氫谷動能股份有限公司
HYDROGEN VALLEY POWER CO., LTD.

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Hydrogen Powers Green Mobility for Zero-Carbon Cities



Chairman : Ying-Hao Cheng

Market Analysis

1. Market Demand:

Global Market

- Over 1,200 hydrogen refueling stations have been established worldwide
- The market demand for hydrogen energy is rapidly expanding

Taiwan Market

- According to Industrial Technology Research Institute (ITRI), out of 400,000 electric vehicles by 2025, approximately 25% of buses and trucks are expected to adopt hydrogen-powered vehicles.
- The Ministry of Transportation has officially launched the " Hydrogen Fuel Cell Bus Demonstration Program". The policy implementation will be adjusted dynamically based on market demand

2. Commercial Vehicles in Taiwan:

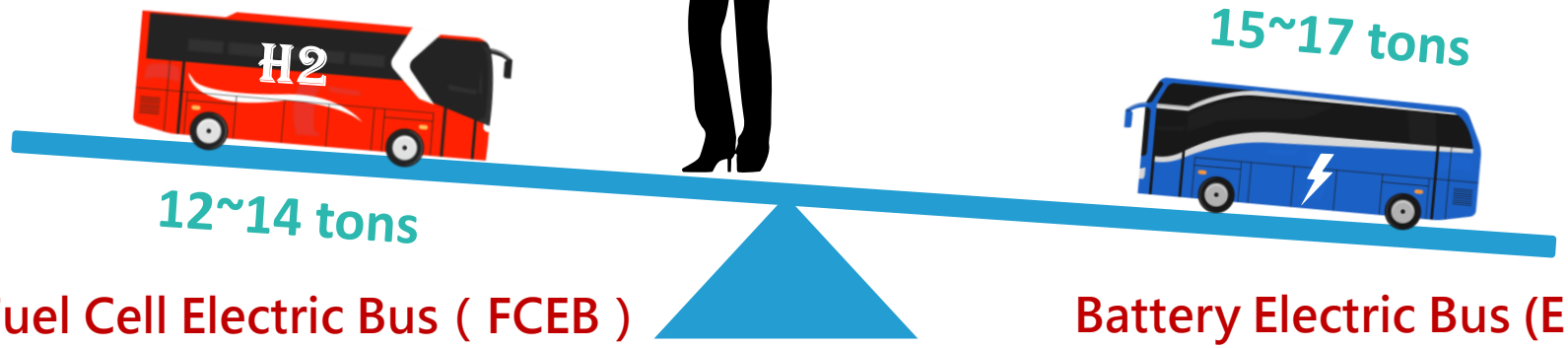
Type	Bus (including Coaches)	Heavy-Duty Trucks	Garbage Trucks (including Recycling Vehicles)	Logistics Vehicles (including Postal Vehicles)	Airport Baggage Tractors
Quantity	29,186 (Commercial) 1,508 (Private)	77,367 (Commercial) 97,124 (Private)	5,325 (Compactor Trucks) 5,528 (Recycling Vehicles)	24,968 (Logistic) 3,284 (Postal)	279 (Taoyuan Airport Services) 265 (Evergreen Aviation Services)
Estimated Demand	30,694	174,491	10,853	28,252	544

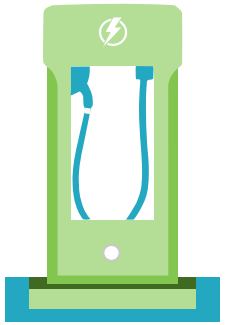
Core Strength – FCEBs Eliminate Key Limitations of EBs

Why Favor Hydrogen (Fuel Cell)?

Fuel Cell Electric Bus (FCEB)		Battery Electric Bus (EB)
Fast refueling in 15 minutes	Hydrogen Refueling	Grid Charging — **Long Charging Time for Lithium Batteries** (Major EB Limitation)
Approx. 450–600 km (Less Battery, Lighter Weight)	Range / Vehicle Weight	Range / Vehicle Weight — **Approx. 200–350 km** (Large Battery Pack, Heavier Weight)
Stable FC Efficiency in Low Temp. (H_2 Refueling Stations Supported by State-Owned Infrastructure and National Policy)	Performance / Infrastructure	Performance / Infrastructure — **Significant Battery Efficiency Drop in Low Temp.** (Charging Stations Limited by Grid Capacity, Difficult to Deploy)
Zero / Low Emissions (only water) (depends on hydrogen production source)	Emissions	Emissions — **Electricity Often Generated from High-Carbon-Emission Thermal Power**
Up to 12–15 Years (No Replacement Needed during Vehicle Lifecycle)	FC Lifespan	Battery Lifespan — **Approx. 5–8 years** (No subsidy for battery replacement before vehicle retirement)







Product – Taiwan's First Hydrogen Bus & Development

HYDROGEN VALLEY POWER has successfully developed Taiwan's first hydrogen-powered electric bus (Fuel Cell Electric Bus, FCEB) within 18 months. Our FCEB has undergone 100+ iterative tests and 50+ real-world road trials. Moreover, in Q2 2026, our FCEB will undergo full-vehicle hydrogen system international certification in Europe, marking a historic first for Taiwan in the past century.

