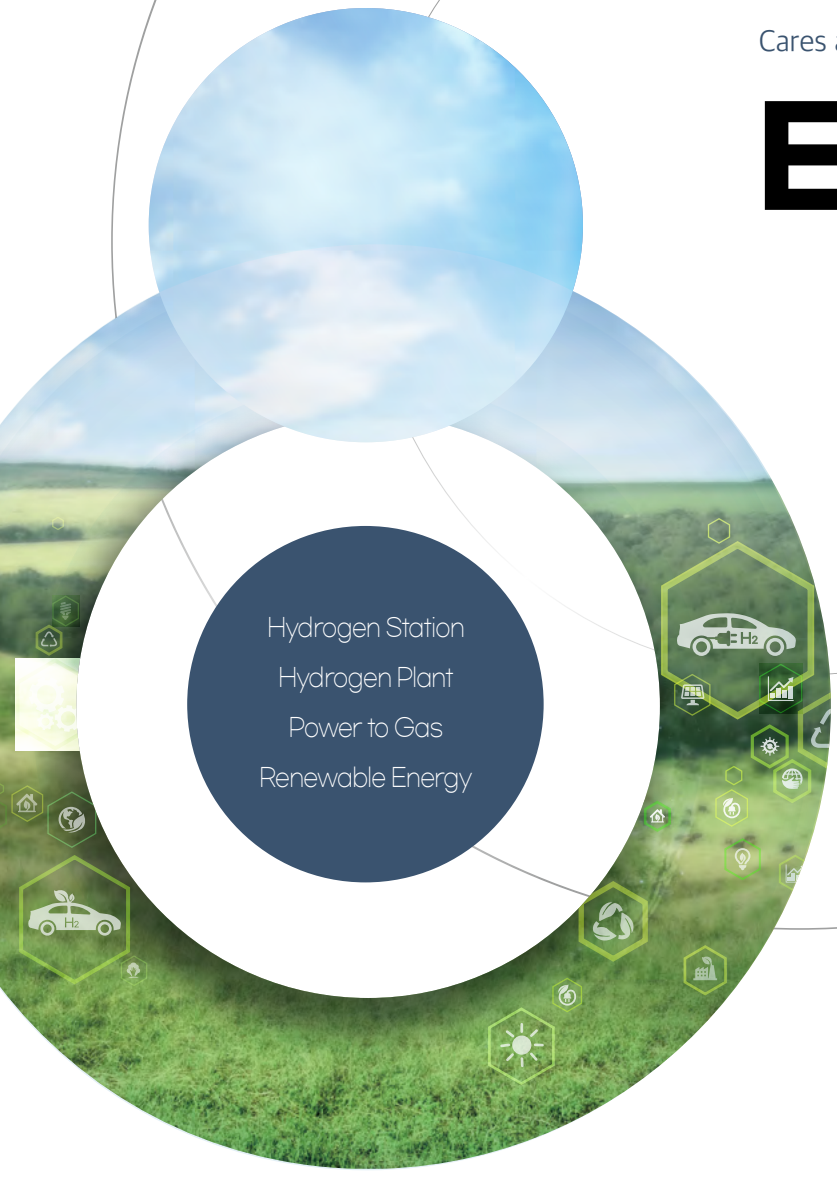
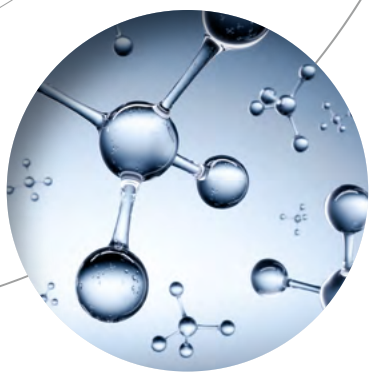
www.yesems.co.kr

GLOBAL GREEN GROWTH ECO-FRIENDLY COMPANY

Cares about environment and wants to make a better world

EMSolution





EM SOLUTION CO., LTD.
ENERGY&MARINE SOLUTION CO., LTD.

Global Green Growth

Eco-Friendly Company

“EMS will grow as a leading company in green energy development with the mind that thinks of environment. ”

EM solution Co., Ltd will try to be grown up a reliable company that fulfills its corporate social responsibility for the happiness of mankind and better future by realizing the continuous quality improvement and technology development in order to cope with the expectation of company.

