Haidian District, Beijing, and Zeng Rong, Vice President of Tsinghua University.

The International Hydrogen Energy Industry Forum was followed by a speech by Tareq Emtairah, Director of the Energy Division of UNIDO, as well as by Counsellors of the Embassies of Australia, Denmark, Japan, South Korea, Norway, the United Kingdom, and representatives of foreign institutions in China.

Keynote speeches were given by: Ouyang Minggao, Member of the Chinese Academy of Sciences and Professor at Tsinghua University; Petra Schwager, Chief of the Energy Technologies and Industrial Applications Division of UNIDO; Professor Martin Freer, Director of the Energy Research Accelerator and Director of the Birmingham Energy Institute (BEI); Li Junhua, General Manager of the Purification Equipment Research Institute of China Shipbuilding Industry Corporation (CSIC); Huang Zhenguo, Professor at the University of Technology Sydney; Tore Sylvester Jeppesen, Senior Vice President of Haldor Topsoe Green Hydrogen; Zhang Zhenhao, General Manager of Von Ardenne

Vacuum Equipment; Jorg Gigler, Director of the Dutch New Gas Innovation Team (TKI New Gas); Zhang Yongming, Professor at Shanghai Jiao Tong University; Knut Vågsæther, Professor at University of South-Eastern Norway; Yang Kai, Project Director of Toyota Motor (China) Investment and Deputy General Manager of United Fuel Cell System R&D; and Zhao Zuozhi, Global Chief Strategy Officer and Head of Asia-Pacific new energy business of Siemens Energy.

In-depth presentations and discussion covered technology of hydrogen production by water electrolysis, SOEC electrolysis technology, perfluorinated membranes in fuel cells, PEM technology, hydrogen safety and relevant projects and demonstration applications in the field of hydrogen energy in different countries.

Over two hundred (200) representatives from government agencies, research institutes and leading companies in the field of hydrogen energy from China, Australia, Denmark, the Netherlands, Norway, Japan, the United Kingdom and Germany and UNIDO attended the seminar online.

3.2. International Exchanges and Cooperation

In 2021, the IHEC introduced the concept and status of International Hydrogen Energy Demonstration Zones at the world's top hydrogen forums, including ACEF2021, the China-US Roundtable Dialogue on Green Hydrogen Policy, the Vienna Energy Forum and the 2021 Global High-Level Forum on Energy Transition.

Since the headquarters of the IHEC came into operation in November 2021, it has received visits by officials from multinational institutions in China, including: Stephen Kargbo, UNIDO Representative and Head of the Regional Office in China; Ma Jian, Deputy Representative of the UNIDO Regional Office in China; Grace Carey, Science and Technology Counsellor at the British Embassy in China; Jeppe Solmer, Counsellor of the Danish Consulate General in Shanghai; Jessica Brown, Counsellor for the Department of Industry, Science, Energy and Resources at the Australian Embassy in China; Chang Ho Seung,

Counsellor in Economic Department Embassy of the Republic of Korea in China; Haruko Yoneyama, Deputy Director-General of the Japan Science and Technology Agency (JST); and Xu Lin, Chairman of the China-US Green Fund. Discussion focused on global cooperation in building the International Hydrogen Energy Demonstration Zones.

In addition, the IHEC has also carried out specific hydrogen R&D and demonstration projects with leading companies in the industry, such as Vestas and Haldor Topsoe from Denmark, Air Products and Chemicals from the US, Siemens from Germany, Fortescue Metals Group from Australia, and Itochu and Panasonic from Japan.

Meetings

with Haruko Yoneyama



with Grace Carey





Research and Development of H₂ Energy Technology

4.1. Participation in Establishing the National Hydrogen Industry Innovation Center and Comprehensive Planning of Hydrogen Industry Chain

Under the leadership of Academician Ouyang Minggao, Chairman of the Scientific Advisory Committee, the IHEC has actively participated in the preparatory work of establishing the National Hydrogen Industry Innovation Center, which plays an important role in leading and driving regional economic and industrial development.

