

HEPS

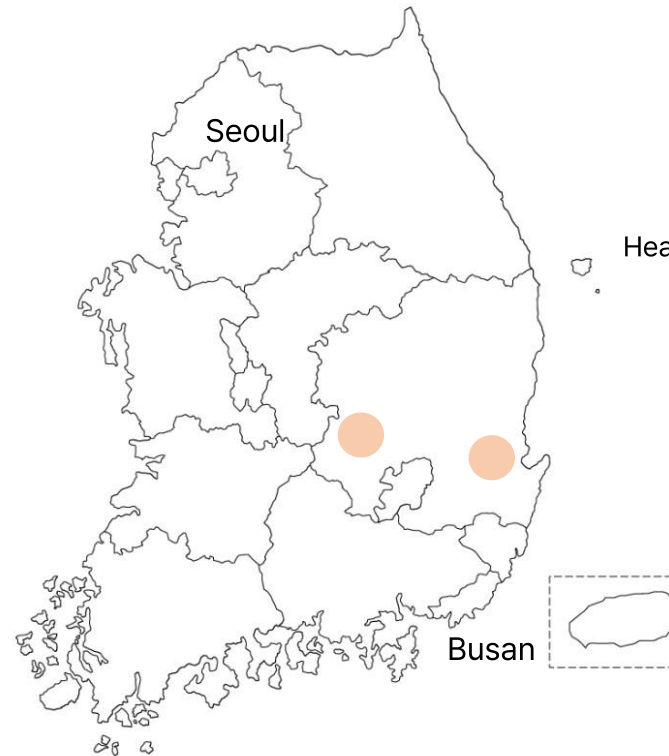
Hydrogen Electricity Power System



Company Introduction



Company name	HEPS, Co.,Ltd
CEO	Lee Donghwal
Date of establishment	November 20, 2021
Head Office	Gumi city, Gyeongsangbuk-do
Branch	Pohang city, Gyeongsangbuk-do
Capital/Sales	530 million won 2,200 million won ('22)
website	www.hepshappy.com
Main business	Hydrogen fuel cell (stack, powerpack, system, recycling) PEM Electrolysis hydrogen production



Headquarters: Gumi city, Gyeongsangbuk-do, Industrial Park 1



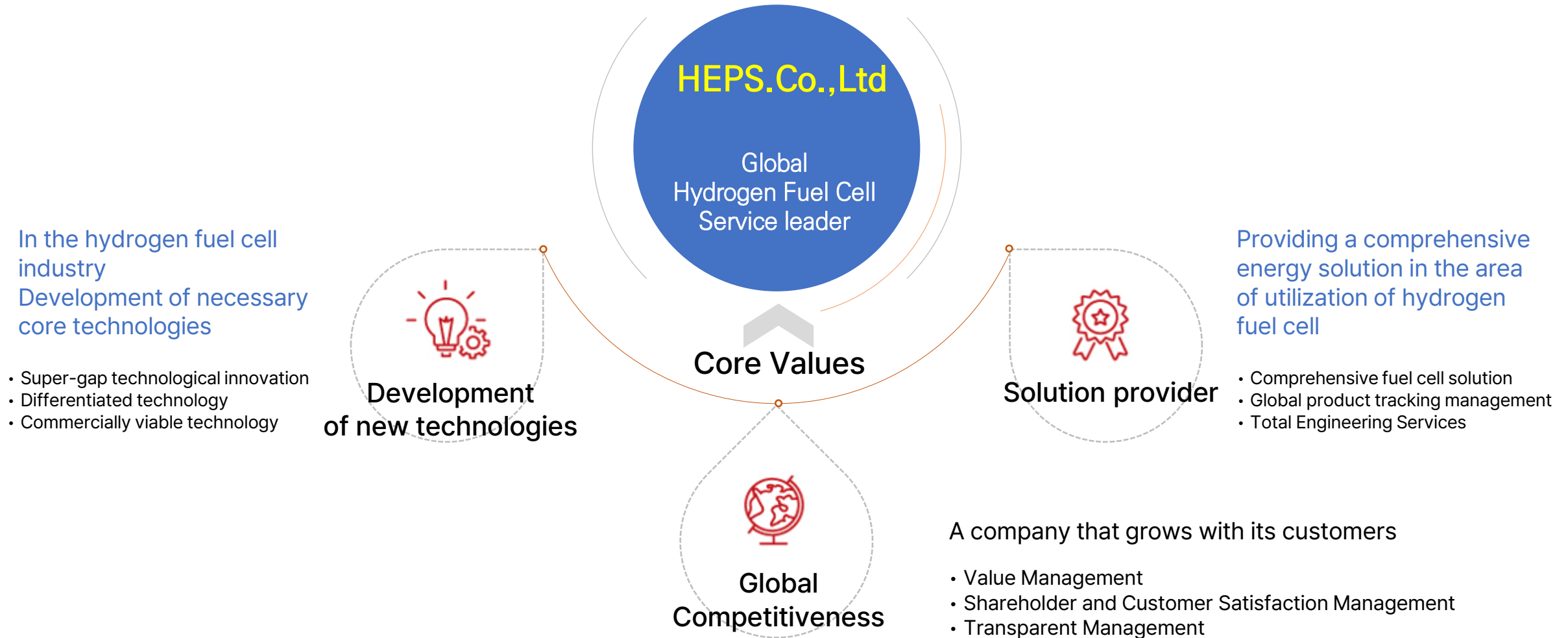
Branch: Pohang city, Gyeongsangbuk-do, Pohang Technopark

- 2023**
 - 09. 2023 Venture Business Innovation Award, North Gyeongsangbuk-do Province, South Korea
 - 08. Designated as a hydrogen specialized company (Ministry of Trade, Industry and Energy, Gyeongsangbuk-do No. 1)
 - 07. Supply of hydrogen fuel cell powertrains for cargo bikes (eFlow Inc)
 - 06. Completion of the Entrepreneurship-oriented University Project (Hydrogen Fuel Cell Bicycle, First Prize)
 - 05. Technical cooperation on fuel cell power packs for mobility (Germany)
 - 05. Won a special mobility project (Ministry of Small and Medium Venture Enterprises)
 - 04. Designated as a preliminary hydrogen specialized company (Pohang City)
 - 03. Promotion of stack recycling business

