



碳能科技
CARBON ENERGY

ALL-VANADIUM REDOX FLOW BATTERY

Carbon Energy Technology
(Beijing) Co., Ltd

公司商业秘密不得外泄
The company's business secrets shall not be disclosed

Shape a sustainable future

COMPANY PROFILE

Carbon Energy Technology (CE) is a research company dedicated to the development of transformative carbon neutrality technology, founded in 2015 by Dr. Peng Kang.

CE provides carbon neutrality solutions with positive economics. Through key catalysts, reactors and advanced process, CE can efficiently convert CO₂ to green chemicals and materials, such as synthesis gas, synthetic oil and methanol, contributing to a “net-zero” future.

The technology advantage of CE attracts many attention and recognition, and CE has received investment from leading venture capitals and collaborated with key industry partners.



Founder



康鹏博士
Dr. Peng Kang

2000.9-2004.6

Univ. of Science and Technology of China, B.S. in Chemistry

2004.9-2010.11

Stanford University, Ph.D. in Chemistry

2010.11-2015.4

Univ. of North Carolina, DOE Solar Fuels EFRC

2015.3-Now

Founder, Carbon Energy, Beijing, China

2015.5-Now

Professor, CAS & Tianjin University, China

CORPORATE CULTURE

MISSION

Develop
economically
positive carbon
neutrality
technology

VISION

Found the Bell Lab
of New Energy
Shape a
sustainable future

VALUE

Achieve
transformation
Innovation through
research

SPIRIT

Work Hard
Work Smart

INDUSTRIAL DISTRIBUTION

HAIDIAN R&D CENTER

Located in Yiyuan Industry Base, Haidian, Beijing, as the main office, R&D lab and engineering design.



XI'AN MEMBRANE PRODUCTION BASE

Xi'an Carbon Energy Technology Co., Ltd. focuses on the production of key membrane materials for hydrogen production.

FANGSHAN PILOT BASE

Located in Fangshan, Beijing, it has an 800-square-meter pilot laboratory, equipped with large reactor evaluation platforms, process test platform and CNC machining systems, which mainly undertakes the test and operation of large electrolytic reactors, electrolytic process testing, and reactor assembly.

WEIFANG CATALYST PILOT BASE

Weifang Carbon Energy Technology Co., Ltd., located in Weifang, Shandong, has a 500-square-meter laboratory and a 2000-square-meter production workshop, responsible for batch preparation of catalysts.

HONORS

National high-tech enterprise

Zhongguancun high-tech enterprise

Little Giant of Beijing

Certificate of Beijing Municipal Enterprise Science
and Technology Research and Development
Institution

