

Green Hydrogen Energy

# LIGHT BRIDGE CATALOGUE

lightbridge.co.kr



- Established in 2012
- Location Dongtan, South Korea
- Approx. 200 customers in over 40 countries
- Specialized in electrolyzer technologies
- YoY sales growth 500%







# **Table of contents**

### Intro

- 2 Intro
- 4 Established superiority over others
- 5 Technique and Industrial Strategy

### Product

- 6 LBE-SC-series Stacks
- 8 LBE-C-series Stacks
- 9 Alkaline Water Electrolysis System
- 10 LBE-PSC-series Stacks
- 11 LBE-PC-series Stacks
- 12 PEM Water Electrolysis System
- 14 Technology of Water Electrolysis System
- 15 Smart hydrogen station
- **16** H<sub>2</sub> Purifier
- 17 Stack evaluation equipment

### Company

- 18 Certifications & Patents
- 20 LightBridge Co.,Ltd

# Classification according to production method

Naturally occurring

**Coal gasification** 

**From fossil fuels** 

Nuclear power

Intro



**Methane pyrolysis** 

Hydrolysis with renewable power

Nutural gas with carbon capture

### What is green hydrogen?

### Water electrolysis hydrogen



Wind power





Hydrogen

 Hydrogen produced by water electrolysis from renewable energy

- Clean, unlimited energy source
- Role as an energy carrier
- Best energy source for decarbonization
- Key to democratization of Economy and energy

### **Green Hydrogen Cogeneration**



Eelctrolyser

compressor

H<sub>2</sub> Storage



### **Classification according to water electrolysis method**

### **AEL water electrolysis**

### **Advantages**

- Proven techonology
- Inexpensive catalysts
- High durability
- Relatively low investment cost
- Scalability of stack

### **Disadvantages**

- Low current density
- Large and complicated system
- Refining facility required
- Low water electrolysis pressure

### **PEM water electrolysis**

### Advantages

- Hight current density
- High efficiency
- Achieves high pressure with small stacks

### Disadvantages

- Expensive catalysts
- Durability decreases over time
- Difficult to manufacture sizable stack

### **AEM water electrolysis**

### **Advantages**

- Hight current density
- Inexpensive catalysts
- High efficiency
- Achieves high pressure with small stacks

### Disadvantages

- Low durability
- Membrane verification required
- Difficult to manufacture sizable stack

### Water Electrolysis Comparison

	AEL	РЕМ	AEM
Cost	Low	High	Low
Capacity	100 MW+	10 MW+	Up to 1 MW
Operating pressure	Low	High	High
Operating temperature	Low	Low	Low
Current density	Low	High	High
Electrolyte	Liquid (KOH ~30wt%)	Solid	Solid
Energy efficiency	Low	High	Varying (R&D stage)
Hydrogen purity	99.5 - 99.9%	99.97 - 99.99%	99.9%
Durability	High	Low	Decent

# Established superiority over others

Compactness Cost Effectiveness Scalability Easy maintenance Mass production

(PRIA)

# Technique and Industrial Strategy

### **Technical Competitiveness**

Light Bridge offers reduced size of 1/10 compared to other electrolyzer products in the market.





### **Stack comparison**

Light Bridge can scale up by connecting stacks in parallel series and using a modularized unit stack instead of one large stack.

### Cell design : Zero-gap configuration

- More complex design
- Requires use of porous electrodes
- Better cell performance
- Higher efficiency
- Allows for a more compact design
- Can obtain higher current density
- Reduces Ohmic resistance contribution from electrolyte
- Forces gas bubbles to be released from backside of electrode

(a)

cathode



# PRODUCT

# **LBE-SC-series Stacks**



LBE-SC Series is a compact alkaline electrolysis stack. Hydrogen and oxygen are generated by the electrolysis principle using KOH(Potassium hydroxide) electrolyte.

The development of high-efficiency nickel electrodes based on the core technology reduces the system production cost and generates hydrogen through the high-yielding rate per input power, and this technology has a long life cycle activating over 70,000 hours (for nickel based electrodes). The estimated lifetime for the alkaline electrolyser stack (or individual cells present in the stack hardware) is 70,000 operational hours.