- 2022**
 - 12. Technology Guarantee Fund Investment Promotion (500 million won)
 - 12. Establishment of Pohang Branch and Moved into Pohang R&D Special Zone
 - 09. Supply of fuel cell stacks for buildings (domestic)
 - 08. Supply of water-cooled stack modules (domestic)
 - 05. Acquired venture business certification (innovative growth type)
 - 05. Korea Industrial Park Registered (Gumi)
 - 03. KS Q/ISO9001:2015 Certification
 - 02. Establishment of a company-affiliated research institute

- 2021**
 - 12. Signed a contract for the supply of Horizon Inc. Fuel Cell
 - 12. Signed a contract for the supply of Galoric Inc. hydrogen extractor
 - 11. Establishment of HEPS

Hydrogen utilization ('23), hydrogen production ('25)



Members



CEO, Lee Dong-hwal

CEO of HEPS

Director, Bumhan Fuel Cell Co., Ltd, 2015~2021
GS Caltex, Senior Researcher, 2008~2015
Dongjin Semichem, 2001~2008
Seoul National University, Applied Chemistry,
master degree, 2001
Major experience: 23 years of experience in fuel cell
stacks, hydrogen extractors, system technology
development, production and commercialization



Director, Ahn Byeong-kap

Business Division Manager

Fuel Cell Engineering & Business Development
Engineering, system equipment development
CEO, PTS Co., Ltd 2012~2021
CEO, Fungwoon Co., Ltd., 2021
Major experience: 20 years of experience Fuel cell
engineering, evaluation equipment development



Director, Yoo Sang-yeon

R&D Center, R&D Director

Responsible for stack and system technology
development
POSCO Energy, Hyundai Mobis Senior Researcher
(2005~2022)
Major experience: 18 years of experience in fuel
cell reliability evaluation



General Manager, Kim Jung-woo

Head of Production Division

Responsible for stack & system production quality
Weed CEO, 2018~2021
Rayzen, 2008~2018
Major experience: 15 years of experience
development of automation equipment
development experience

Promotion of hydrogen fuel cell business in 4 fields



Hydrogen fuel cell Stack Platform Business

- Stack sales (water cooling, air cooling)
- Providing maintenance services
- OEM, ODM stack fabrication



Hydrogen fuel cell Powerpack & System Business

- Powertrain for micro-mobility & special purpose mobility
- Hydrogen fuel cell system for distributed power generation (for buildings, power generation)



Fuel cells for power Generation & Engineering Business

- MW fuel cell power plant engineering design
- Blue Hydrogen and Gray Hydrogen-linked Fuel Cell Power Plant Construction Project
- Power Plant LTSA Maintenance Contract



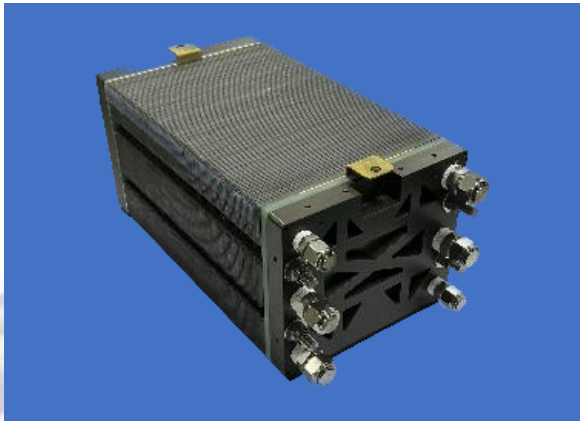
Stack Reuse & Recycling Business

- Providing stack reuse services
- Stack and fuel cell recycling business under consideration



Fuel Cell Stack for Stationary

H-WCS-SP series

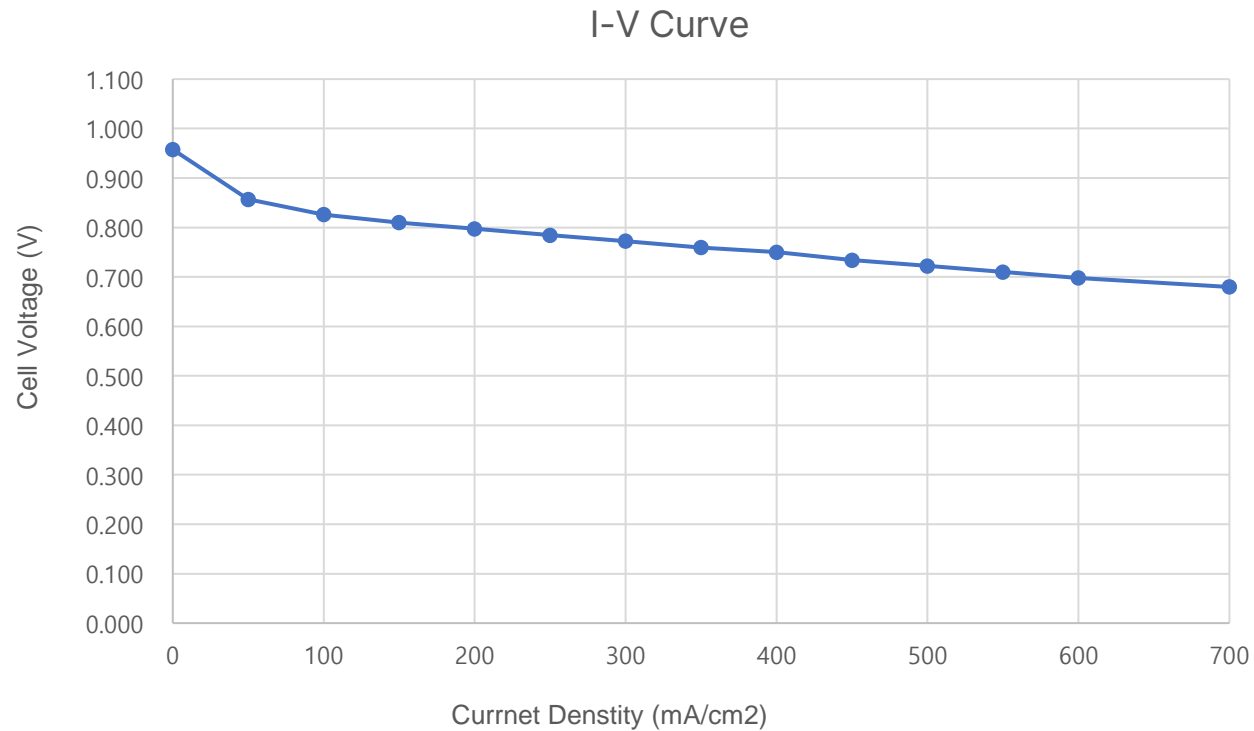


- PEM Fuel Cell Stack for stationary application (for building, plant fuel cell system)
- Application of thin carbon separator plate
- Application of MEA capable of high-temperature and low-humidity operation
- Ambient pressure operation
- Lower cost
- High durability
- Minimize stack volume