CONTENTS

History

Continuous growth engine of EM Solution is **“The Power of Positive Thinking and People”**

1987-

1987.03 Established DONGWOO Precision

2000 - 2010

2000.10 Development of hydrogen/ oxygen mixed gas generator

2003.03 Established EM Korea Co., Ltd.

2004.10 Development of alkaline 2Nm^3/h hydrogen generator

2005.08 Registration of brown gas mixing device pa tent

Registration of extension type electrolytic tank patent

2005.09 The Merger of DONGWOO Precision & EM KOREA Co., Ltd.

2006.11 Awarded the Primer’s Letter of commendation for management innovation

2007.10 Listed in KOSDAQ (EM KOREA Co., Ltd)

2007.12 Development of water electrolysis system connected to solar power

2008.03 CE certification for food waste machine

2008.12 Development of hydrogen-based hybrid green home system

2010.11 Awarded the Excellent job creation companies (Gyeongsangnam-do)

2011 - 2013

2011.04 First shipment of hydrogen generator (Saemangeum theme park)

2011.05 Awarded the Silver Tower order of industrial service merit

2011.09 Development of 1kW fuel cell system using hydrogen and oxygen

500 hours demonstration of hydrogen-based hybrid green home system

2012.04 Development of 20Nm^3/h mobility type hydrogen plant

2012.09 Registration of food waste recycling device patent

2012.12 1,000 hours demonstration of water electrolysis type hydrogen station in Jeju

2013.10 Construction and operation of water electrolysis type hydrogen station in Daegu

2013.11 Registration of hydrogen purification device for alkaline water electrolyzer patent

EM Solution is making the Future of Technology.

2014 - 2017

2014.01 Registration of organic waste disposal device patent

2014.10 Construction of hydrogen station in Gwangju, Jingok

2014.12 Registration of water electrolysis tank assembly jig patent

Registration of electrolyte diffusion/gas emission efficiency water electrolysis tank patent

Registration of electrolyte manufacturing apparatus patent

2015.07 Registration of preheating cooling system for hydrogen fuel supply patent

2015.08 Acquired KC certification for food waste recycling device

2016.01 Established EM Solution Co., Ltd. (Physical division from EMK Co.,Ltd)

2016.07 Acquired ISO9001 certification

2017.03 Construction of hydrogen station in Changwon, Palyong

2017.12 Construction of KGS Chamber facility in Yeongwol

2018 - 2019

2018.01 Acquired Green Technology Certification for food waste recycling device

2018.02 Construction of hydrogen station in Gangneung/ Pyeongchang, operation during the Olympics (bus & car, simultaneous refueling)

2018.03 Construction of hydrogen station in Gwangju, Donggok

2018.08 Acquired ISO14001 certification

2018.12 Construction of hydrogen station in Seongju, Changwon

2019.01 Construction of hydrogen generating facility (600Nm^3/h) for Navy

2019.04 Signed MOU with KEPCO, Ulsan city to demonstrate solar power P2G system

Registration of food waste treatment vacuum dryer patent

Registration of food waste disposal, and water purification system

2019.12 Construction of hydrogen station in Changwon, Deokdong

2020 - 2021

2020.06 Construction of hydrogen station in Wanju (Hyundai Motors Jeonju Plant)

2020.08 Construction of hydrogen station in Yeosu (SPG)

2020.12 Construction of hydrogen station in Ulsan, Deokha & Together

Approved at Yeongcheon city for food waste recycling system(100 ton/day) operation

2021.01 Construction of hydrogen station in Changwon, Jinhae

2021.03 Final operation approval for food waste recycling system at Yeongcheon factory

2021.04 Delivery of High efficiency 100Nm^3/h water electrolyzer to demonstrate P2G solar system with KEPCO

2021.06 Registered as a company specialized in hydrogen business

2021.07 Construction of hydrogen station in Gimhae, Andong

2021.09 Acquired INNOBIZ Certification

Hydrogen Station

EMS will achieve **Carbon Zero** with clean hydrogen energy.

We should think about the environment, needed to quickly replace gasoline cars with Hydrogen fuel cell cars and electric cars. EM Solution is in a leading position to develop and distribute the commercialization technology of water electrolysis type hydrogen station adopted by advanced countries such as the United States and EU to supply and expand hydrogen fuel cell cars. This technology is designed to compress and store hydrogen produced by electrolyzing water and supply hydrogen through dispenser, and refueling is available with 35 MPa and 70 MPa.

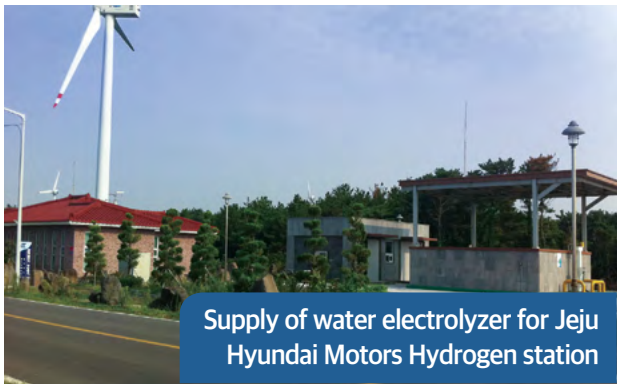
• Hydrogen station supply record

Pyeongchang/Gangneung Hydrogen Station (2018 Winter Olympics)