ISO 9001 certificate

ISO 14001 certificate

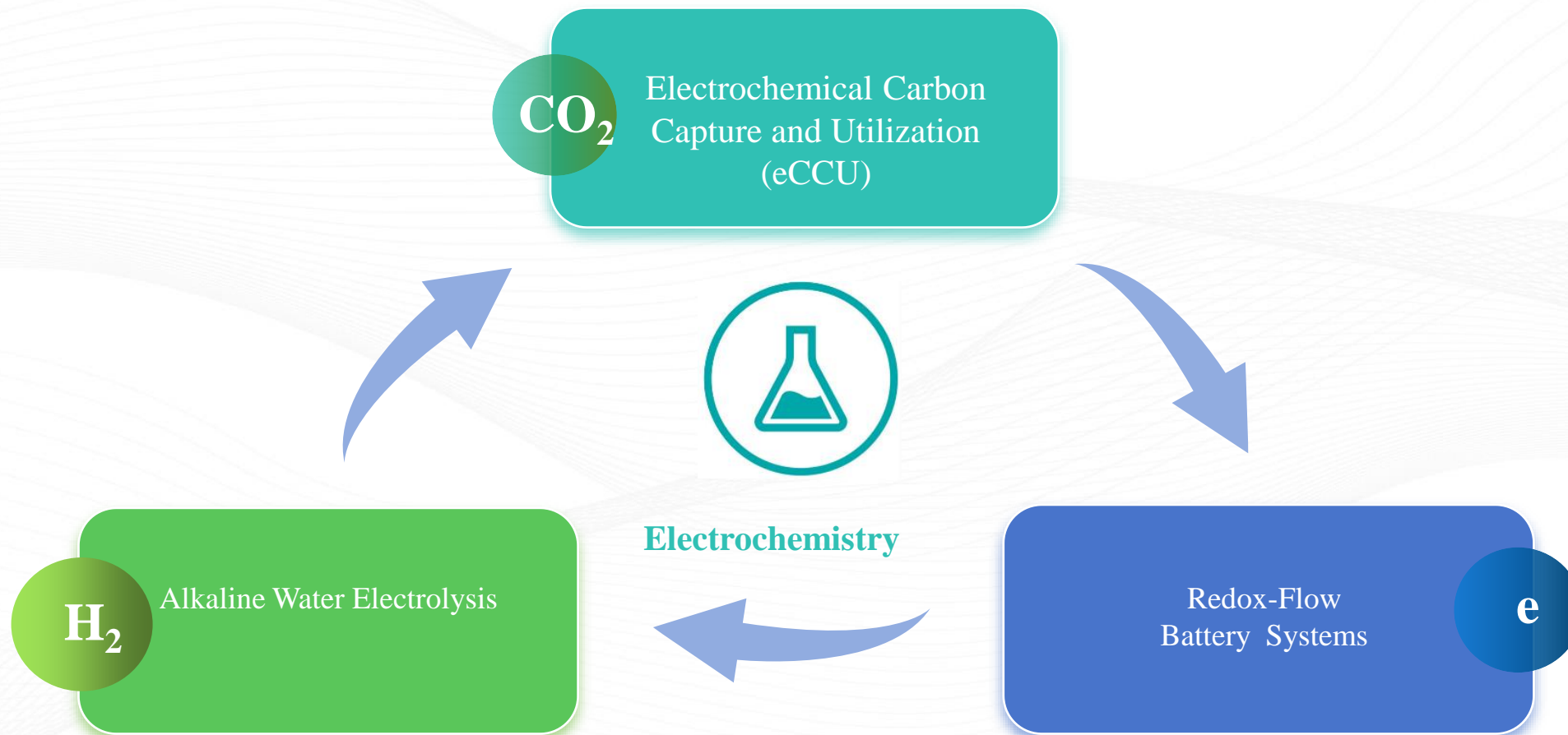
ISO 45001 certificate



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BUSINESS



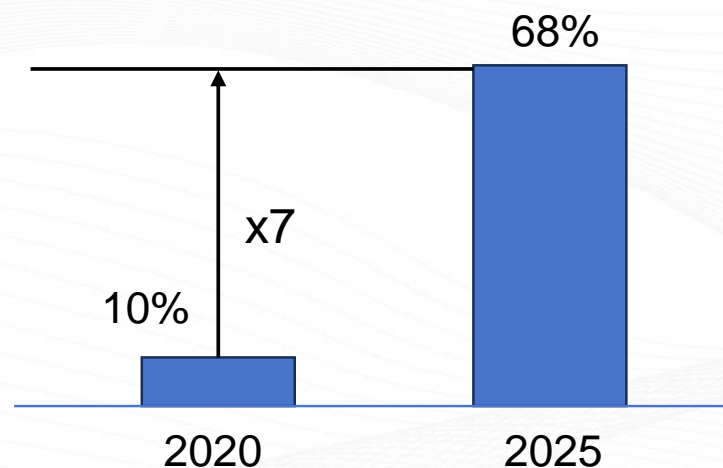
THE ENERGY STORAGE MARKET

Making long-term energy storage an essential requirement

Predicting the global share of wind and solar power generation

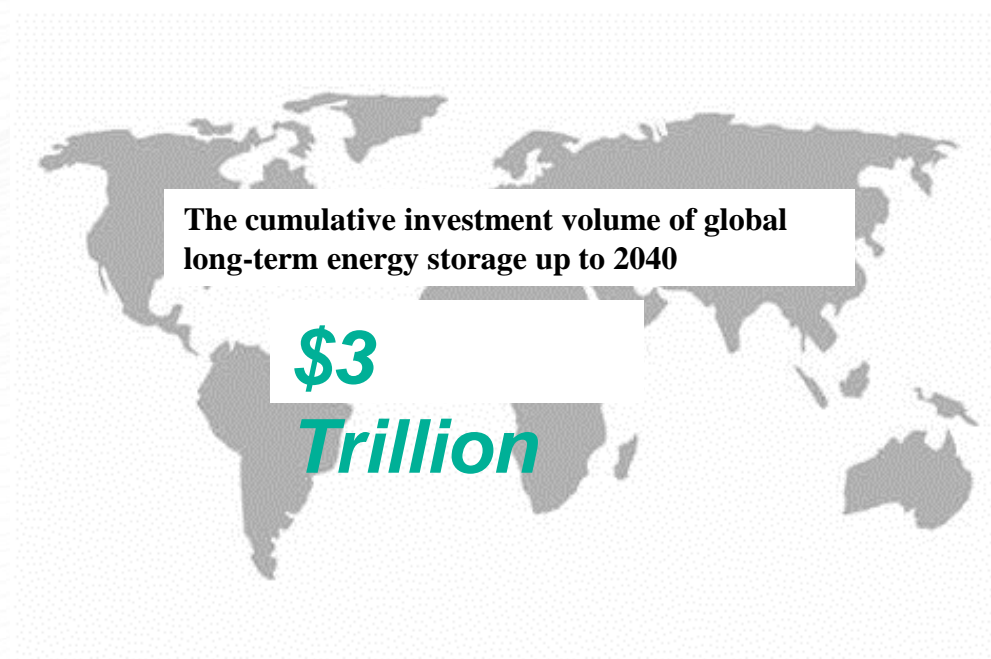
Characteristics of the new energy production

The demand for long-term energy storage is increasing worldwide.