	H-WCS-SP-1K	H-WCS-SP-3K	H-WCS-SP-5K	H-WCS-SP-7K	H-WCS-SP-10K
Power (kW, DC)	1kW	3kW	5kW	7kW	10kW
Voltage (V)	12.8	38.3	63.8	89.3	114
Current (A)	80	80	80	80	120
Size (W/D/H, mm)	200/240/125	200/240/225	200/240/325	200/240/425	400/155/450
Weight (kg)	15	20	27	35	35
Fuel	H2, >99.97%				
Operating Condition	H2/Air=1.5/2.5 stoic, Temperature 70~ 80 °C, ambient pressure (<20kpa) An/Ca RH = 50%/80%				
Active area	200	200	200	200	300
Number cell of stack	17	51	85	119	114

(May differ from the actual product)

H-WCS-SP series stack cell performance



H₂/Air=1.5/2.5 stoic, Temperature 70~ 80°C, ambient pressure (<20kpa)
An/Ca RH = 50%/80%

Fuel Cell Stack for heavy duty mobility

H-WCS-HM series

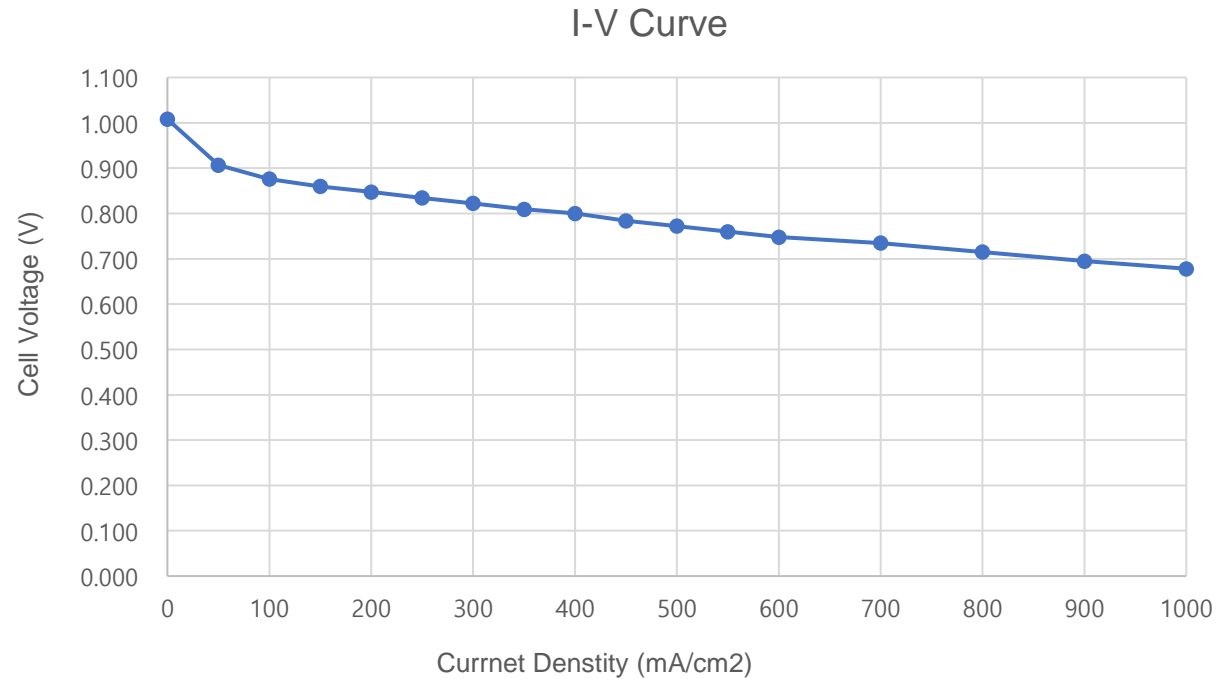


- PEM Fuel Cell Stack for mobility application
- Application of thin carbon separator plate
- Application of thin carbon separator plate
- Vibration-resistant, indentation-resistant, environment-resistant stacks
- Output scalable stack, Lower cost
- High durability
- Minimize stack volume

	H-WCS-HM-10k	H-WCS-HM-30k	H-WCS-HM-60k	H-WCS-HM-100k
Power (kW, DC)	10kW	30kW	60kW	100kW
Voltage (V)	38.2	111.2	222.4	375.3
Current (A)	270	270	270	270
Size (W/D/H, mm)	400/155/240	400/155/545	(400/155/545)*2	(400/155/545)*3
Weight (kg)	25	45	45*2	45*3
Fuel	H ₂ : >99.99%			
Operating Condition	H ₂ / Air max 200kpa, Temperature 75~80°C, Anode/Cathode Relative humidity = 50%/80%			
Active area	300	300	300	300
Number cell of stack	55	160	320	540

(May differ from the actual product)

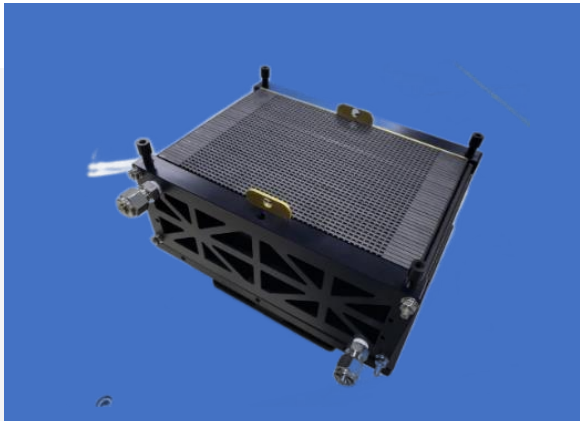
H-WCS-HM series stack cell performance



Anode & Cathode In pressure : max 150kpa / max 150kpa
Temperature 80°C, An/Ca RH = 50%/80%

