HeleTitanium
MATERIALS, ENGINEERING, MACHINING

Your One-Stop PEM Electrolyzer Manufacturer



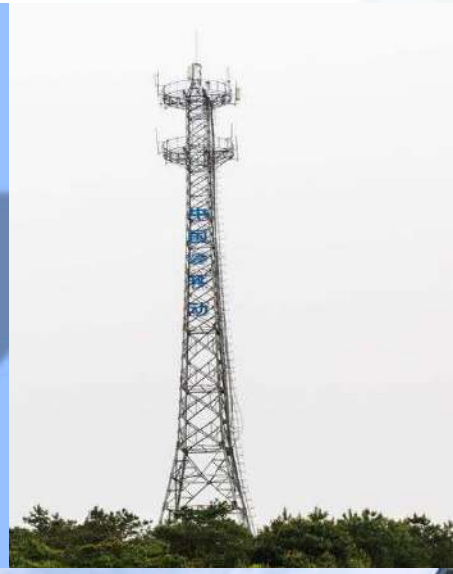


Key Projects Have Been Completed

June 2016:

Leveraging Hele Titanium's proprietary PEM electrolyzer technology and equipment, the company successfully supported the implementation of a hydrogen electrolysis solution for the China Mobile Shanghai Fengxian Base Station Demonstration Project. This marked a key milestone in showcasing the integration of clean hydrogen energy within telecommunications infrastructure.









Key projects have been completed

December 2018:

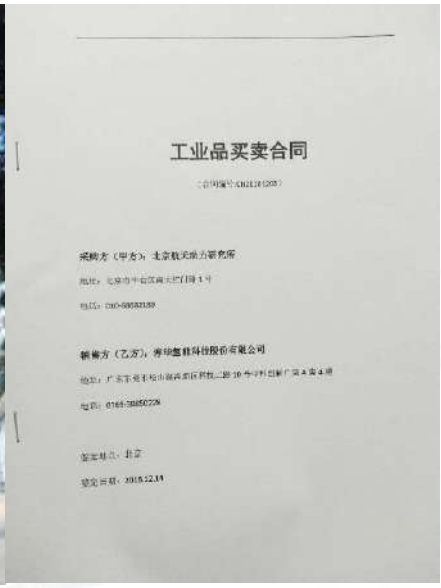
On December 14, 2018, Hele Titanium signed a supply contract with the Beijing Institute of Aerospace Power (also known as the 11th Institute of the China Aerospace Science and Technology Corporation) for the delivery of a **PEM2/3.5 medium-pressure solid polymer electrolyte hydrogen production system**.

Founded in 1958, the Beijing Institute of Aerospace Power is a core research institution under China Aerospace Science and Technology Corporation and is recognized as the birthplace of China's liquid rocket propulsion technology. Over the past five decades, it has led the development of multiple liquid rocket engines used in national space launch missions. The collaboration with Hele Titanium marked a key milestone in advancing hydrogen energy integration within China's aerospace sector.

中国航天 CASC







Key projects have been completed











Hele Titanium supplies core technology and technical expertise to support central state-owned enterprises in the manufacturing of large-scale water electrolysis hydrogen production systems.

SAF (Sustainable Aviation Fuel) Research Project – University in Shanghai

Project Overview:
The Sustainable Aviation Fuel (SAF) Research Project, led by a prominent university in Shanghai, focuses on the development of next-generation aviation fuel derived from renewable resources and waste materials. SAF is designed to replace conventional fossil-based jet fuels, with the goal of significantly reducing lifecycle carbon emissions across the aviation sector.



Production Process:
Key pathways in SAF production include the hydrogenation of waste oils, greases, and carbon dioxide. These processes require a reliable and high-purity hydrogen supply under controlled pressure conditions.

Hele Titanium's Role:
Hele Titanium supports this research initiative by supplying advanced **PEM water electrolysis hydrogen production equipment**, delivering both **high-pressure** and **ultra-high purity hydrogen**. Our systems ensure a stable hydrogen source essential for the hydrogenation stages of SAF synthesis, contributing directly to the success of sustainable aviation fuel development in China's academic and research community.

Semiconductor Hydrogen Supply Project – Overseas Client

Project Overview:
In semiconductor manufacturing, hydrogen plays a critical role in various high-precision processes due to its chemical stability and strong reducing properties. One of the most essential applications is in **high-temperature annealing**, where hydrogen is used to enhance wafer surface quality and purity.