Hydrogen generated from the water electrolyzer is used as the energy storage medium for HESS(Hydrogen Energy Storage System). The water electrolyzer can be even powered by renewable energy such as solar, wind-power, tidal, night-time electricity, and surplus power energy. When needed, hydrogen is converted to electricity by the fuel cell.

### **LBE-SC Series Alkaline Stack**

- Requires a caustic solution of 30 wt% KOH (Potassium hydroxide) for efficient operation
- High efficiency nickel electrodes reducing production cost and generate hydrogen through high-yielding rate per input

The stack can be customized from 1 to 20 cells, depending on the electrolysis system. The end plate material is optional.





**LBE-SC** 

LBE-3SC

LBE-10SC



### **Application**

- Redundant renewable energy transformation and storage
- Lab experiment and teaching
- Laboratory analytic instrument
- Hydrogen healthcare industry
- Hydrogen beauty industry
- Fuel for various areas
- Hydrogen supply for fuel cell
- Other pure H<sub>2</sub> applications

Material	Membrane	Current range @1.8V	Operating temperature range	Electrolytes	Active Area per Cell
FRP, Engineering plastic	Porous polymer	6~10A	15~70°C	Alkali solution (KOH, 30wt%)	15.2cm <sup>2</sup>

Model name	Size(mm) (L X W X H)	Number of Cell	H <sub>2</sub> Flow rate	O <sub>2</sub> Flow rate	Applied voltage range	Power capacity range
LBE-SC	100 X 100 X 27	1	70ml/min	35ml/min	1.7~2V	2.5~20W
LBE-2SC	100 X 100 X 33	2	140ml/min	70ml/min	3.4~4V	5~40W
LBE-3SC	100 X 100 X 39	3	210ml/min	105ml/min	5.1~6V	7.5~60W
LBE-5SC	100 X 100 X 51	5	350ml/min	175ml/min	8.5~10V	12.5~100W
LBE-10SC	100 X 100 X 81	10	700ml/min	350ml/min	17~20V	25~200W
LBE-20SC	100 X 100 X 141	20	1400ml/min	700ml/min	34~40V	50~400W

# **LBE-C-series Stacks**

### **LBE-C Series Alkaline Stack**

- RRequires a caustic solution of 30 wt% KOH (Potassium hydroxide) for efficient operation
- High efficiency nickel electrodes reducing production cost and generate hydrogen through high-yielding rate per input

The stack can be customized from 5 to 48 cells, depending on the electrolysis system. The end plate material is optional.







LBE-48C



LBE-5C

LBE-10C



### **Application**

- Redundant renewable energy transformation and storage
- Lab experiment and teaching
- Laboratory analytic instrument
- Hydrogen healthcare industry
- Hydrogen beauty industry
- Fuel for various areas
- Hydrogen supply for fuel cell
- Other pure H<sub>2</sub> applications

Material	Membrane	Current range @1.8V	Operating temperature range	Electrolytes	Active Area per Cell
FRP, Engineering plastic	Porous polymer	60~100A	10~80°C	Alkali solution (KOH, 30wt%)	177cm <sup>2</sup>

Model name	Size(mm) (L X W X H)	Number of Cell	H <sub>2</sub> Flow rate	O <sub>2</sub> Flow rate	Applied voltage range	Power capacity range
LBE-5C	265 X 265 X 61	5	3.5I/min	1.75I/min	8~10V	150W~800W
LBE-10C	265 X 265 X 91	10	7I/min	3.5I/min	16~20V	300W~1.6kW
LBE-20C	265 X 265 X 151	20	14I/min	7I/min	32~40V	600W~3.2kW
LBE-30C	265 X 265 X 211	30	21I/min	10.5l/min	51V~60V	900W~4.8kW
LBE-48C	265 X 265 X 320	48	33I/min	16.5l/min	81-96V	1.4kW~8.7kW

# Alkaline Water Electrolysis System

### **Technical Specifications**

Model name	LBEX-5K	LBEX-10K			
Size(mm) (L X W X H)	1000 X 550 X 1200				
Power Consumption	<5KW	<10KW			
Gas Production /h	Hydrogen gas 1,000L, Oxygen gas 500L, respectively	Hydrogen gas 2,000L, Oxygen gas 1,000L, respectively			
Adjustable Pressure	0~7 barg				
Temperature	10~80°C				
Purity of gas	Hydrogen gas 99.5~99.9%, Oxygen gas 98%				