- Volatility
- Intermittency
- Randomness

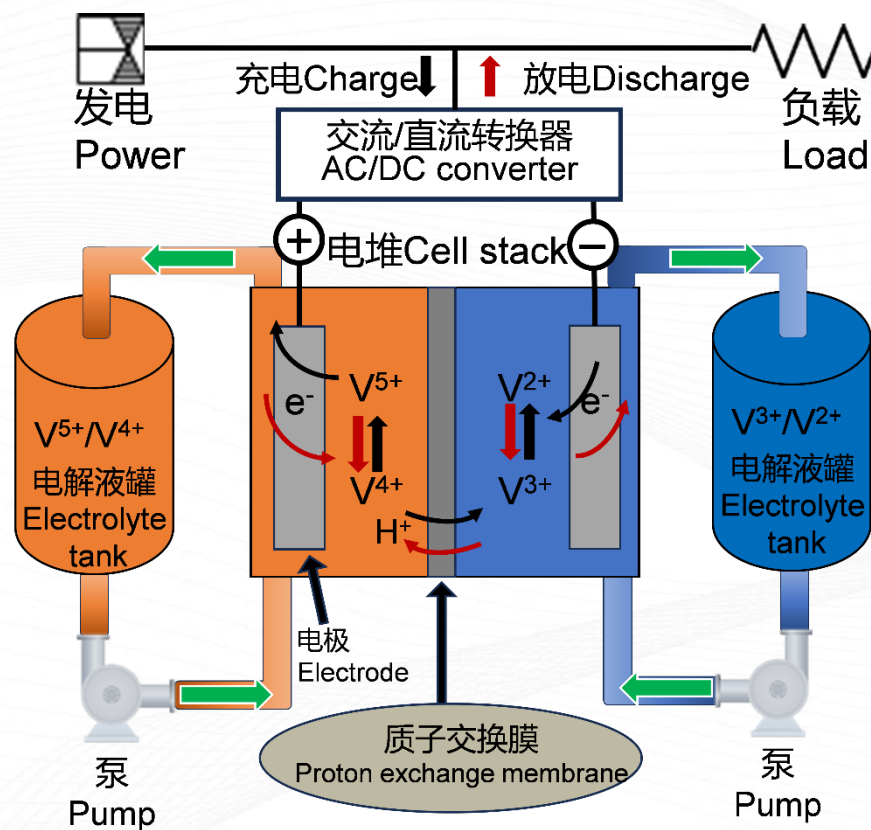
The long-term storage of energy is an unavoidable option for integrating a high proportion of wind and solar power generation into the grid.



COMPARISON OF DIFFERENT TECHNOLOGIES FOR STORING CHEMICAL ENERGY

Type Item	All-vanadium (VRB)	Iron-chromium (Fe/Cr)	Zinc-bromine (ZnBr)	Sodium-sulfur (Na/S)	Li (Li ion)
Cycling Life	More than 20,000 times. The existing operating records exceed 200,000 times and are approaching an infinite lifespan.	10000,	2000-6000	2500	2000-5000
Energy Density of Materials	15-40Wh/L	13-30Wh/L	75-85Wh/kg	150-240Wh/kg	300-400Wh/L, 130-200Wh/kg
Scalability	easy	easy	Middle	Middle	High difficulty
Corrosive	Middle	Middle	High	Middle	High
Safety	good	good	There exists a potential risk of Br ₂ leakage.	The leakage of Na poses a fire risk.	Excessive heat is prone to cause an explosion.
Operation temperature interval	5-40	-20-70, The reactivity at room temperature is low.	20-50	300-350	The minimum starting ambient temperature is -45°C.
Efficiency of AC	80-83%	70-75%	55-65%	65%-80%	90%
Self-discharge	Extremely low	low	low	Low	0.1-0.3%each day
Disposal of Used Batteries	The electrolyte is regenerable.	The electrolyte is regenerable.	High difficulty	Middle	High difficulty
Advantages and disadvantages.	The fully liquid system is characterised by a long lifespan, with over ten years of industrial validation, but is relatively expensive.	The period for industrial verification is short. The hydrogen evolution reaction can't be avoided. The active ions swap. The energy storage capacity goes down.	The working current density is low, and the single stack power density is also low, currently only 5kW.	The number of cycles is low, the operating temperature is high, and it is not safe.	It is flammable, unsafe and unable to store energy in the long term.。