Location	Pyeongchang-gun, Gangwon-do / Gangneung-si, Gangwon-do
Capacity	Pyeongchang: 25kg/hr Gangneung: 30kg/hr x 2 units
Refueling Capacity	Pyeongchang : 50 cars/day Gangneung : 20 buses/day
Hydrogen Supply Method	Truck-In(Tube-Trailer)

Daegu Hydrogen Station (2013)

Location	Seobyeon-dong, Buk-gu, Daegu
Capacity	Max 60Nm^3/hr
Refueling Capacity	5 cars/day
Hydrogen Supply Method	Electrolysis



Supply of water electrolyzer for Jeju Hyundai Motors Hydrogen station

Location	Gimnyeong-ri, Gujwa-eup, Jeju-si, Jeju-do
Capacity	5 Nm^3/hr X 1 unit
Hydrogen Supply Method	Electrolysis

Supply of Water Electrolyzer for Buan Saemangeum Hydrogen Station

Location	Saemangeum Renewable Energy Theme Park, Buan-gun, Jeollabuk-do
Capacity	12 Nm^3/hr X 2 units
Hydrogen Supply Method	Electrolysis

Gimhae Andong Hydrogen Station

Location	53 Gimhae-daero 2596beon-gil, Gimhae-si, Gyeongsangnam-do
Capacity	55kg/hr
Refueling Capacity	10 cars/hr, 2 buses/hr
Hydrogen Supply Method	Truk-In(Tube-Trailer), Refomer

Changwon Jukgok Hydrogen Station

Location	San31-2, Jukgok-dong, Jinhae-gu, Changwon-si, Gyeongsangnam-do
Capacity	55kg/hr
Refueling Capacity	10 cars/hr, 2 buses/hr
Hydrogen Supply Method	Truck-In(Tube-Trailer)

Ulsan Together Hydrogen Station

Location	99, Sanwha-ro, Nam-gu, Ulsan
Capacity	55kg/hr
Refueling Capacity	10 cars/hr, 2 buses/hr
Hydrogen Supply Method	Pipe Line

Ulsan Deokha Hydrogen Station

Location	Sangnam-ri, Cheongnyang-eup, Ulju-gun, Ulsan
Capacity	55kg/hr
Refueling Capacity	10 cars/hr, 2 buses/hr
Hydrogen Supply Method	Truck-In(Tube-Trailer)

Hydrogen Station

• Hydrogen station supply record

Yeosu Hydrogen Station (SPG)

Location	603 Yeosu Sandan-ro, Yeosu-si, Jeollanam-do
Capacity	27.5kg/hr
Refueling Capacity	5 cars/hr
Hydrogen Supply Method	Pipe Line (SPG Hydrogen)

Wanju Hydrogen Station (Hyundai Motors)

Location	930, Gwahak-ro, Bongdong-eup, Wanju-gun, Jeollbuk-do
Capacity	110kg/hr
Refueling Capacity	10 cars/hr, 2 trucks/hr, 2 buses/hr
Hydrogen Supply Method	Truck-In(Tube-Trailer)

Changwon Deok-dong Hydrogen Station

Location	252 Hyeondong-ro, Masanhappo-gu, Changwon-si, Gyeongsangnam-do
Capacity	27.5kg/hr
Refueling Capacity	5 cars/hr, 1 bus/hr
Hydrogen Supply Method	Truck-In(Tube-Trailer)

Changwon Seongju Hydrogen Station

Location	43 Bulmosan-ro, Seongsan-gu, Changwon-si, Gyeongsangnam-do
Capacity	27.5kg/hr
Refueling Capacity	5 cars/hr, 1 bus/hr
Hydrogen Supply Method	Truck-In(Tube-Trailer)

Gwangju Donggok Hydrogen Station

Location	326 Donggok-ro, Gwangsan-gu, Gwangju
Capacity	27.5kg/hr
Refueling Capacity	5 cars/hr
Hydrogen Supply Method	Truck-In(Tube-Trailer)

Changwon Palyong Hydrogen Station

Location	Sogye-ro 1, Uichang-gu, Changwon-si, Gyeongsangnam-do (Palyong-dong)
Capacity	27.5kg/hr
Refueling Capacity	5 cars/hr
Hydrogen Supply Method	Truck-In(Tube-Trailer)

Gwangju Jingok Hydrogen Station

Location	55 Jungang-ro, Jingoksandan, Gwangsan-gu, Gwangju
Capacity	19.84kg/hr
Refueling Capacity	4 cars/hr
Hydrogen Supply Method	Truck-In(Tube-Trailer)

Hydrogen Plant

Hydrogen is not for the Futures, but **the Present**

EMS improves the economic feasibility by supplying hydrogen on-site, simultaneous use of high purity oxygen, for hydrogen stations and other industrial facilities. EMS's hydrogen plant produces hydrogen and oxygen from water, fills them in each compressed container, and distributes, supplies, and uses these filled containers. Hydrogen produced with high purity will be used in various ways for power generation cooling, semiconductor and turbine cooling, and oxygen can be used for food research such as protein synthesis.