The IHEC has cooperated with hydrogen experts from the School of Vehicle and Mobility at Tsinghua University to comprehensively plan a hydrogen energy industry chain covering hydrogen production from renewable energy, hydrogen storage and transportation, hydrogen power supply, hydrogen power and hydrogen raw materials, as well as 16 integrated systems, 47 types of core equipment and 140 key

technologies. In addition, the development plan for the National Hydrogen Industry Innovation Center has been drafted, which focuses on international exchanges, technology research, equipment research and application demonstration needed to build the hydrogen energy industry chain. The development plan will be submitted to the National Development and Reform Commission. Upon approval, the IHEC will serve as an important component of the National Hydrogen Industry Innovation Center to carry out international exchanges and cooperation and research and development of key technologies.

4.2. Participation in National Demonstration Project of Hydrogen Energy and Establishment of Pilot Platform of Hydrogen Energy

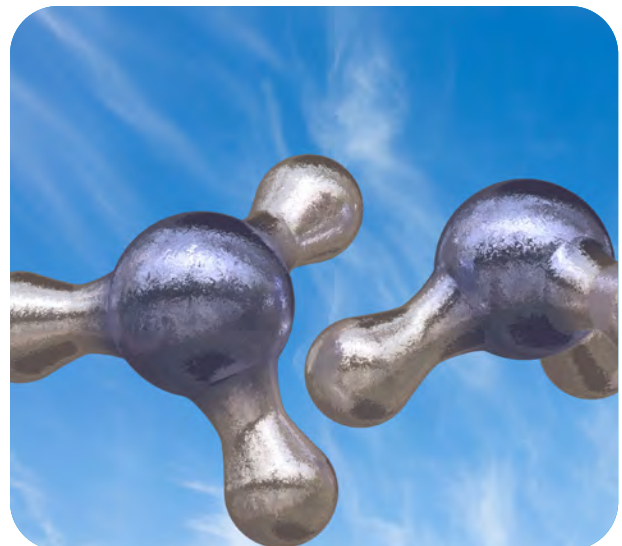
To promote the development of Beijing's hydrogen industry, the Beijing Municipality

plans to work with the Ministry of Science and Technology of China to establish the national demonstration project “Hydrogen: Fuel of the Future”. Focusing on the national strategy, the demonstration project comprehensively sorts out the underlying technologies for the entire industry chain for hydrogen energy. Based on the needs of the country and the conditions for industrialization, it points out the direction for innovation and demonstration, strengthens Beijing-Tianjin-Hebei coordination, takes full consideration of the industrial foundation and scene characteristics of the three regions, and forms a division of labour and cooperation chain. Demonstration application has been carried out in 28 key directions of seven key fields: multiple green hydrogen preparation, liquid hydrogen industrial system, green ammonia intermediate route, new power generation technology, hydrogen power system, metallurgical engineering application & innovative characteristic park.

The IHEC is undertaking the construction task of the green ammonia intermediate route in the demonstration project. In view of the challenges faced by the large-scale preparation of green hydrogen and green ammonia, the IHEC makes use of the scientific research resources of the Tsinghua Industrial R&D Institute and the global cooperation network of UNIDO to formulate a strategy for key technology R&D, equipment development, pilot test and production scale demonstration of green hydrogen and green ammonia, and establish a complete R&D system of technology research and development, equipment development and industrial demonstration in this regard. The IHEC will build the world’s leading hydrogen pilot test base in Changping District, Beijing. In view of the need of equipment development and system integration in the engineering verification stage of hydrogen energy technology, the IHEC is equipped with qualified sites, professionals, public auxiliary facilities, test conditions, and other hardware and software facilities to meet development requirements. The IHEC will also carry out technology R&D, equipment manufacturing, system integration and pilot demonstration, promote the equipment and products resulting from technical progress, cultivate entrepreneurial enterprises in the hydrogen energy industry, and explore the technological path towards a zero-carbon energy system to achieve carbon neutralization.