This product is a high-performance water electrolysis system

- It can be expanded according to the power desired by the customer.
- To build a 1 MW Power System plant, the LBEX-100K can be connected in parallel with 10 units.
- Including stack, process bath, cooling system and circulation system, hydrogen pressure control and regulation function (optional: external tank, ultra purifier, distilled water supply device, chiller)
- And power module, electronic control board (optional: electronic module with communication protocol to monitor the system through web server interface)

### **Technical Specifications**

LBEX-5K LBEX-10K

Model name	LBEX-30K	LBEX-60K	LBEX-100K			
Size(mm)(L X W X H)	1800 X 550 X 2200					
Input voltage		380V 3phase, 50/60Hz				
Operating temperature range		50~80°C				
Ambient temperature range	10~30°C					
Purity of gas	Hydroq	Hydrogen gas 99.5~99.9%, Oxygen gas 98%				
Stack(LB-C series)	48cell X 3ea	48cell X 6ea	48cell X 10ea			
H <sub>2</sub> Flow rate	6,000l/h	12,000l/h	20,000l/h			
O <sub>2</sub> Flow rate	3,000l/h 6,000l/h 10,000l/h					
Adjustable Pressure	0-7 barg					
Power consumption range	6kW~30kW	12kW~60kW	20kW~100kW			



# **LBE-PSC-series Stacks**

The stack can be customized from 1 to 24 cells, depending on the electrolysis system. Stacks require Type I distilled water.









LBE-P4SC

LBE-P10SC

LBE-P24SC

### **Application**

- Redundant renewable energy transformation and storage
- Lab experiment and teaching
- Laboratory analytic instrument
- Hydrogen healthcare industry
- Hydrogen beauty industry
- Fuel for various areas
- Hydrogen supply for fuel cell
- Other pure H<sub>2</sub> applications

Material	Membrane	Current range @1.8V	Operating temperature range	Electrolytes	Active Area per Cell
Anodizing Aluminium, Ti	Nafion	Max 40A	15~70°C	Type I distilled water	25cm <sup>2</sup>

Model name	Size(mm) (L X W X H)	Number of Cell	H <sub>2</sub> Flow rate	O <sub>2</sub> Flow rate	Applied voltage range	Power capacity range
LBE-PSC	100 X 100 X 27	1	370ml/min	185ml/min	1.7~2V	10W-80W
LBE-P2SC	100 X 100 X 33	2	740ml/min	370ml/min	3.4~4V	20W-160W
LBE-P4SC	100 X 100 X 45	4	1.48I/min	740ml/min	6.8~8V	30W-240W
LBE-P10SC	100 X 100 X 81	10	3.7I/min	1.851/min	17~20V	50W-400W
LBE-P12SC	100 X 100 X 93	12	4.4I/min	2.2I/min	20.4~24V	100W-800W
LBE-P24SC	100 X 100 X 153	24	8.8I/min	4.4I/min	40.8~48V	200W-1.6kW

# **LBE-PC-series Stacks**

The stack can be customized from 1 to 50 cells, depending on the electrolysis system. Stacks require Type I distilled water.







LBE-P6C

LBE-P12C

### Application

- Redundant renewable energy transformation and storage
- Lab experiment and teaching
- Laboratory analytic instrument
- Hydrogen healthcare industry
- Hydrogen beauty industry
- Fuel for various areas
- Hydrogen supply for fuel cell
- Other pure H<sub>2</sub> applications

Material	Membrane	Current range @1.8V	Operating temperature range	Electrolytes	Active Area per Cell
Anodizing Aluminium, Ti	Nafion	Max 500A	15~80°C	Type I distilled water	270cm <sup>2</sup>