• Water electrolysis plant

600Nm^3/h

KEPCO P2G demonstration project
High efficiency 100Nm^3/h

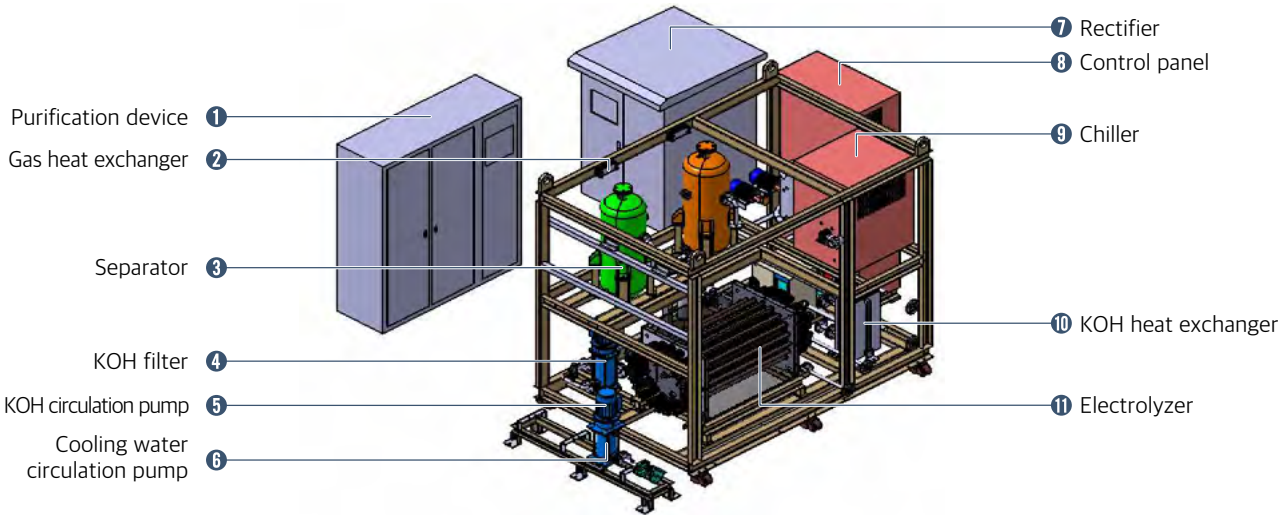
• Technical specifications (Medium-Lagre size)

MODEL	Hydrogen production capacity (Nm^3/h)	Oxygen production capacity (Nm^3/h)	Electrolyzer (Set)	Supply pressure (MPa)
EHP™-100	100	50	100Nm^3/h x 1	0.1 ~ 0.8
EHP™-200	200	100	100Nm^3/h x 2	
EHP™-400	400	200	100Nm^3/h x 4	

• Technical specifications (Small size)

MODEL	Hydrogen Production capacity (Nm^3/h)	Design pressure (MPa)	Hydrogen purity (%)	Frequency of Power supply	Power consumption (kWh)	Voltage	Water supply (ℓ/h)	Water supply quality (㎲/cm)	Size (W×B×H)	Weight (kg)
EHG-302A	3	0.99 MPa	99.8% (Option more over 99.999%)	60HZ / 3Ø (Option 50HZ)	18	220V / 380V / 440V	3	0.1 ~ 0.5	1,380×1,200×1,850	1,200
EHG-502A	5				30		5		1,380×1,200×1,850	1,500
EHG-103A	10				60		10		1,450×1,350×1,960	2,400
EHG-203A	20				120		20		3,000×9,000×2,600	9,000
EHG-403A	40				240		40		3,000×12,000×2,600	12,000
EHG-603A	60				360		60		3,000×12,000×2,600 3,000×3,000×2,600	15,000
EHG-803A	80				480		80		3,000×12,000×2,600 3,000×3,000×2,600	16,000