Process Description:
During the annealing process, hydrogen reacts with the silicon oxide (SiO_2) layer present on the surface of silicon wafers, facilitating the following reaction:

$$SiO_2 + 2H_2 \rightarrow Si\ (crystalline) + 2H_2O\uparrow$$

This reaction effectively removes the oxide layer, improving surface cleanliness and enhancing overall semiconductor performance.

Hele Titanium's Role:
Hele Titanium supplies high-purity hydrogen through its **PEM water electrolysis systems**, ensuring a stable, clean, and precisely controlled hydrogen source. Our technology supports the client's high-temperature annealing operations, helping to meet the strict quality standards required in advanced semiconductor fabrication.



University Hydrogen Production and Pressurization Project

Project Overview:
This project involves the delivery of a complete high-pressure hydrogen generation and pressurization system for a university client. The system was designed and manufactured by Hele Titanium to support research and experimental applications requiring high-pressure hydrogen.

System Description:
The integrated solution begins with a **PEM water electrolysis system**, which produces hydrogen at an output pressure of **3 MPa**. This hydrogen is then further compressed using a **gas booster pump**, raising the final output pressure to **35 MPa**—suitable for applications such as hydrogen storage, fuel cell testing, and refueling simulations.

Hele Titanium's Role:
Hele Titanium provided the full system, including hydrogen generation, compression, and safety controls. Our equipment ensures **reliable performance, high-purity output, and safe operation**, supporting the university's efforts in hydrogen energy research and practical training.



Xi’an Jiaotong University & Gree – Small Photovoltaic Off-Grid Hydrogen Production Project

Project Overview:
This collaborative project between Xi’an Jiaotong University and Gree explores the integration of off-grid photovoltaic (PV) energy with hydrogen production using PEM water electrolysis. With its rapid response capability and high efficiency in adapting to fluctuating power inputs, the **PEM electrolyzer** is a key technology for off-grid renewable hydrogen systems.



System Description:
The system utilizes locally generated solar power to produce hydrogen at a rate of **up to 1 Nm³/h**, providing a reliable and clean hydrogen source without relying on the conventional power grid. It serves as a demonstration of sustainable energy conversion and storage in decentralized environments.

Hele Titanium’s Role:
Hele Titanium supplied the PEM hydrogen production equipment for this project, ensuring stable performance under variable solar input. The system supports experimental research, technology validation, and showcases a practical model for small-scale renewable hydrogen production.

Xi'an Jiaotong University – PEM Hydrogen Production + Electrochemical Compression Research Project

Project Overview:
This project involves the development of an integrated **PEM hydrogen production and electrochemical compression system** for Xi'an Jiaotong University, supporting advanced research in hydrogen storage and transport technologies.

System Description:
The front-end of the system features a **PEM electrolyzer** producing hydrogen at **3 MPa**. This hydrogen is then compressed to a significantly higher pressure through an **electrochemical compression module**, with a theoretical compression ratio of up to **1:100**. Unlike traditional mechanical compressors, electrochemical compression achieves pressure increase through redox reactions—without moving parts—offering advantages such as **high efficiency, low noise, and ultra-high hydrogen purity**.

Electrochemical Compression Principle:
Anode Reaction: H_2 (low pressure) → $2H^+ + 2e^-$
Cathode Reaction: $2H^+ + 2e^-$ → H_2 (high pressure)
By applying current, hydrogen molecules are split into protons at the anode, migrate through the **proton exchange membrane (PEM)**, and recombine into high-pressure hydrogen at the cathode. This enables **directional hydrogen transfer from low to high pressure**, fully driven by electrochemical potential.



Significance:
Electrochemical compression is a critical enabling technology for **cost reduction and efficiency improvement** across the hydrogen value chain. Its advancement supports breakthroughs in **hydrogen storage, renewable hydrogen utilization, and fuel cell vehicle applications**. With progress in materials science and system integration, this technology is expected to **accelerate the commercialization of hydrogen energy** and contribute to achieving **global carbon neutrality goals**.

On-Site Hydrogen Production Project for Special Ceramics Manufacturing

Project Overview:
In the sintering process of special ceramics, hydrogen is used as a reducing gas to inhibit surface oxidation reactions and minimize lattice defects in the material. Maintaining a stable and pure hydrogen atmosphere is critical to achieving high-performance ceramic products.

System Description:
This project delivers an on-site **PEM water electrolysis hydrogen production system** that provides a continuous supply of **high-purity, high-pressure hydrogen** tailored for special ceramic manufacturing environments.