Fuel Cell Stack for micro-mobility

H-ACS-M series

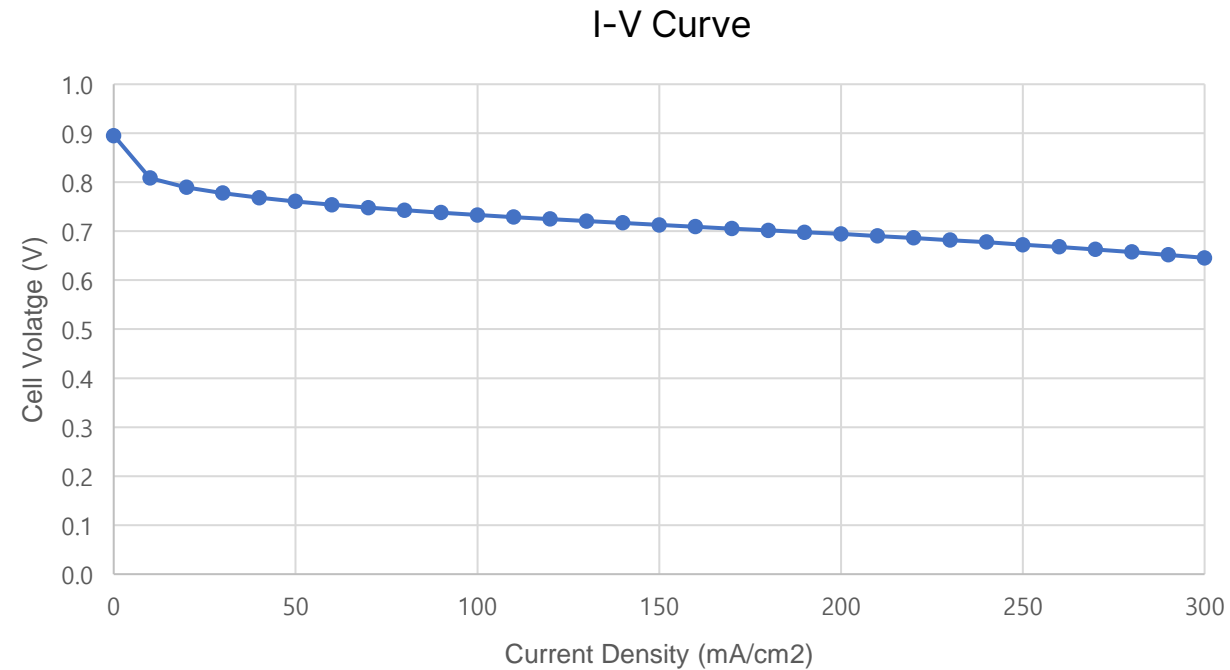


- PEM Stack for micro mobility powerpack
- Application of thin carbon separator plate
- Cathode open air cooling stack structure
- Cathode closed air cooling stack structure
- Lower cost
- High durability
- Minimize stack volume

	H-ACS-M250	H-ACS-M500	H-ACS-M1000	H-ACS-M2500
Power (kW, DC)	250W	500W	1000W	2500W
Voltage (V)	14.8	29.6	59.2	147.9
Current (A)	17.5	17.5	17.5	17.5
Size (W/D/H, mm)	100/200/135	100/200/200	100/200/330	100/200/580
Weight (kg)	4.2	5.2	7.5	12.0
Fuel	H ₂ : >99.97%			
Operating Condition	H ₂ <50kpa, Temperature 45~50°C, no humidification			
Active area	70	70	70	70
Number cell of stack	22	44	88	176

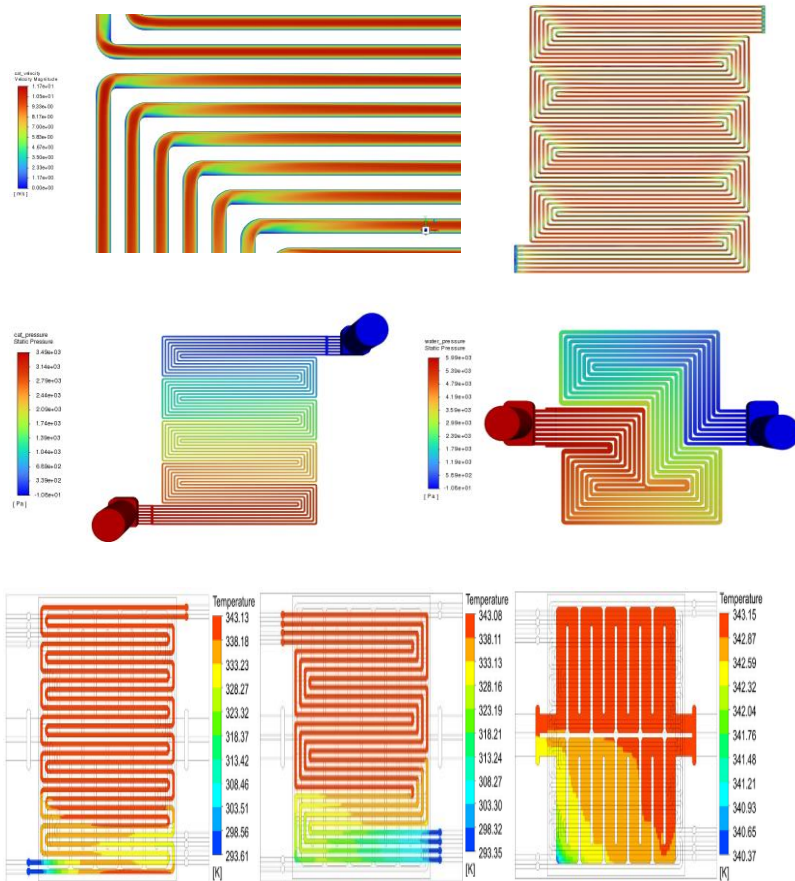
(May differ from the actual product)