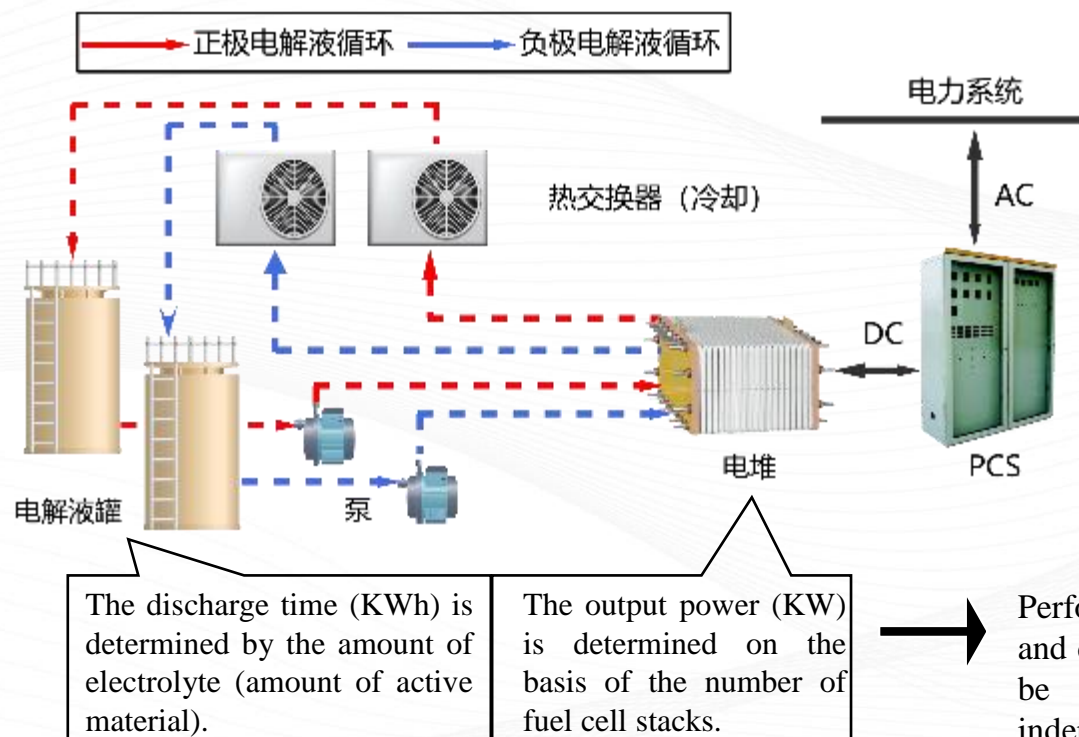
TECHNICAL PRINCIPLE



Features and benefits:

1. High performance: higher vanadium resistance, higher coulombic efficiency, higher energy efficiency, lower self-discharge;
2. Low cost: material cost is reduced by 90%, resulting in a 7% reduction in the EPC cost of the system;
3. High stability: low swelling rate, chemically stable;
4. Large width: the membrane width can be more than 1 m.

TECHNICAL PRINCIPLE



Long-term energy storage possible to the full extent

- ✓ The marginal cost of energy storage capacity is extremely low.
- ✓ The stored energy is linked to the speed at which it is absorbed and released.
- ✓ Extensive deployability and scalability, not limited by geography and not reliant on rare elements.
- ✓ Construction time is shorter than grid modernization or expansion.
- ✓ Safety and environmental friendliness throughout the entire life cycle are still required.

Safety: An aqueous electrolyte is used which is non-flammable and does not pose a risk of combustion or explosion.