Model name	Size(mm) (L X W X H)	Number of Cell	H <sub>2</sub> Flow rate	O <sub>2</sub> Flow rate	Applied voltage range	Power capacity range
LBE-PC	214 X 266 X 100	1	230L/h	115L/h	1.7~2V	0.8kW
LBE-P6C	214 X 266 X 120	6	1,400L/h	700L/h	10.2~12V	5kW
LBE-P12C	214 X 266 X 144	12	2,800L/h	1,400L/h	20.4~24V	10kW
LBE-P24C	214 X 266 X 192	24	5,600L/h	2,800L/h	40.8~48V	20kW
LBE-P36C	214 X 266 X 240	36	8,400L/h	4,200L/h	61.2~72V	30kW
LBE-P48C	214 X 266 X 288	48	11,200L/h	5,600L/h	81.6~96V	40kW

# PEM Water Electrolysis System



LBEX-P2K

### **Technical Specifications**

Model name	LBEX-P2K
Size(mm) (L X W X H)	580 X 374 X 550
Power Consumption	<2KW
Gas Production /h	Hydrogen gas 500L, Oxygen gas 250L, respectively
Adjustable Pressure	0~7 barg
Temperature	10~80°C
Purity of gas	Hydrogen gas 99.97~99.99%, Oxygen gas 99%



LBEX-P5K LBEX-P10K

Model name	LBEX-P5K	LBEX-P10K
Size(mm) (L X W X H)	1000 X 55	50 X 1200
Power Consumption	<5KW	<10KW
Gas Production /h	Hydrogen gas 1,000L, Oxygen gas 500L, respectively	Hydrogen gas 2,000L, Oxygen gas 1,000L, respectively
Adjustable Pressure	0~7 barg	
Temperature	10~8	30°C
Purity of gas	Hydrogen gas 99.97~99.99%, Oxygen gas 99%	



### 1 Mega Watt unit concept



LBEX-P20K LBEX-P40K

LBEX-P60K LBEX-P80K

LBEX-P100K

This product is a high-performance water electrolysis system

- It can be expanded according to the power desired by the customer.
- To build a 1 MW Power System plant, the LBEX-P100K can be connected in parallel with 10 units.
- Including stack, process bath, cooling system and circulation system, hydrogen pressure control and regulation function (optional: external tank, ultra purifier, distilled water supply device, chiller)
- And power module, electronic control board (optional: electronic module with communication protocol to monitor the system through web server interface)

Model name	LBEX-P20K LBEX-P40K LBEX-P60K LBEX-P80K LBEX-P100K				LBEX-P100K
Size(mm) (L X W X H)	1800 X 550 X 2200				
Input voltage		380V 3phase, 50/60Hz			
Operating temperature range	10~80°C				
Ambient temperature range	10~30°C				
Purity of gas	Hydrogen gas 99.97~99.99%, Oxygen gas 99%				
Stack(LBE-PC series)	12cell X 2ea	12cell X 4ea	12cell X 6ea	12cell X 8ea	12cell X 10ea
H <sub>2</sub> Flow rate	4,000l/h	8,000l/h	12,000l/h	16,000l/h	20,000l/h
O <sub>2</sub> Flow rate	2,000l/h	4,000l/h	6,000l/h	8,000l/h	10,000I/h
Adjustable pressure	0~7barg				
Power consumption range	4kW~20kW	8kW~40kW	12kW~60kW	16kW~80kW	20kW~100kW

# Technology of Water Electrolysis System

Extended Connection Scale-up



**500kW** Water Electrolysis System Hydrogen production rate 100~120Nm<sup>3</sup>/h



**1MW** water Electrolysis System Hydrogen production rate 200~240Nm<sup>3</sup>/h

## **Application of ICT Platform**



### Hydrogen Energy Capability Matrix



Light Bridge-Electrolysers

# Smart hydrogen station H-BRIDGE



Size(mm) (L X W X H)	1200 X 2000 X 2000	
Hydrogen production	20kg/day	
Charging pressure	700barg	
Hydrogen charging speed	1kg/10minutes, (i.e. Hyundai Nexo charging speed 80%/20minutes)	
Purity of gas	99.97%	
Storage capacity	20kg	
Compression method	EHC(Electrochemical Hydrogen Compression)	
Electric charging	50kw fast	