4.3. R&D of Key H2 Energy Technology

Currently, the IHEC is cooperating with global hydrogen energy leading enterprises to carry out research in the field of direct coupling of renewable energy to produce green hydrogen. It has researched and developed the hydrogen energy comprehensive planning system based on the fluctuation characteristics of renewable energy. The system simulates the energy, material and economic balance process from renewable energy to green hydrogen, and uses nonlinear optimization and artificial intelligence technology to find the optimal scale configuration. This work will take the lead in mastering the industrial system planning technology under fluctuating conditions. In addition, the IHEC is researching and developing the core equipment for the direct coupling of renewable energy to produce green hydrogen, including a new generation of wind-to-hydrogen electronic equipment, equipment of hydrogen production by water electrolysis and electrochemical ammonia synthesis equipment. This will lead to breakthroughs in a number of major core technologies, such as high-power IGBT power electronic equipment, wide-fluctuation alkaline electrolytic tanks and low-power ammonia reaction holders. By doing so, the core equipment for preparation of green hydrogen and green ammonia can be continuously adjusted within the load range of 10% to 100 %, and the response speed can reach the minute level, so as to maximize the matching of wind power and photovoltaic fluctuation characteristics.





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Demonstration of Hydrogen Energy Industry

Taking advantage of the hydrogen industry basis of the Tsinghua Industrial R&D Institute and the global cooperation network of UNIDO, the IHEC is conducting industrial-scale demonstrations in the transport sector and the hydrogen industry. In the transport sector, it successfully carried out the world's largest demonstration of operating hydrogen fuel cell commercial vehicles at the 2022 Winter Olympic Games. More than 850 hydrogen fuel cell vehicles were used for Beijing 2022, providing transportation services for athletes and officials from various countries, with a total of 2-million-kilometre driving distances, a 200-ton consumption of hydrogen and a 2000-ton reduction of carbon emissions. For the first time, it completely showed the impact of a hydrogen energy system and hydrogen transportation system. In addition, the Hydrogen Fuel Cell Logistics Vehicle Demonstration Zone was established in Daxing District, Beijing, which built the world's largest hydrogenation station of 4.8 tons per day and released 100

hydrogen logistics vehicles for the first time in the world.

The application of hydrogen energy is an important starting point for industrial low-carbon transformation. China's steel and chemical industries are the main source of CO₂ emissions. Making use of China's abundant resources of renewable energy, the metallurgical and chemical industry can carry out large-scale green hydrogen production by water electrolysis, and take green hydrogen as the main raw material, which can be used for green metallurgy technology, such as direct reduction of iron by hydrogen, and green chemical technology, such as producing ammonia and methanol by hydrogen. In this way, the metallurgical and chemical industry can realize a zero-carbon transformation in the field of green metallurgy featured by short-process and zero-carbon steelmaking and a green chemical industry marked by carbon fixation and emission reduction.

The IHEC is also cooperating with leading global enterprises to carry out the world's largest demonstration of hydrogen production by renewable energy and application in the hydrogen metallurgy chemical industry in Baotou, Inner Mongolia, including the construction of water electrolysis fueled by renewable energy to produce green hydrogen

with an annual output of 300,000 tons, the construction of direct reduction iron by using green hydrogen as a reducing agent with an annual output of 1.1 million tons, and the construction of green ammonia synthesis by using green hydrogen and air to capture nitrogen as raw materials with an annual output of 1.2 million tons.

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UNIDO and the Government of China recognize the **crucial role that hydrogen can play in the future energy system**. They understand the urgent need to promote hydrogen technology to make it more **scalable, inclusive and affordable globally**.

*LIU Heng
UNIDO Senior Technical Advisor and
Project Manager, UNIDO*

Interested in collaborating with IHEC?

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United Nations Industrial Development Organization / The People's Government of Beijing Municipality

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