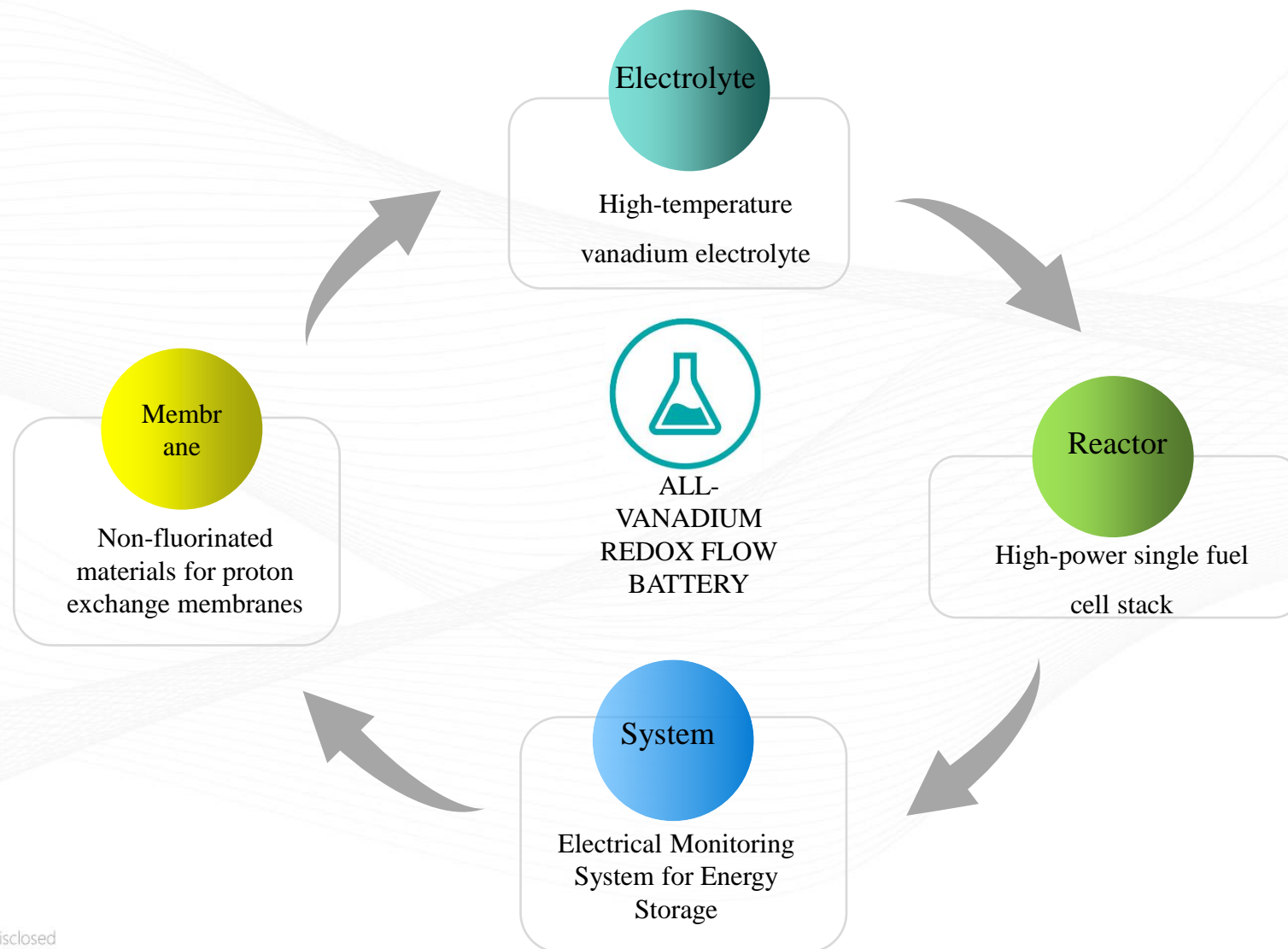
Long service life: 100% deep discharge, the number of cycles is more than 20000 times, and the planned service life is more than 20 years.

No mitigation: Online recovery can be achieved and the capacity can be reset to the original value.

Independent power capacity: modular design, implementation and expansion

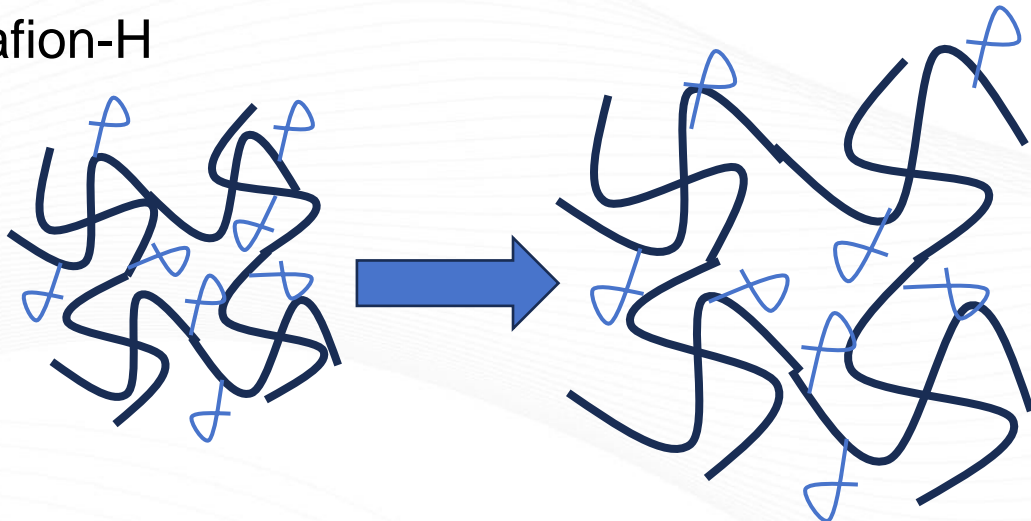
Pollutant-free: The raw materials are abundant, environmentally friendly and no pollutants are produced.