Benefits:
By implementing on-site hydrogen generation, the system ensures:

- A **reliable and high-standard hydrogen supply**
- Enhanced **process stability and material quality**
- Improved **production safety** by reducing the need for high-pressure hydrogen storage and transportation

Hele Titanium's Role:
Hele Titanium provided the full hydrogen production solution, supporting the client's advanced ceramic processes with safe, efficient, and clean hydrogen generation directly at the point of use.



Hydrogen Production and Storage Integration Project for a State-Owned Enterprise

Project Overview:
This project involves a fully integrated hydrogen production and storage system developed by Hele Titanium for a state-owned enterprise. It is designed to meet the growing demand for safe, efficient, and on-demand hydrogen supply in industrial applications.

System Description:
The system combines **PEM water electrolysis** for high-purity hydrogen generation with **high-pressure hydrogen storage modules**. It operates with advanced control and monitoring functions to ensure stable output, efficient operation, and full safety compliance. The integrated design allows for compact installation and ease of maintenance.



Hele Titanium's Role:
Hele Titanium was responsible for the **complete system design, equipment manufacturing, integration, and technical support**. Leveraging its proprietary PEM electrolysis technology, the company delivered a tailored solution to support the client's long-term hydrogen energy strategy, ensuring both operational reliability and scalability.

PEM Hydrogen Production Project for Fuel Cell Enterprise

Project Overview:
This project provides a dedicated **5 Nm³/h high-purity hydrogen supply system** based on **PEM water electrolysis technology**, specifically designed to meet the operational needs of a fuel cell manufacturing enterprise.

System Highlights:
Stable and continuous hydrogen output at 5 Nm³/h
High purity hydrogen suitable for fuel cell applications
Compact and efficient system design optimized for industrial integration

Hele Titanium's Role:
Hele Titanium supplied the complete hydrogen generation system, including design, production, and technical commissioning. The system ensures a reliable and clean hydrogen source, supporting the client's fuel cell testing, calibration, and production processes.



10 Nm³/h Hydrogen Production System – Exported to the United States

Project Overview:
This system, designed and manufactured by Hele Titanium, was exported to the United States to support a **photovoltaic-based hydrogen generation and power supply project**

System Specifications:
- **Hydrogen Production Capacity:** 10 Nm³/h
- **Hydrogen Purity:** ≥99.999%
- **Application:** Solar-powered hydrogen generation for clean energy applications

Hele Titanium's Role:
Hele Titanium provided the complete PEM hydrogen production system, including engineering design, fabrication, and export logistics. The system delivers high-purity hydrogen with stable performance, supporting renewable energy integration and sustainable power solutions in the U.S. market.



Hydrogen Supply Project for Diamond Manufacturing – Henan

Project Overview:
In diamond manufacturing, hydrogen serves as a critical process gas, playing multiple roles such as plasma excitation, impurity etching, surface passivation, and protective atmosphere control. Ensuring a stable and high-purity hydrogen supply is essential to maintaining process quality and material integrity.

System Highlights:
- Fully automated PEM hydrogen production system
- Stable hydrogen output with purity ≥99.999%
- Equipped with advanced safety features, including leak detection and automatic pressure regulation
- Designed for optimal performance in terms of **purity, safety, and cost-efficiency**



Hele Titanium's Role:
Hele Titanium supplied the complete hydrogen generation solution for the client's Henan-based diamond production facility. The system ensures a **reliable and continuous supply of high-purity hydrogen**, supporting critical manufacturing processes while meeting stringent safety and operational standards.

Ultra-High Purity Hydrogen (99.99999%) Supply Project for a Materials Laboratory

Project Overview:
In advanced materials research, ultra-pure hydrogen (7N, 99.99999%) plays essential roles as a **cleaning agent**, **reducing agent**, and **protective gas**. Its use spans a wide range of applications—from the purification of traditional metal materials and semiconductor fabrication to the synthesis of cutting-edge energy materials.

As materials science evolves toward **higher precision and performance**, the demand for ultra-pure hydrogen continues to grow, driving innovation in hydrogen generation and purification technologies.

System Highlights:
- **Hydrogen Purity:** 99.99999% (7N-grade)
- **Fully automated control system** for precision and ease of operation
- **Integrated purification module** to ensure ultra-high purity output
- **Real-time purity monitoring** and safety alarm features



Hele Titanium's Role:
Hele Titanium provided the complete **7N ultra-pure hydrogen production system**, specifically engineered for use in a high-end materials laboratory. The system delivers a consistent and reliable hydrogen supply, fully supporting research in **materials preparation, processing, and high-purity experimentation**, while meeting the most stringent laboratory standards.