H-ACS-M series stack cell performance



H₂ <50kpa, Temperature 45~50°C, no humidification

Stack Fluid Analysis



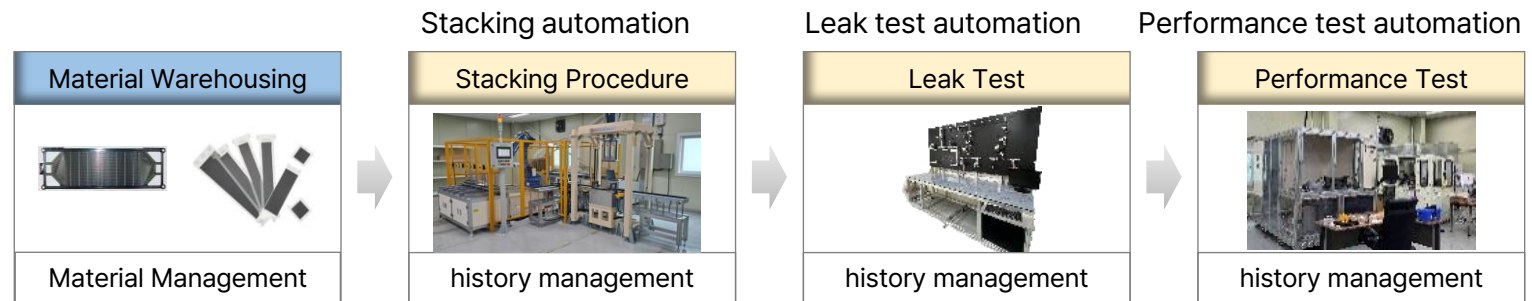
Thin one piece carbon bi-polarplate



- Anode/Cathode/Gasket integrated laminated carbon separator reduces stack volume and number of parts
- 35% reduction in stack volume to improve unit volume power density, and reduce the number of parts to improve productivity

Automatic production of Stack

- Stack manufacturing, leak evaluation, and performance evaluation process automation to improve productivity (1000ea/yr.)

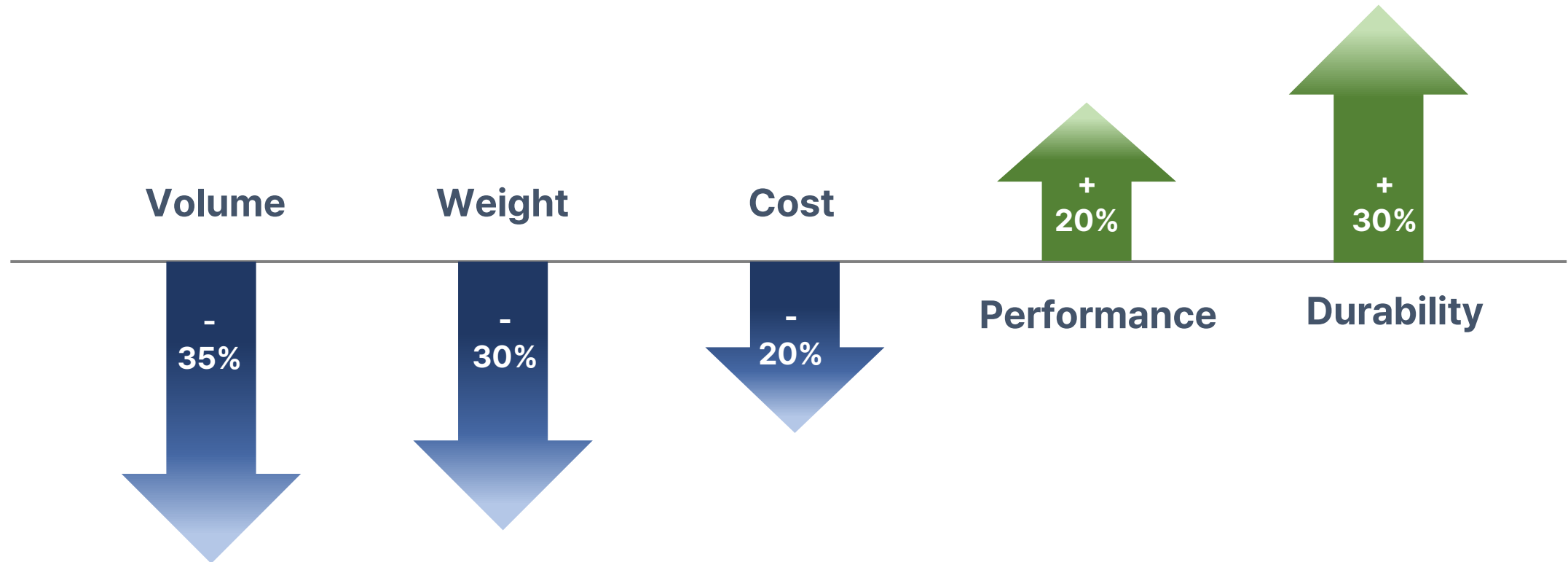


Establishment of product tracking management MES system (Introduction of network, barcode equipment)



Advantages of the HEPS Stack Platform

Low size, weight, and price, while high performance and durability



Fuel Cell Powerpack for micro-mobility

H-FC-MM Series (fuel cell supercapacitor hybrid power train)

- To compensate for the battery's long charging time and short range, a fuel cell battery hybrid powertrain is constructed
- The output specification can be freely designed according to the company's air-cooled stack-based application.
- The Fuel Cell Power pack is applied as a power source for micro mobility.