TECHNICAL ADVANTAGE

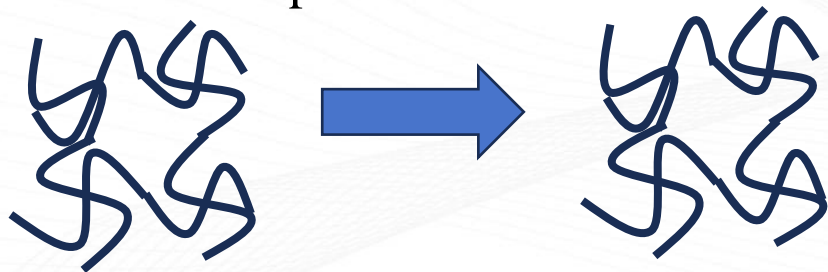


NON-FLUORINATED PROTON EXCHANGE MEMBRANE

Nafion-H



The fluorine-free proton



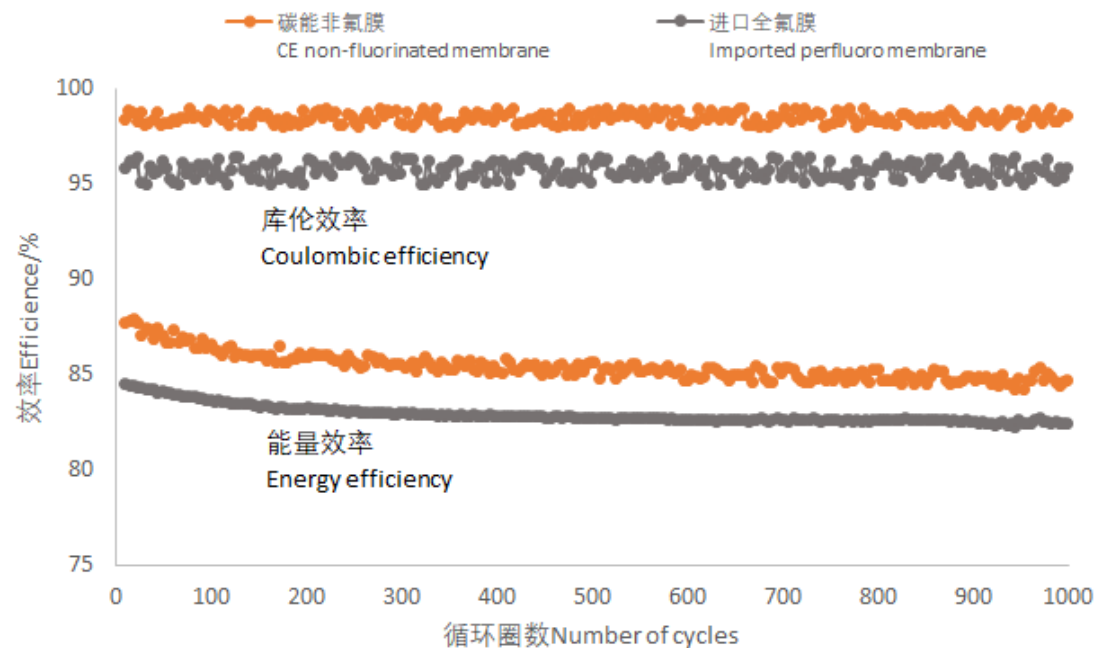
The microphase separation of hydrophilicity and hydrophobicity in non-fluorine membranes is smaller, and the ion selectivity is higher.



The fluorine-free proton exchange membrane independently developed by CE, which is composed of hydrocarbon polymers, has excellent performance and can be used for a variety of energy storage scenarios, such as all-vanadium flow batteries and iron-chromium flow batteries, which provide a core material guarantee for the rapid development of energy storage.