• Configuration of a water electrolysis type hydrogen generating device



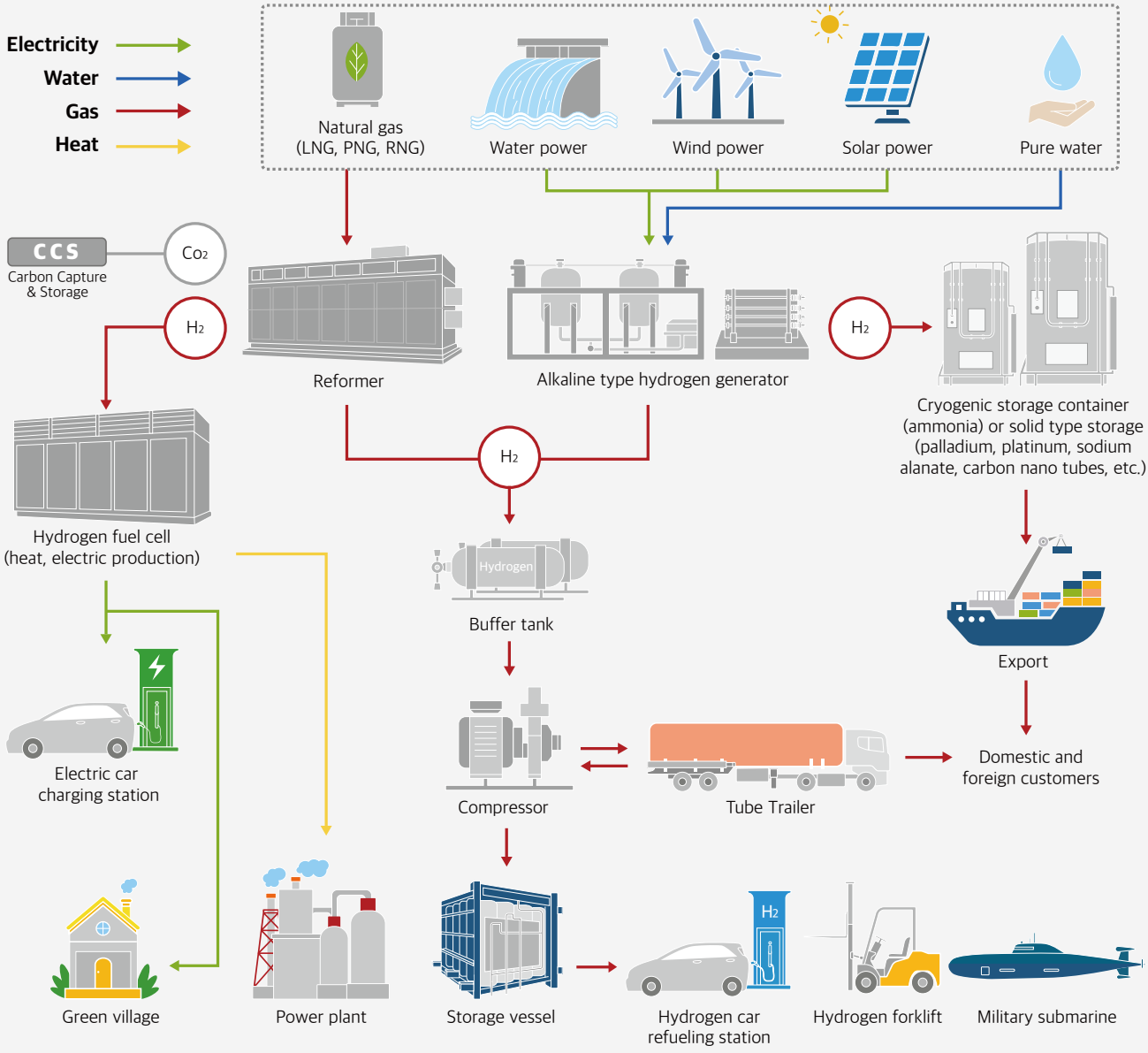
❶ It increases the purity by removing impurities of gas(H_2O and O_2).
❷ It cools down the high-temperature gases (hydrogen, oxygen)
❸ It separates the KOH solution and the gas (hydrogen, oxygen) by specific gravity difference.
❹ It removes the impurities from the KOH solution.
❺ It circulates the KOH solution separated from the separator into an electrolytic bath.
❻ It circulates the cooling water through the KOH heat exchanger.
❼ It converts AC into DC.
❽ A device that manages a system through electrical control.
❾ A device that cools down the cooling water in the gas heat exchanger.
❿ It cools down the heat of KOH solution continuously generated by the Joule's heat of electrolytic tank with coolant.
⓫ A device that produces gas (hydrogen, oxygen) through water electrolysis process.

P2G (Power to Gas)

EMS will lead the **Green Hydrogen** Production technology.

P2G is a technology that converts electricity into gas such as hydrogen and methane to be utilized for energy storage, transportation, and injection to the existing gas pipelines. The surplus power generated by the increase in renewable energy such as solar power and wind power can be stored as gas to solve problems such as output volatility, mismatch between power supply and demand, and restricted transmission and distribution. It can be converted into electricity, if necessary, enabling flexible operation.

• Example of P2G system establishmet



• Comparison of P2G (Power to Gas) and Li-ion Battery

P2G (Power to Gas) and Li-ion Battery, in addition to the common function of stabilizing renewable output in terms of power system operation, focuses on the stabilization of battery while P2G aims to relieve transmission restrictions.