Large-Scale On-Site PEM Hydrogen Production Project

Project Overview:
As PEM hydrogen production technology transitions from demonstration to commercialization, both domestic and international enterprises are accelerating deployment through **technological innovation** and **policy support**.

PEM electrolysis is widely regarded as a key pathway for **green hydrogen production**, with strong potential to become the mainstream solution before 2030.

Hele Titanium's Role:
Hele Titanium provided a **skid-mounted PEM hydrogen production system** tailored for on-site hydrogen generation. The system delivers **high-purity, high-pressure hydrogen** with modular design advantages—enabling easy installation, flexible deployment, and stable operation across various industrial applications.



SOFC Hydrogen Supply Project for a College

Project Overview:
Solid Oxide Fuel Cells (SOFCs) are high-temperature, all-solid-state electrochemical devices that convert the chemical energy of fuel directly into electricity and heat. As a representative of the third generation of fuel cell technologies, SOFCs offer high efficiency and fuel flexibility for both stationary and distributed energy applications.

Core Electrochemical Reactions:
Cathode Reaction:
$O_2 + 4e^- \rightarrow 2O^{2-}$ (Oxygen is reduced to oxygen ions at the cathode)
Anode Reaction:
$H_2 + O^{2-} \rightarrow H_2O + 2e^-$ (Hydrogen is oxidized at the anode, releasing electrons)
Overall Reaction:
$H_2 + ½O_2 \rightarrow H_2O$ + electricity + heat



Hele Titanium's Role:
Hele Titanium provided the **hydrogen generation system** for this project, delivering a stable and high-purity hydrogen supply to support SOFC research and development at a university laboratory. The system ensures consistent performance under high-temperature operation, enabling precise experimentation and performance evaluation of solid oxide fuel cells

Ultra-Pure Hydrogen Supply Project for MOCVD Equipment

Project Overview:
MOCVD (Metal-Organic Chemical Vapor Deposition) is a critical technology for the **epitaxial growth of semiconductor materials** such as GaN and GaAs.
The process demands **extremely high hydrogen purity**, typically at **9N (99.9999999%)**, as hydrogen is used as a **carrier gas**, **reducing gas**, and **reaction gas**. The quality of the epitaxial layers—and ultimately, device performance—depends directly on the stability and purity of the hydrogen supply.

System Solution:
The auxiliary hydrogen system provided by Hele Titanium addresses all aspects of the hydrogen supply chain, including:

- **On-site ultra-pure hydrogen generation**
- **Advanced purification technology**
- **High-pressure storage solutions**
- **Stable, continuous hydrogen delivery**

The system is engineered to meet the **stringent purity requirements of MOCVD processes**, while also supporting **large-scale production** and **cost-effective operation**.

Hele Titanium's Role:
Hele Titanium designed and delivered the complete hydrogen solution, ensuring a **reliable, high-purity hydrogen supply** for semiconductor epitaxy applications. This supports enhanced process control, material quality, and operational efficiency for high-end semiconductor manufacturing.



Ultra-Pure Hydrogen Supply Project for MOCVD Equipment

Project Overview: 2Nm3/h

MOCVD (Metal-Organic Chemical Vapor Deposition) is a critical technology for the **epitaxial growth of semiconductor materials** such as GaN and GaAs.

The process demands **extremely high hydrogen purity**, typically at **9N (99.9999999%)**, as hydrogen is used as a **carrier gas**, **reducing gas**, and **reaction gas**. The quality of the epitaxial layers—and ultimately, device performance—depends directly on the stability and purity of the hydrogen supply.



System Solution:

The auxiliary hydrogen system provided by Hele Titanium addresses all aspects of the hydrogen supply chain, including:

- **On-site ultra-pure hydrogen generation**
- **Advanced purification technology**
- **High-pressure storage solutions**
- **Stable, continuous hydrogen delivery**

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Hele Titanium's Role:

Hele Titanium designed and delivered the complete hydrogen solution, ensuring a **reliable, high-purity hydrogen supply** for semiconductor epitaxy applications. This supports enhanced process control, material quality, and operational efficiency for high-end semiconductor manufacturing.

Ultra-Pure Hydrogen Supply Project for MOCVD Equipment

Project Overview: 1Nm3/h

MOCVD (Metal-Organic Chemical Vapor Deposition) is a critical technology for the **epitaxial growth of semiconductor materials** such as GaN and GaAs.