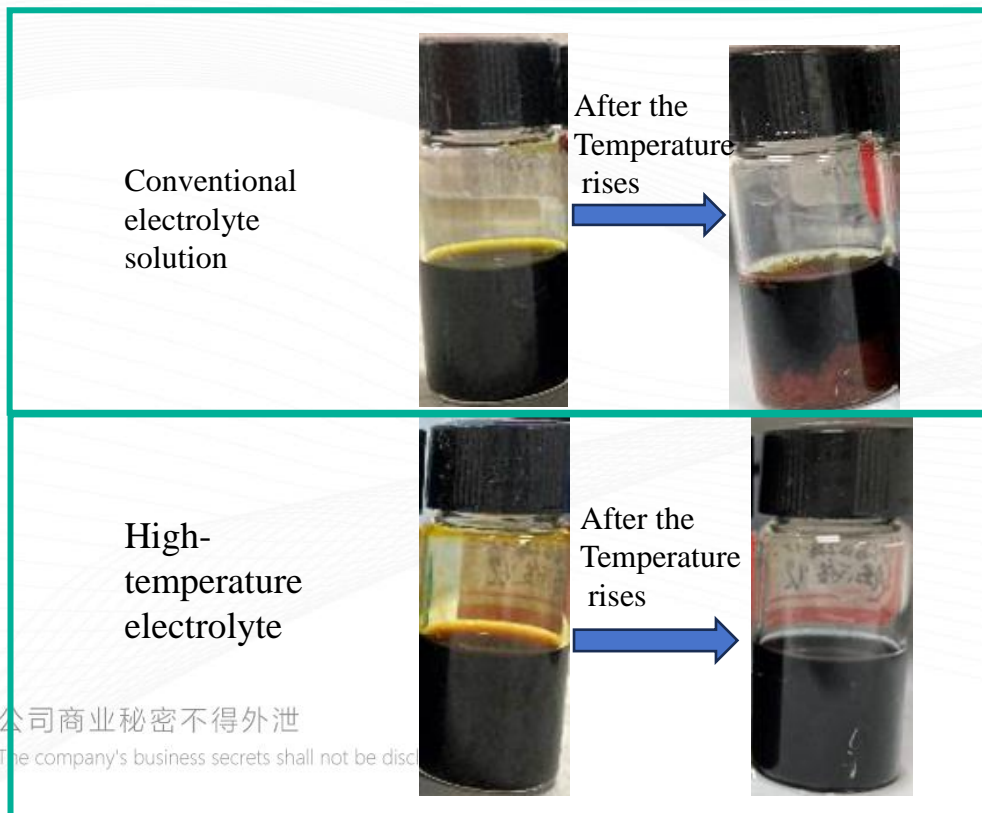
NON-FLUORINATED PROTON EXCHANGE MEMBRANE

Manufacturer	Thickness (μm)	面电阻Surface resistance (Ω·cm ²)	面电导率Surface conductivity (mS·cm ⁻¹)	VO ²⁺ 渗透率Permeability (cm ² ·min ⁻¹)
Domestic Perfluorinated Proton Exchange Membrane	50	0.11	45.5	4.16×10 ⁻⁷
Imported Perfluoro Proton Exchange Membrane	50	0.08	65.8	2.67×10 ⁻⁷
CE non-fluorinated Proton Exchange Membrane	50	0.08	62.2	5.56×10 ⁻⁸



Vanadium electrolyte at high temperature

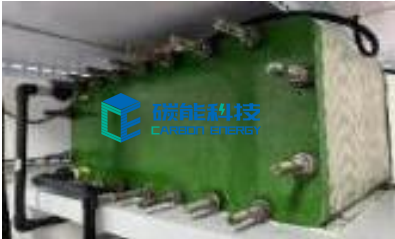
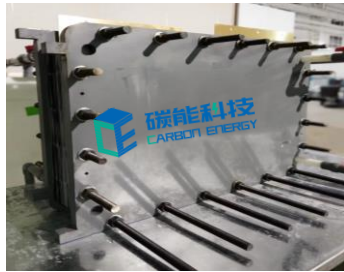
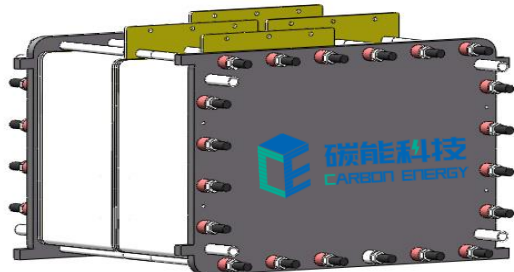
- Heat is generated during the charging and discharging processes of all-vanadium redox flow batteries. Even if the ambient temperature is relatively low, the temperature of the electrolyte continues to rise after a long charging and discharging process.
- Studies on the temperature stability of the electrolyte solution for the all-vanadium redox flow battery in the sulphuric acid system focus mainly on the high-temperature stability, i.e. the stability of the positive electrolyte solution.



Electrolyte type	Conventional electrolyte	High-temperature electrolyte
Status	Considerable amount of precipitation	Without precipitation
Concentration of Vanadium(V) Ions mol/L	1.2	1.38
Concentration of Vanadium(IV) Ions in mol/L	0.3	0.12

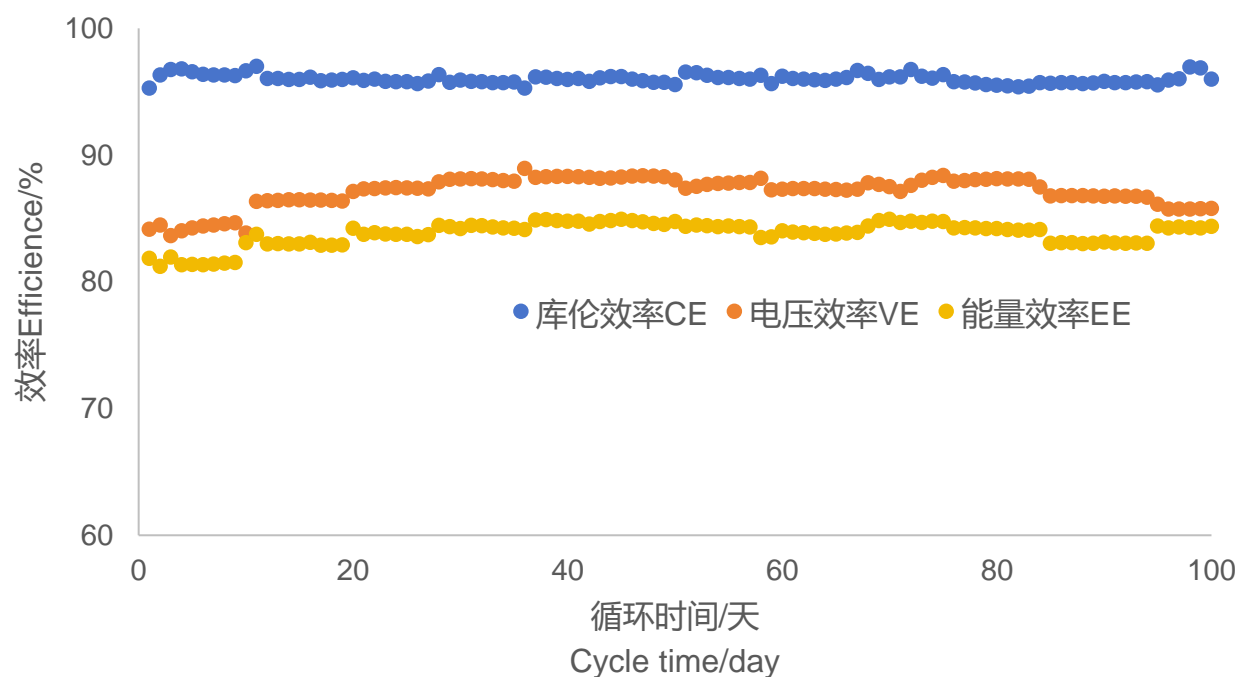
Test conditions: A solution of 1.5 M VO_2^+ and 3 M H_2SO_4 heated at a constant temperature in a water bath at 65 °C.