# H<sub>2</sub> Purifier LBPX-10K



### **Technical Specifications**

Gas	Hydrogen	
Size(mm) (L X W X H)	1000 X 550 X 1200	
Input Voltage	380VAC	
Power consumption	<5kW	
Gas Processing rate	Hydrogen gas 2Nm^3/h	
Adjustable Pressure	Max 10 barg	
Purification Method	Catalyst/Absorption.	
	H <sub>2</sub> O(Dewpoint 10°C)	
mermpunties	O <sub>2</sub> (<1000(ppm))	
Outlot Purition	H <sub>2</sub> O(Dewpoint<-100°C)	
Juliet Furilies	O <sub>2</sub> (<1~2(ppm))	

### **Utility Specification**

Section	Size	Туре	Flow Rate	Contents
Process(In/Out)	3/8"	Male VCR	2N/m^3	Supplying Gas
Vent	1/4"	Male VCR		Exhaust Gas during Absorption
Sample Gas	1/4"	Male VCR		Analyzing Purified Gas

List	Detail	
Processing Method	AUTO Process	
Safety Method	Auto blocking, Alarm by Pressure and Temperature	
Control System	PLC (LS산전)	
Power Specification	AC380V 3phase Pt Catalyst Column Heater (1ea) – 1kW X 1ea Adsorber Column Heater (2ea) – 1kW X 2ea System – 1kW Total Power – 4kW	
Etc	Ethernet, RS-485	

# **Stack evaluation equipment**





LBWS-5K

PEM, AEL, AEM Stack Test Station (customisable, power supply: >5kW)

### **LBWS-100**

PEM, AEL, AEM Stack Test Station (customisable, power supply: >100W)

### **Technical Specifications for LBWS-5K**

Stack Connections		Stack Potentiostat		
2-terminal (V+, V-)		Full Scale Current Ranges	100A	
V	Water & Electrolyte Handling         Current Resolution         0.1% of range		0.1% of range	
Flow Path		All 316 SS	Voltage Measurement Resolution	10 mV
Feed Water Reservoir		1L, 316 SS, auto-water fill	Sense Lead Input Resistance	1.0 GΩ
Circulation Pump(electroly	te)	50 – 400 mL/min, software controlled	Modes of Operation	Constant, Scan, Step-Stair; V and I
Stack Temperate Range	ure	Ambient to 70°C		Power Supply
Purge Gas (N <sub>2</sub>	)	PC-controlled MFC on Negative; Manual on Positive	Maximum Current	100A
Liquid/Gas Separator/ Dehumidifiers	6	2 (Negative, Positive), condensers & collection tanks	Voltage Range	0 - 50 V
Data Acquisition		4 Temperature + 6 Analog(e.g., 0-5 V, 4-20 mA)	Power	Up to 5kW
Product Mass Flow Meters		2 (35 SLM H <sub>2</sub> , 20 SLM O <sub>2</sub> )	Phys	ical and Environment
In-Line Gas Purity Sensors	H <sub>2</sub> Tr O <sub>2</sub> Tr	ransmitter for monitoring of $H_2$ in Product $O_2$ ransmitter for monitoring of $O_2$ in Product $H_2$	Operating Temperature	5-35°C
Pressure sensor		0~10barg 4~20mA	Power Source	220-240VAC, 1 phase
			Size (excluding tubing connections)	L800 X W980 X H1570 mm
			Weight	120 kg

# **Certifications & Patents**

CERTIF	TICATE	
This is to certify that the		
Quality Mana	igement Syster	n
LightBridge Co.,	Ltd.	
Room 512 APEXCITY, Gyeonggi-do, Korea	823 Dongtansunhwan-da	ero, Hwaseong-s
complies with the required	ments of	
ISO 9001:2015	j	
This certificate is valid co	ncerning all activities relate	ed to:
For the Scope of Development of modula	ar water electrolyzer	
IAF Code : 19		
Certificate Valid Date : .	26-Apr-2022 ~ 25-Apr-	2025
Date of Initial Approval	: 11S-KQ-01957 : 26-Apr-2022	STAL TENOLO
Date of Issue	: 26-Apr-2022	ITS
by Park Joon Your	ng	Sum 2
President		
INTERNATIONAL TEO	CHNOLOGY STANDAR	RD CERTIFICAT
#50ho Na=dord, 135	Maagangbyvorbangang -ro. Hanam-si.	Gyeonggi-éé, Kerés
IAF AS	<ul> <li>1A578.23)(可能性量が必要定時1350 Mail 化量量の(142)(用量化量、2552(142))用量量の</li> </ul>	apindia System 1127(0.2.2. 0000: 1127(31)(1)
ACCRECITED	· 142 30.3 도고는 QSSUUS에 대한 전쟁도 2010 - 전쟁병장가의 전쟁기관에 대한 전쟁도 2010	물기존불제시구의 약세다수간상로 다
This certificate is t	the property of ITS Inc. and must b	returned on request by
propriate and		Ve