Division	Storage type	Function and role	Facility capacity (WM)	Efficiency
P2G	Power → Gas (Fuel)	Restricted power transmission is solved by stabilizing the output of renewable energy	0.01~1,000	70~75%
Li-ion Battery	Power → Power	Renewable output stabilization frequency, reserve power	0.1~20	85~95%
Remarks	CO_2 reuse (CCS linkage is possible)	P2G: Unidirectional (excess output), Battery: Bidirectional control (charge/discharge)	P2G: Large capacity, Battery: Small capacity	Based on CH_4

• P2G research status

- Project Name: An empirical study on P2G-based multi-microgrid operation and distribution system linkage.

Korea Electric Power Corporation	Final goal of the project of the supervising institution
Ulsan Techno Park, EM Solution, Elchemtech, Pyeongsan Electric Power Technology, and Daekyung Industrial Electronics	• Development of a standard model for operating the P2G based MW class MG distribution system and securing a track record.
2019. 05. 01 ~ 2022. 04. 30 (36 months)	

• EM Solution's Goal

• Design of Large-area, high-efficiency Zero-gap electrolytic tank MW-class stack, BOP design/production/installation

- Technical specifications

MODEL	Hydrogen production capacity (Nm^3/h)	Design Pressure (MPa)	Hydrogen Purity(%)	Frequency of Power supply	Power consumption (kWh)	Water supply (ℓ/h)	Water supply quality (μs/cm)	Size(mm) (W×B×H)
$100Nm^3/h$	100	0.99 Mpa	99.80%	60Hz/3ph / 380V	500	100	0.1 ~ 0.5	4,500x2,860x2,811

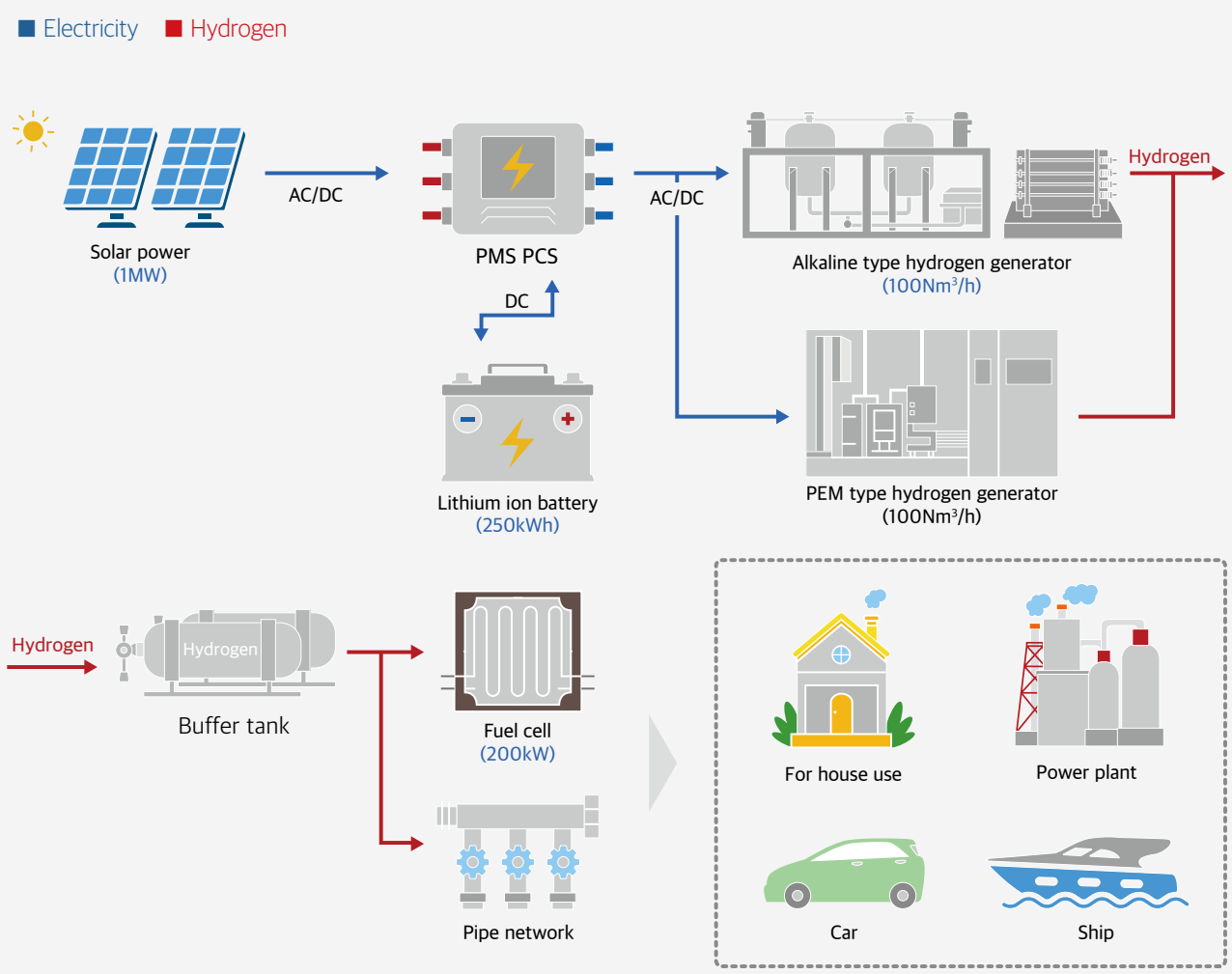
P2G (Power to Gas)