The process demands **extremely high hydrogen purity**, typically at **9N (99.9999999%)**, as hydrogen is used as a **carrier gas**, **reducing gas**, and **reaction gas**. The quality of the epitaxial layers—and ultimately, device performance—depends directly on the stability and purity of the hydrogen supply.



System Solution:

The auxiliary hydrogen system provided by Hele Titanium addresses all aspects of the hydrogen supply chain, including:

- **On-site ultra-pure hydrogen generation**
- **Advanced purification technology**
- **High-pressure storage solutions**
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The system is engineered to meet the **stringent purity requirements of MOCVD processes**, while also supporting **large-scale production** and **cost-effective operation**.

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Key projects have been completed

10th Standard Multi-Energy Complementary Coupling Demonstration Project

Project Overview:

This project serves as a demonstration of multi-energy complementary coupling, integrating renewable energy sources with hydrogen production technologies.

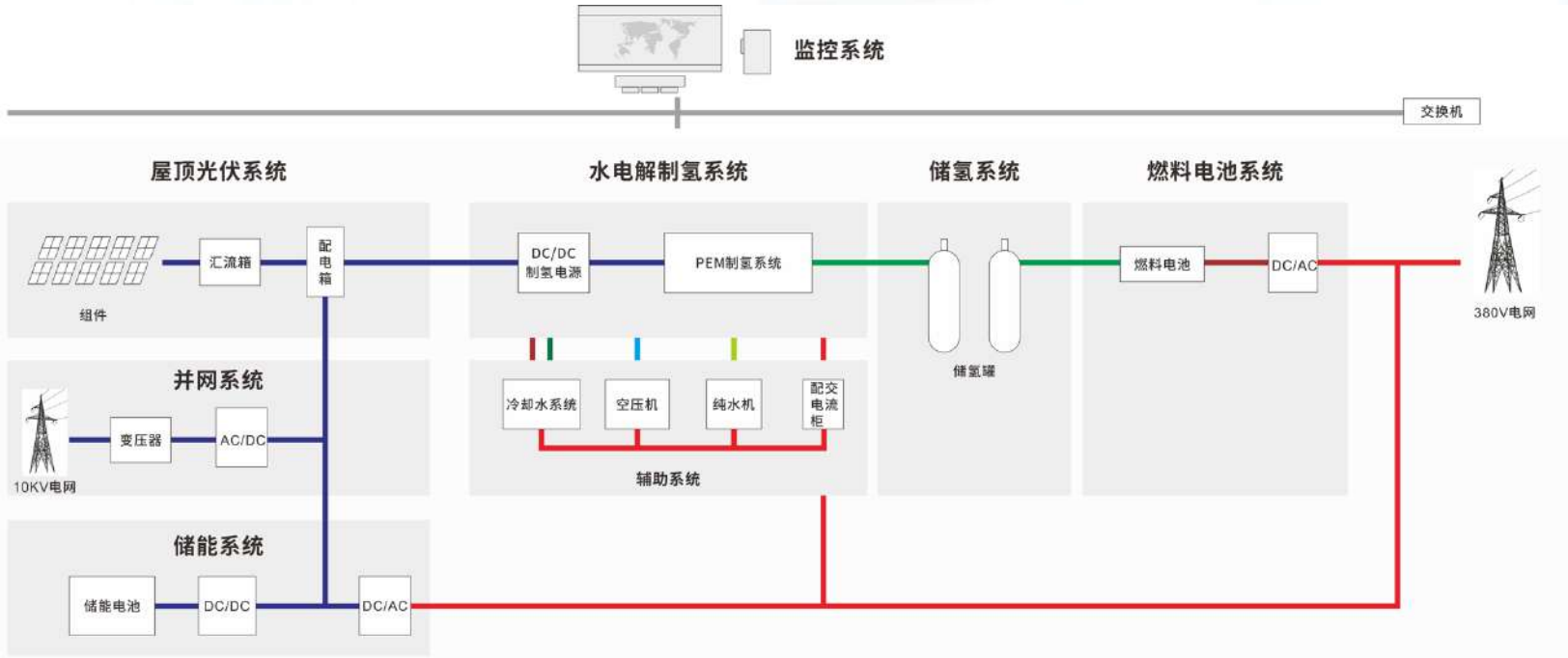
Project Scope:

- **Renewable Energy Capacity:** 60 kW (photovoltaic and wind power combined)
- **Hydrogen Production System:** PEM water electrolysis system with a capacity of 10 Nm³/h