Hydrogen Bicycle



250W, 300W (48V)

air-cooled type fuel cell/supercapacitor/battery hybrid powertrain commissioning evaluation ('22~'23)

Hydrogen Cargo Bike



1500W (48V)

Pursued commercial applications in GERMANY

Hydrogen Scooter



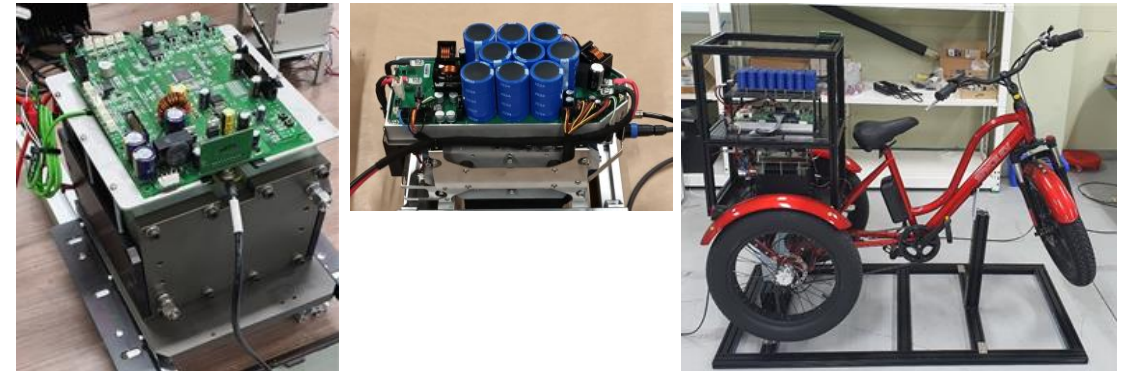
2500W (76V,96V)

Hydrogen scooter equipped with 2kW air-cooled power pack will be launched with scooter manufacturer ('24)

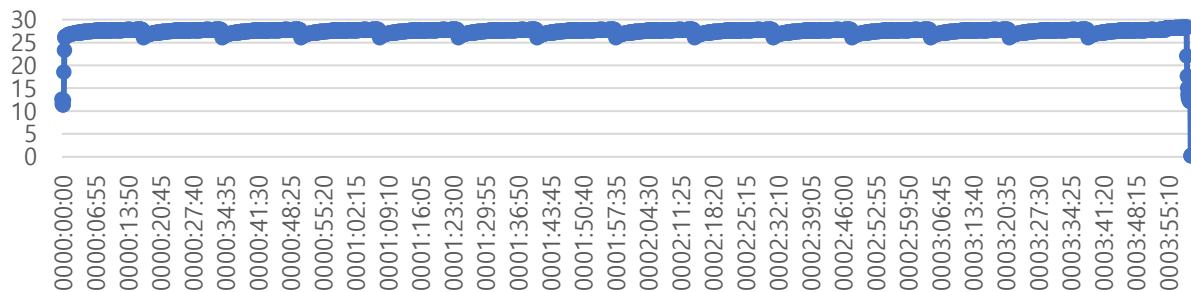
Fuel Cell Powerpack for micro-mobility

H-FC-MM-1000W demonstration

- The Fuel Cell Power pack is applied as a power source for micro mobility.
- Demonstration of cargo bike car mounting, 2023
- Issuance of official certification test report form KIER(Korea Institute Energy Research), 2023
- CE certification to be obtained, 2024

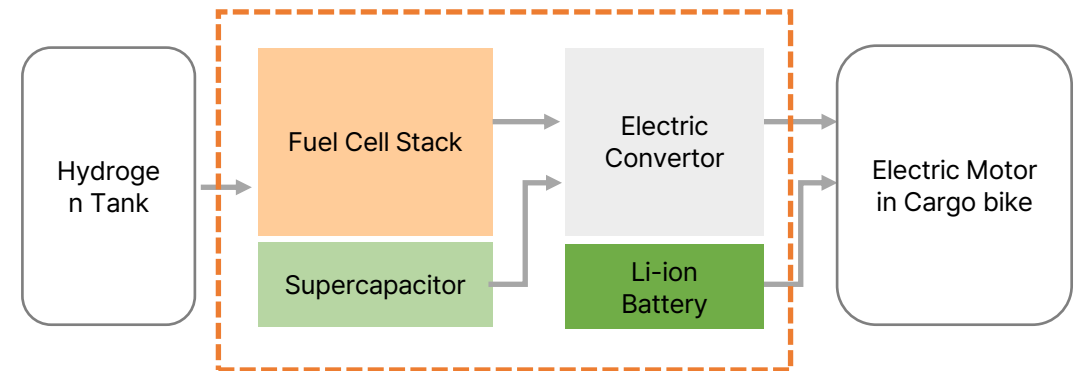


Stack voltage



As a result of long-term continuous operation data, it was confirmed that the stack voltage was maintained without dropping.

Power train diagram



Fuel Cell supercapacitor battery hybrid system

Fuel Cell Powerpack for heavy duty mobility

H-FC-M Series (construction machinery application)

- In the case of battery forklifts, the charging time and operation time are limited, so hydrogen forklifts equipped with hydrogen fuel cell power packs are rapidly spreading in large logistics centers.
- Hydrogen fuel cell stack technology with enhanced vibration resistance
- The system has enhanced vibration and dust resistance.
- A fuel cell battery hybrid system was applied.
- Optimal thermal management design through CFD analysis
- Development of 5kW hydrogen fuel cell-based multi-modularization technology, 2023



Fuel Cell powerpack
(5kW,10kW,50kW)