특허증 CERTIFICATE OF PATENT 특허 제 10-1848292 호 동일번호 제 10-2017-0046280 호 2017년 04월 10일 응원일 Ring Date 2017년 04월 10일 등육일 Rogistation Date 2018년 04월 06일 발명의 명칭 Title of the Invention 고면적, 다공성 타입의 유로 내장형 전기화학적 전극 및 이를 가지는 스택형 전기분해 시스템

특히권지 Patentee 주식회사 라이트브릿지(131411-\*\*\*\*\*\*\*) 경기도 수원시 영통구 대학4로 17, 306호(이의통, 에이스광교타워)

발명자 (monu) 김종준(810725-\*\*\*\*\*) 경기도 수원시 명통구 경고증양로 247 , 3212등906호((하중,유민시아아파트))

위의 발명은 「특허법」에 따라 특허등록원부에 등록되었음을 증명합니다. This is to certify that, in accordance with the Patent Act, a patent for the has been registered at the Korean Intellectual Property Office.



CERTIFICATE **Environmental Management System** LightBridge Co., Ltd. Room 512 APEXCITY, 823 Dongtansunhwan-daero, Hw Gyeonegi-do, Korea

5

ITS

### ISO 14001:2015 Constant

This certificate is valid concerning all activities related to For the Scope of Development of modular water electrolyzer 1AF Code : 19 Certificate Valid Date : 26-Apr-2022 ~ 25-Apr-2025 Certificate No. : ITS-KE-01047 Date of Initial Approval : 26-Apr-2022 Date of Issue : 26-Apr-2022 by Park Joon Young INTERNATIONAL TECHNOLOGY STANDARD CERTIFICATION This certificate is the property of

특허증 특허 제 10-2258287 호 출원번호 Anglication Number 제 10-2019-0077824 호 Application Number 중원일 Filing Date 등록일 Registration Date 2019년 06월 28일 2021년 05월 25일

발명의 명칭 Tife of the Invention 전기화학적 수소 압축기

득히진자 Paterizee 주식회사 에어브릿지(141211-\*\*\*\*\*\*) 강원도 원주시 상지대질 83 ,상지대학교창업보육센터(우산동,벤치창업관101호)

일양적 (memo-김종훈(810725-\*\*\*\*\*\*) 경기도 수원시 영통구 광교중앙로 247, 3212동906호((하동,휴면시아아파트))

위의 발명은 「특허법」에 따라 특허등록원부에 등록되었음을 증명합니다. This is to certify that, in accordance with the Patent Act, a patent for the invention has been registered at the Korean Intellectual Property Office.



















LightBridge Co.,Ltd Research and Development Status

**R&D of Solid Storage Alloys** 

**Development of high-efficiency electrode for Alkaline Water Electrolysis** 

**Development of Stack mass production** 

Development of Modular Water Electrolysis system

**R&D of AEM & PEM Stack** 

The front and back sides of the electrode made of nickel are composed of an asymmetric shape. A large amount of electrolysis takes place on the surface with a large surface area, and the gas generated in the large porous structure on the opposite side quickly escapes. Which enables the increased efficiency.











LightBridge aims to serve as the "Bridge" for the future hydrogen community.

### LightBridge Co.,Ltd

### OFFICE

APEXCITY #512, Dongtansunhwan-daero 823, Hwaseong-si, Gyeonggi-do, Republic of Korea (18471)

### CONTACT

SCAN ME :)

0

(+82)70-4407-2400

 (+82)31-5183-5229

 Iightbridge.sales@gmail.com

lightbridge.co.kr