50 Nm³/h Photovoltaic Off-Grid Hydrogen Production Project

Project Overview:

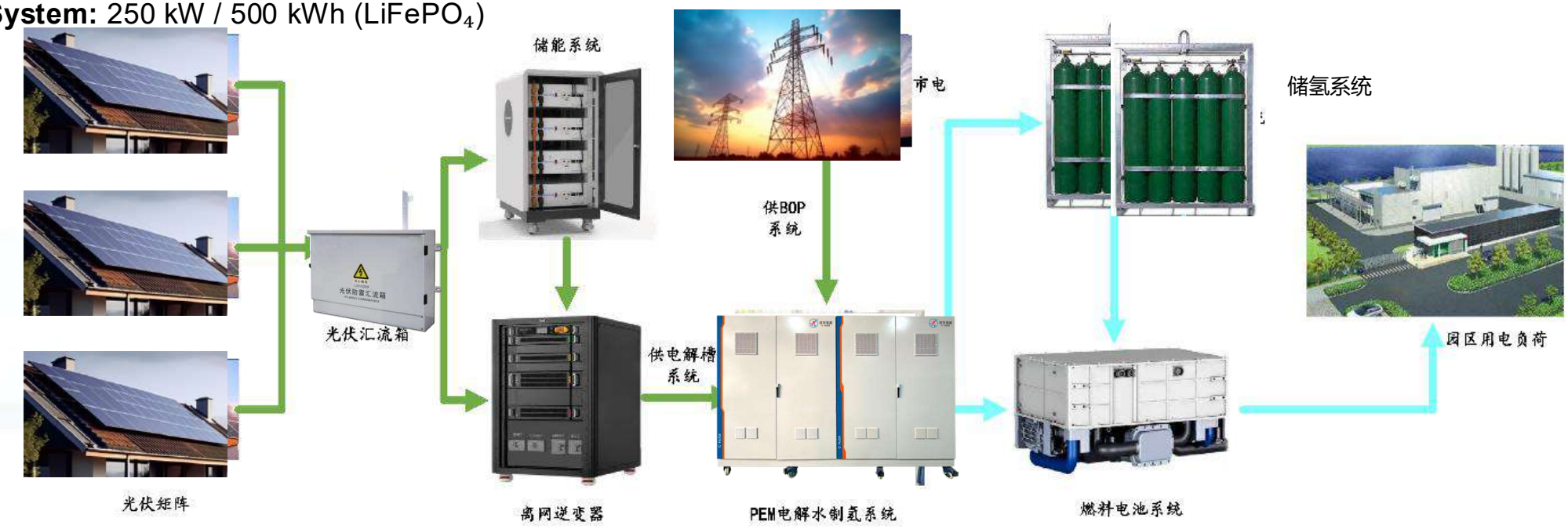
This project integrates **photovoltaic power generation**, **PEM water electrolysis**, **hydrogen storage**, and **fuel cell-based power generation** into a comprehensive off-grid energy solution to support the operations of an enterprise R&D center. The system addresses local photovoltaic grid connection limitations while enabling efficient energy storage for use during nighttime or peak demand periods.

System Workflow:

Photovoltaic Power Generation → Bus Box → Off-Grid Inverter → Energy Storage System + Electrolyzer Power Rectification → Hydrogen Production via PEM Electrolyzer → Hydrogen Storage in Cylinders → PEM Fuel Cell Combined Heat and Power (CHP) System → Inverter → 220V Output to Power the Facility

Project Scale:

- **Photovoltaic Capacity:** 500 kW
- **PEM Hydrogen Production Capacity:** 50 Nm³/h
- **Battery Energy Storage System:** 250 kW / 500 kWh ($LiFePO_4$)



1000 Nm³/h Wind-Powered PEM Hydrogen Production Project

Project Overview:
This project integrates **300 MW of wind power** with a **5 MW PEM water electrolysis hydrogen production system**, featuring a hydrogen output capacity of **1000 Nm³/h**. The goal is to demonstrate the **closed-loop application** of renewable energy generation, hydrogen storage, and fuel cell power generation within a new energy power plant.
The project also enhances the plant's ability to provide **grid frequency regulation**, supporting its development into a **grid-friendly power supply**. Additionally, it addresses regional hydrogen demand—particularly for **local metallurgy sectors** (e.g., antimony and aluminum ore processing)—while contributing to the region's **carbon reduction goals**.

System Workflow:
Wind Power → PEM Electrolyzer → Hydrogen Storage → Fuel Cell Power Generation → Grid or Local Industrial Use