Fuel Cell Forklift



Fuel Cell Excavators



Fuel Cell Tractor

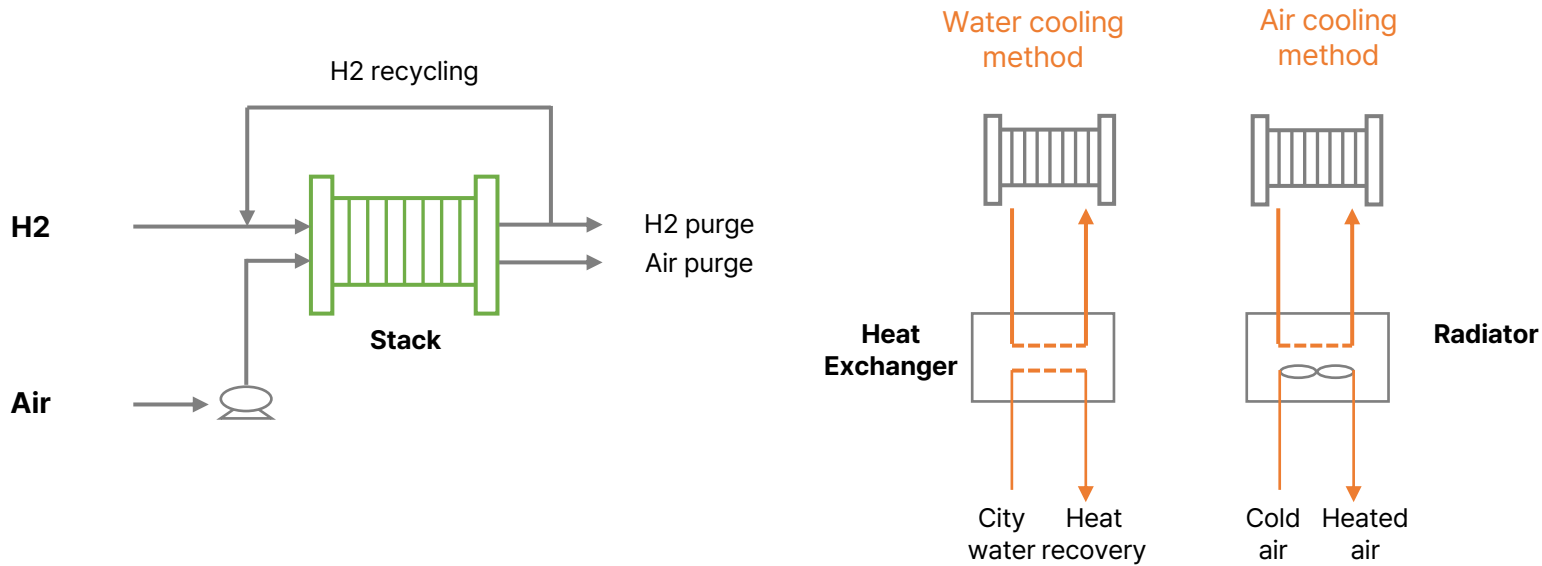
Fuel Cell System for CHP

H-FC-Cogen Series (power & heat cogeneration system)

- The Co gen fuel cell system produces electricity and heat at the same time.
- The application is for distributed power generation of buildings.
- The system cooling method can be selected between water-cooled cooling and air-cooled cooling depending on whether heat is used.



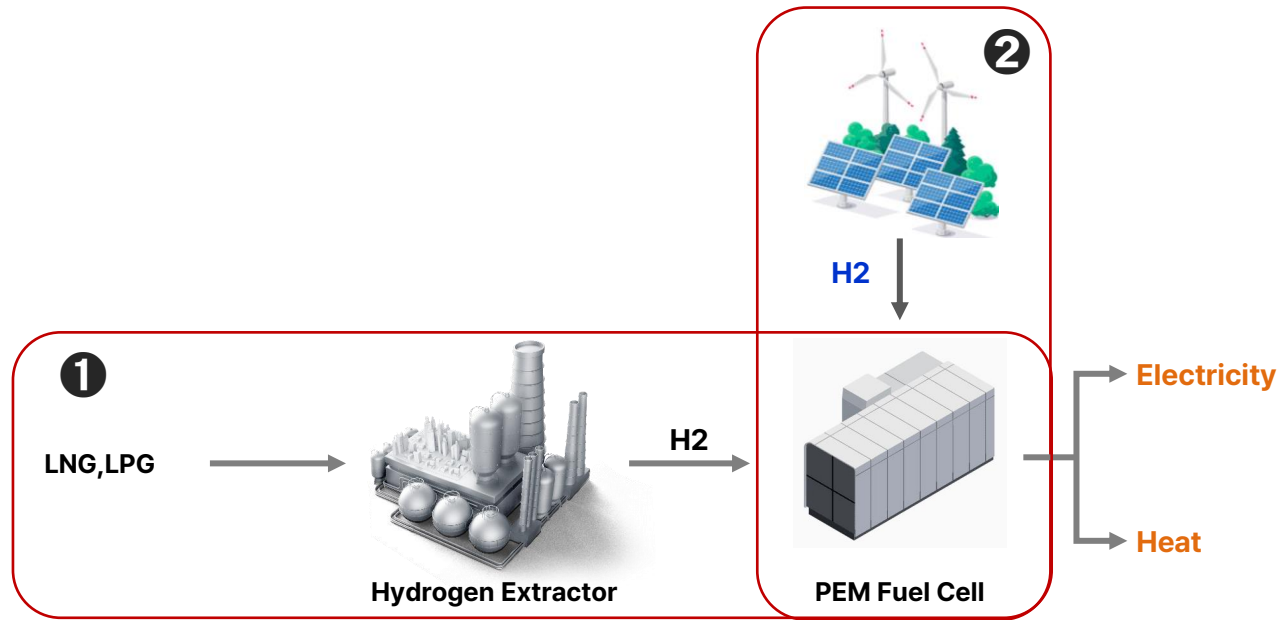
Fuel Cell system
(5kW,10kW,30kW)



Fuel Cell Powerplants

Large scale fuel cell power generation plant engineering (1MW,3MW,6MW,9MW)

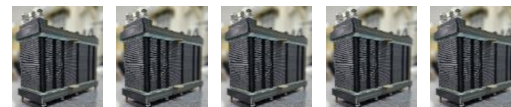
- ① PEM Fuel Cell power plants using blue hydrogen from hydrogen extractor
- ② PEM Fuel Cell power plants using green hydrogen from Solar & Wind Renewable Energy



Product supply contracts have been signed with large hydrogen extractors and large hydrogen fuel cell suppliers.