CELL STACK PRODUCTION

Item			
Rated power	5KW	50KW	100KW
Energy efficiency	≥80%	≥80%	≥80%
Operating temperature	0-40℃	0-40℃	0-40℃
Overload capacity	110% Rated power , 10min	110% Rated power , 10min	110% Rated power , 10min
Lifetime	> 20000	> 20000	> 20000

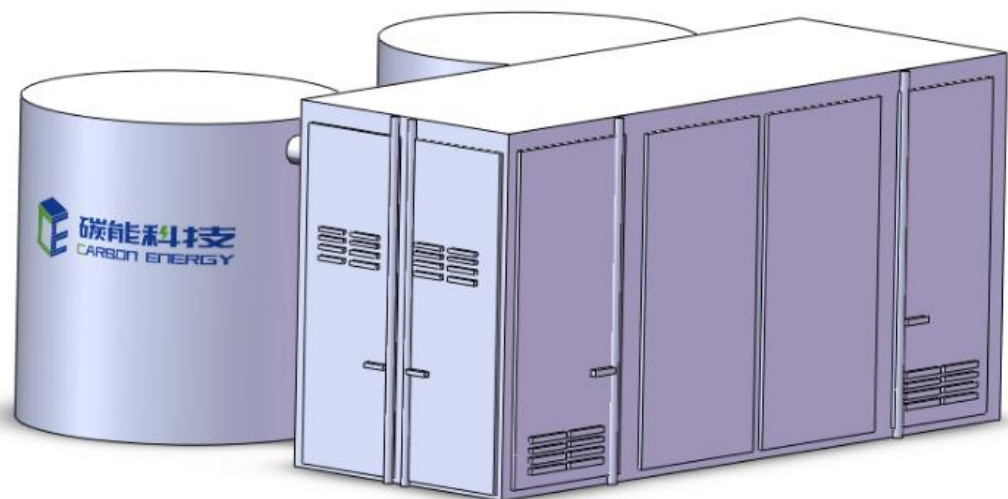
CELL STACK PRODUCTION

◆ The operational stability of the battery is favorable.



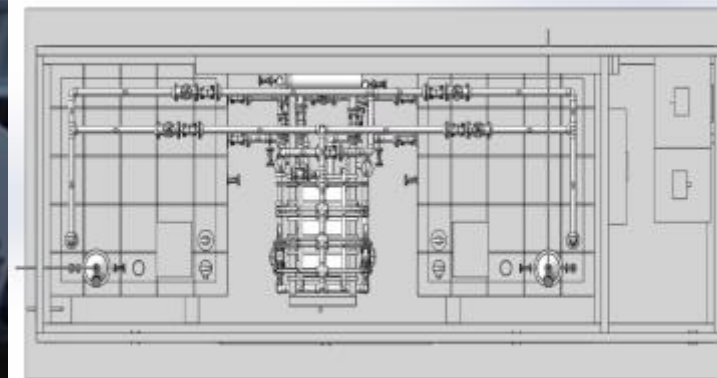
Adoption of advanced flow field and thin layer pole frame design effectively improves the efficiency of the battery, high efficiency of battery volume utilization, low cost, designed double contact sealing structure, sealing is safe and reliable, good stability of battery operation.

FLOW BATTERY ENERGY STORAGE SYSTEM



The energy storage system realizes the physical separation of electrolyte and electric pile, management and control system, integrates the electric pile, BMS, PCS, EMS, communication and monitoring equipment into the unit container, has its own independent power supply system, temperature control system, fire alarm system and other automatic control, connects the backstage monitoring system and the security system, and is more suitable for high-power, long-time and large-capacity energy storage.

PROJECT



Form of energy storage: All-Vanadium Redox Flow;

Project capacity: 50kW/200kWh;

Project location: Xi'an. Baqiao

Power source: Valley power from the grid

Maximum capacity: 300kWh

Utilisation: 0.4kV low-voltage grid connection

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THANKS



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塑造
可持续的未来