Urban FCEB Prototype	Intercity (Highway) FCEB Prototype	Int'l Certified Urban FCEB
November 2011 - May 2023	July 2023 - April 2025	July 2024 - December 2026
		
• Completed hybrid powertrain and ground testing • Taiwan's first urban FCEB prototype	• Completed powertrain & chassis integration and in-facility testing • Taiwan's first intercity hydrogen bus prototype	• Completed full vehicle system integration and road testing • Currently undergoing international certification of hydrogen system
Ballard 70 kW	Toyota 85 kW	Toyota 85 kW

Product – Taiwan Localization Rate Reached 60%



AI System
Taiwan-Advantech

30kg Type III H_2 Supply Module
EU / US / France-Luxfer, Swagelok, OP

Body Frame
Taiwan-H2VP, MFTB

Air Conditioner
Taiwan-SPAC

Destination Sign
Taiwan-LUCKY YU

VCU
Taiwan-H2VP, NCSIST

Digital Instrument Panel
Taiwan-EMTEK

85 kW Fuel Cell
Japan-Toyota

36kWh Aux LFP Battery
Taiwan-Formosa Smart Energy

Front & Rear Axle
Germany-ZF

Bus Chassis
Taiwan-H2VP, KIAN SHEN

235 kW Motor Driver
Taiwan-TECO

Product – Performance Comparison with Competitors

Item	HYDROGEN VALLEY POWER (Taiwan)	Hyundai (Korea)	Hotai (Czechia)	King Long (China)	Wrightbus (UK)	Foton (China)	New Flyer (US)
FC Brand	**Toyota 2.5-generation**	Hyundai	Toyota 2.0-generation	HTWO Guangzhou	Ballard	SinoHytec	Ballard
FC Power	**85kW**	90kW*2	60kW	86kW	70kW	30.5kW	100kW
H_2 Storage Capacity	**22.8kg**	34kg	37.5kg	33.6kg	27kg	33.6kg	37.5kg
Driving Range	**>400 km**	>500 km	>450 km	>500 km	>480 km	>500 km	>600 Km
Operational Efficiency	**18~20 km/kg**	14.7 km/kg	12 km/kg	14.9 km/kg	17.8 km/kg	14.9 km/kg	16 km/kg

HYDROGEN VALLEY POWER adopted Toyota 2.5-Generation 85 kW Low-Temperature Fuel Cell

Core Competitiveness - Price Comparison

	HYDROGEN VALLEY POWER	T (Asia)	H (Asia)	W (Europe)	A (Australia)
					
Fuel Cell (kW)	**85**	65	90*2	70	60
Aux. Battery (kWh)	**30~36**	44	78	54	41
Motor Drive (Kw)	**235**	180	300	300	150
H_2 Storage Capacity (kg)	**22.8~30**	38	27	40	35
Driving Range (km)	**450~650**	400	470	900	500
Price (USD)	**600,000**	800,000	750,000	700,000	650,000

Competitive End-User Pricing in the Global Market

Product – Technical Collaboration & Improvement

Hydrogen Valley Power has collaborated with the National Chung-Shan Institute of Science and Technology (NCSIST), with development supported through an Industrial Technology Research Institute (ITRI) project application.
We successfully developed Taiwan's first hydrogen-electric hybrid powertrain firmware architecture, electronic control strategy, and hydrogen leakage detection system.

Relevant patents and technology transfer agreements have been filed.



✓ **Technology Transfer Item:**

Design of Hybrid Energy System for Electric Vehicles

✓ **Patent Transfer Items ：**

CONTROL METHOD FOR HYBRID POWER SUPPLY SYSTEM IN ELECTRIC VEHICLES

Taiwan Patent No. I797921

HYBRID POWER SYSTEM AND CONTROL METHOD FOR FUEL CELL VEHICLES

Taiwan Patent No. I875280

HYDROGEN LEAKAGE MONITORING SYSTEM, VEHICLE USING THE SAME AND HYDROGEN LEAKAGE MONITORING METHOD USING THE SAME

Taiwan Patent No. I879199

Product –Internationally Certified H_2 Supply (Distribution) Modules

All hydrogen supply (distribution) system components used by HYDROGEN VALLEY POWER —including storage cylinders, valves, fittings, piping, and refueling receptacles—comply with international regulations, including **EU EC79** and **UN R134**, with a total of nine certified items.

✓ EU / EC79:

EC 79

- **Hydrogen piping (316 stainless steel)_e24-79/2009-406/2010-0019-01 (Approved in 2022)**

EC 79

- **Refueling receptacle_e24-79/2009-406/2010-0019-01 (Approved in 2019; Extended in 2023)**

✓ UN / R134:

R 134

- **Hydrogen storage cylinder_Type Ⅳ_E4-134R-010021 (Approved in 2022; Extended in 2025)**

R 134

- **Cylinder Valve_E4-134R-010019 (Approved in 2022; Extended in 2025)**

Product – First Full Vehicle Certified under UN R134

HYDROGEN VALLEY POWER's first urban hydrogen bus has been shipped to Europe and commissioned to a German hydrogen certification group to undergo UN R134 certification for the complete hydrogen supply system.
This marks the first domestically developed hydrogen vehicle in Taiwan to undergo one of the world's most stringent international certification standards.