P2G R&D/Commercialization

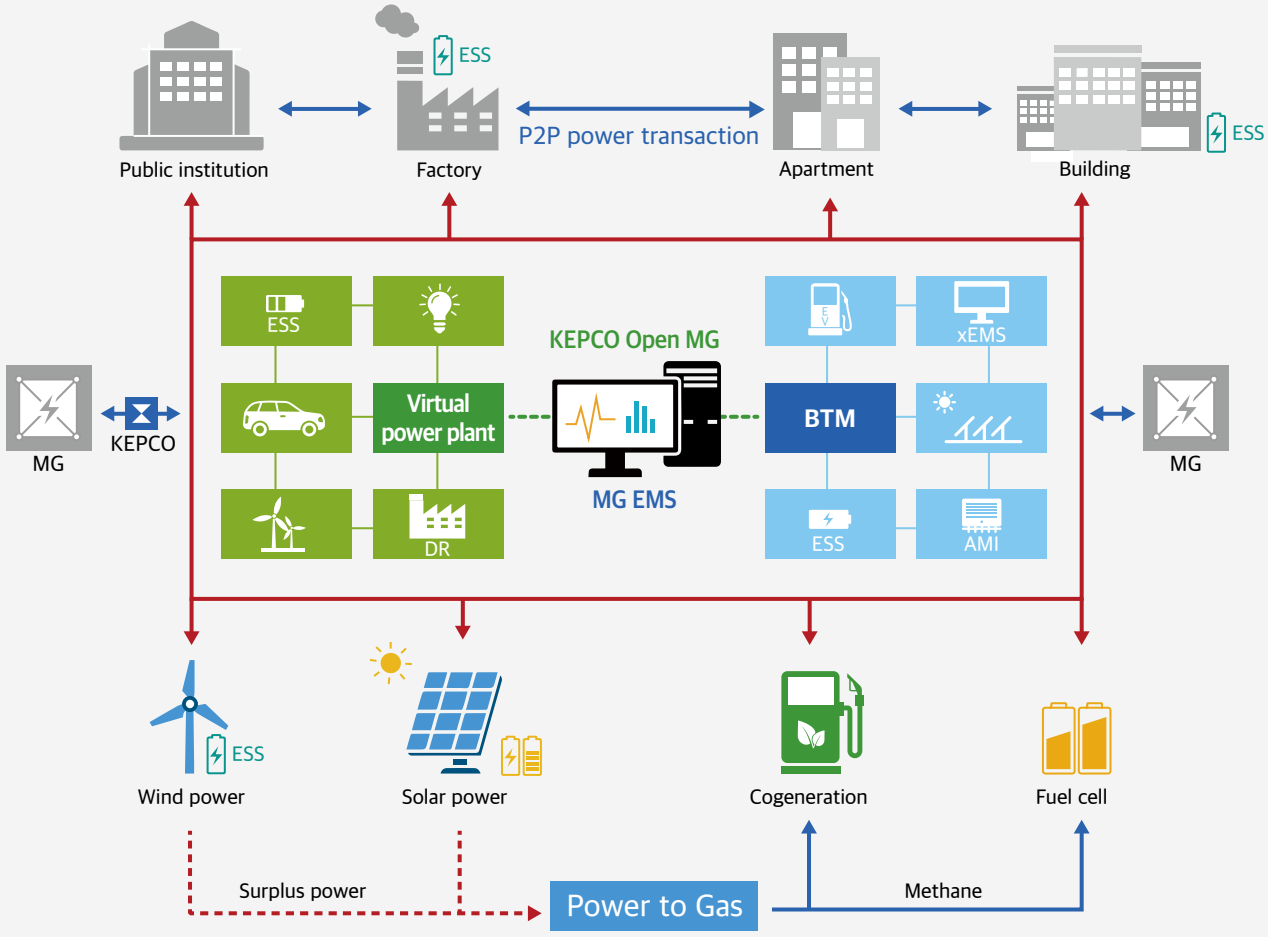
R&D contents: Development and demonstration of 1MW class, alkaline + PEM water electrolysis P2G facility using solar power in Ulsan Technopark, Zero-gap electrolyzer 100Nm^3/h (Max. 200Nm^3/h class)

• P2G flow process

Using electricity such as wind power or solar power, it is stored in a lithium-ion battery or electrolyze water to generate hydrogen for power generation and used as an energy sources such as power plant, automobiles for daily life through fuel cells and pipe networks.