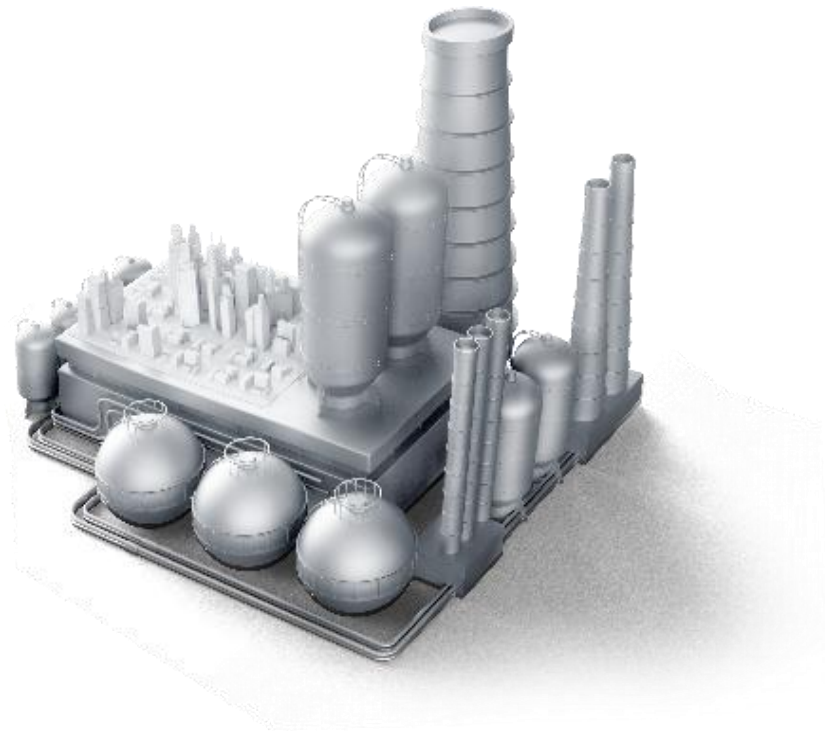
Hydrogen Extractor	PEM Fuel Cell
450 Nm ³ /hr	500 kW
850 Nm ³ /hr	1000 kW
1650 Nm ³ /hr	1500 kW
2400 Nm ³ /hr	3000 kW
6500 Nm ³ /hr	

Supplying HEPS stacks
(30kW, 100kW)



Hydrogen Extractor

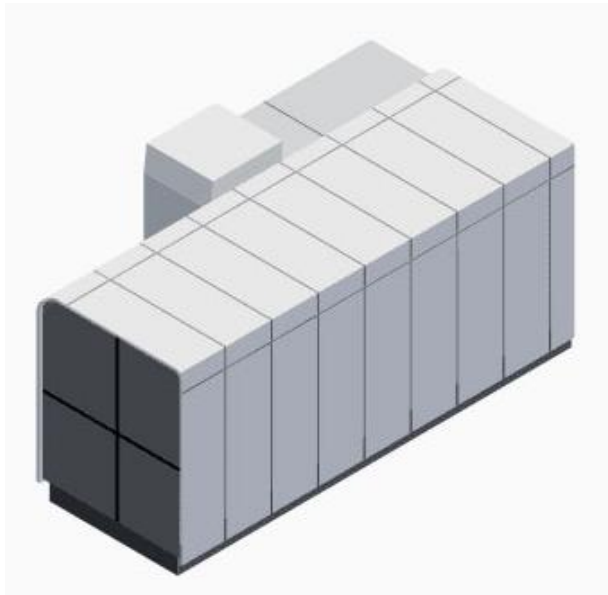
Steam methane reformer



Product supply contracts have been signed with Cooperative companies



Large PEM Fuel Cell Specification



Product supply contracts have been signed with Cooperative companies

	Specification	Comment
• Model	H-1500kW	
• Output (electrical/thermal)	1500kW/h, 1100kW/h	Heat of production 946Mcal/h
• Efficiency (electrical/thermal)	52% / 40%	total : > 92%
• Output Voltage/Frequency	AC 480V, 3 phase, 60Hz	AC 380V, 3phase, 60Hz possible
• Fuel	hydrogen, 99.999%	
• Size	12.2 X 2.5 X 2.6 (W/D/H, m)	40ft container
• weight	17 ton	17 ton
• Operating temperature range	-20°C ~ 45°C	
• Emissions	none	
• noise	70 dB	
• Start-up time	< 10 min	30 min @ cold start
• Operating condition	0-95% 상대습도	non condensing

Fuel Cell Powerplants installation

Installation of distributed power generation fuel cell system



Human Resource Development Institute, 100kW



Leisure Town. power plant, 100kW



Hospital. Power plant, 200kW

Installation in progress
(2023)

Data Center(indoor installation), 200kW

We create hydrogen fuel cell available everywhere !!!

Domestic and foreign customers and technical cooperation partners

- We are supplying our stack platform products to domestic and foreign fuel cell companies and
- we are conducting technical cooperation with government-funded research institutes and institutions for technology development.



Patent / Certificate / MOU

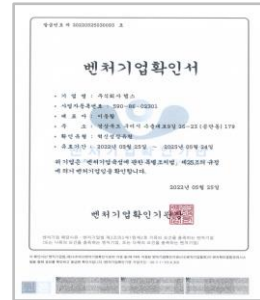
Patent



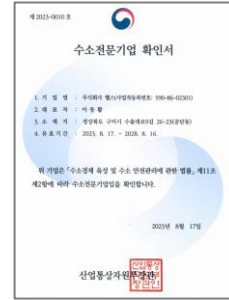
Certification



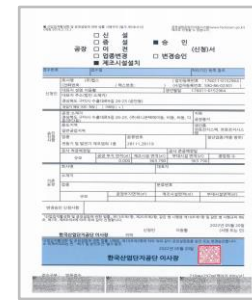
Certificate of Affiliated Research Institute



Venture Business Confirmation



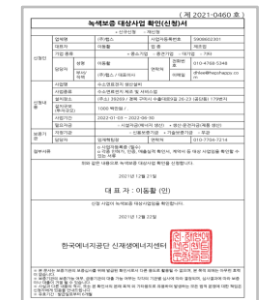
Confirmation of a company specializing in hydrogen



Factory Registration Certificate

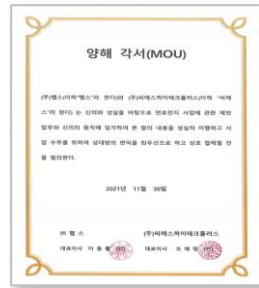


KS Q ISO 9001:2015

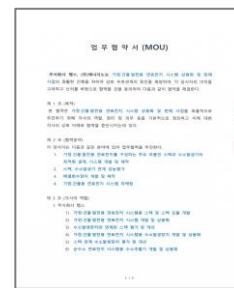


Confirmation of Green Guarantee Project

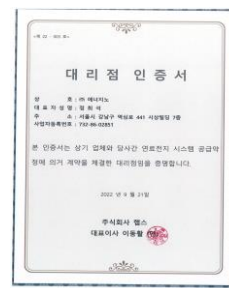
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We create hydrogen fuel cell available everywhere !!!



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