✓ Certification Scope:(7 items / 4 categories)

- Installation & Construction Verification
- Post-Crash Integrity Test
- Single Fault Condition Test
- Leakage Test

Complete Vehicle Hydrogen Supply System



Product – Enhanced Vehicle Safety Design

Emergency Power Shutoff System



Real-time monitoring of H_2 refueling port, supply module, piping, and fuel cell system. Shut down power automatically before pressure exceeds safety limits.

Safety Relief Valve for Fuel Cell System



Equipped with latest Toyota fuel cell system featuring a safety valve and pressure relief design to rapidly release excess pressure and protect the system.

Hydrogen Leak Detection System



10 H_2 sensors installed across key points including refueling port, valves, supply system, and fuel cell to ensure full-vehicle hydrogen monitoring.

Certified Piping & Valves



Uses EC79-certified hydrogen pipes and valves to minimize hydrogen embrittlement and leakage risks.

Reinforced Fuel Cell Compartment



Strengthened steel structure around the fuel cell compartment to minimize impact in case of abnormal events and improve passenger safety.

H_2 Exhaust Outlet Design

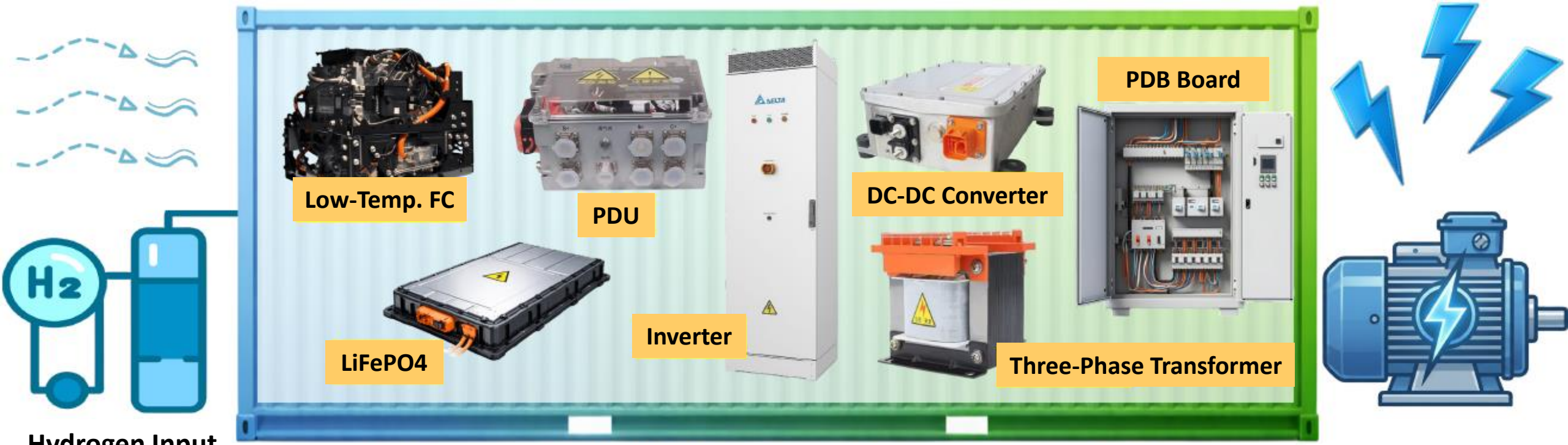


Dedicated exhaust outlet design ensures residual hydrogen (<2%) is safely discharged to prevent accumulation inside the vehicle.

✓ Next Product – Low-Temp. H_2 Storage & Power System

This developing system is based on an 85kW low-temperature fuel cell as the core power generator, efficiently converting hydrogen into electricity. It is integrated with a lithium iron phosphate ($LiFePO_4$) energy storage system to balance load and enhance power stability.

Through a Power Distribution Unit (PDU) and voltage conversion modules, a 100kW inverter enables both grid-connected and off-grid operation modes. The system outputs a stable 400V, and via DC-DC converters and three-phase transformers, provides multiple voltage outputs including 110V / 220V / 380V to meet diverse application requirements.



Concept Overview of H_2 Storage & Power System

✓ Future Application – H_2 Micro Power Plant

A micro power plant concept integrating multiple hydrogen energy storage systems operating in parallel, managed by an Energy Management System (EMS) for optimized power dispatch.

Built with a redundant architecture, the system ensures continuous operation even if a single unit fails, enhancing overall reliability and stability. EMS enables intelligent load balancing and peak/off-peak scheduling to improve energy efficiency.

Designed with a modular containerized structure for rapid deployment and scalability, enabling flexible application across various scenarios.





Concept Overview of H_2 Micro Power Plant

Potential Applications

- **Hospitals & critical public facilities**
- **Commercial building backup power**
- **Remote or off-grid areas**
- **Construction sites**
- **Outdoor events**
- **Emergency shelters**
- **Medical rescue power supply**
- **AI data centers power systems**



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