• Biz model diagram



Renewable Energy

Eco-friendly energy resource recovery system

Food waste is now **a Recycling Resource**.

With a drying plant system that applies the patent-based technology developed by EM solution [food waste treatment and water purification system using eco-friendly low-temperature evaporative vacuum drying method], EMS installs and operates a resource circulation facility for **recycling leftover food** to not only provide more than 250 food wastes facilities nationwide but also supply/apply them to livestock manure and sewage sludge market step by step for **the protection of natural environment and the realization of energy**. **EMS aims to achieve economic effects, such as reducing environmental contributions and social costs of eco-friendly green growth.**

• Strong points of EMS system (Low-temperature evaporation based on vacuum technology)

01. Energy-saving type recycling system

- Self-produced oil can be used as boiler fuel
- Low-temperature evaporative vacuum drying reduces processing time and saves drying heat
- Reduced processing time compared with other facilities / Heat saving compared with general drying type

02. Odor and exhaust gas removal system

- Removed odor of stored hopper. - Radical water fog spray, scrubber
- Removed exhaust gas - Boiler combustion, scrubber
- Eradicated civil complaints/Real-time monitoring with an environmental monitoring system (optional)

03. Excellent wastewater treatment (Clean technology)

- Self-processing at the workplace. There's no secondary external treatment
- Treated with the generated condensate separation membrane water purification system
- Discharged after water purification to the level of cleanliness, or utilized recycled water

04. Removal of disgust

- Minimized food waste exposure during processing
- Odor satisfied with emission standards
- Optimized installation space by simplifying the facility structure (Sealed type)

05. Resourceization system that can use by-products

- Transform treated food waste powder into resource (pellet molding) - Additive of compounded feed
- Transform treated food wastewater into resource (water purification) - Used as heat exchange cooling water, boiler make-up water, etc.

※ Recycling of treated water: Reusable for toilets, landscaping trees for urban gardens, road spraying water for scattering prevention, and heavy water for buildings

06. Excellent economic feasibility

- Reduced operating costs because high-quality feed and fuel are produced as by-products.
- Wastewater is not generated. No second consignment processing fee.

Renewable Energy

Eco-friendly energy resource recovery system

• Main process results of the demonstration system

Odor



Odor removal

Food waste water



Purified water treatment

Sludge



Pellet raw material

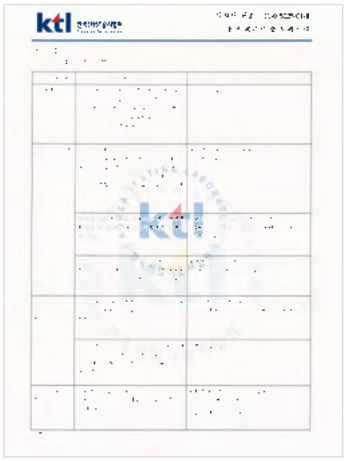
• Result of installation inspection of verification system

Inspection items	Result	Suitability	Test method
Food waste treatment facility	Dry food facility installation inspection (Report No : 21-005228-01-1)	Pass	Waste management method
Food wastewater (discharge water)	BOD 1.5mg/L, TOC 14.3mg/L and 6 other types (Document No : Jungangsucham No. 210208-066-2)	Suitable	Emission limit
Odor	Outlet 448, Site boundary 10 (Document No : OD-210203-11)	Suitable	Air dilution sensory method
Feed (By-products)	23 types of inspection items (Document No : Gi2102015)	Suitable	Feed standard analysis method and many more methods

• Installation inspection results of EMS system

Inspection result report

Common standards



Feed transformation facility

• Component analysis results after treatment

Odor

Water quality

Feed

www.yesems.co.kr

EM Group Business site

EM Solution, EM Korea

Yeongcheon factory of EM Solution

Haman factory of EM Korea

EM SOLUTION CO., LTD.
ENERGY&MARINE SOLUTION CO., LTD.

Changwon factory (Hydrogen business division)
51538, 767 Ungnam-ro, Seongsan-gu, Changwon, Gyungsangnam-do
Tel. +82-55-239-9000 Fax. +82-55-239-9010

Yeongcheon factory (Renewable Energy division)
38823, 69, Samgwi-gil, Yeongcheon, Gyungsangbuk-do
Tel. +82-54-338-9608 Fax. +82-54-338-9610