
# Global Energy Storage Market Outlook & Ampenol Inustrial Full Range of Products Solution Introduction

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Amphenol Industrial



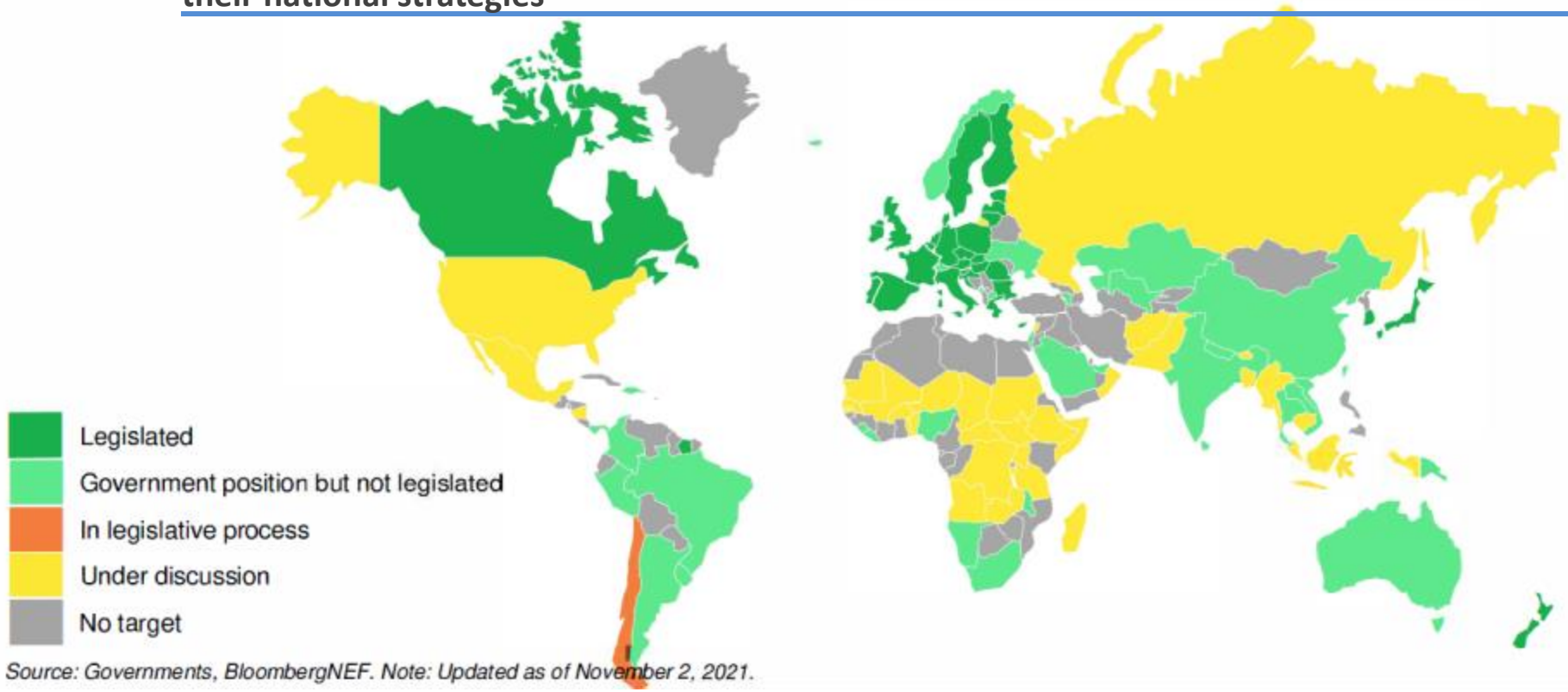
 


# 目录
# CONTENTS

PART 1

# Energy Storage Market Overview

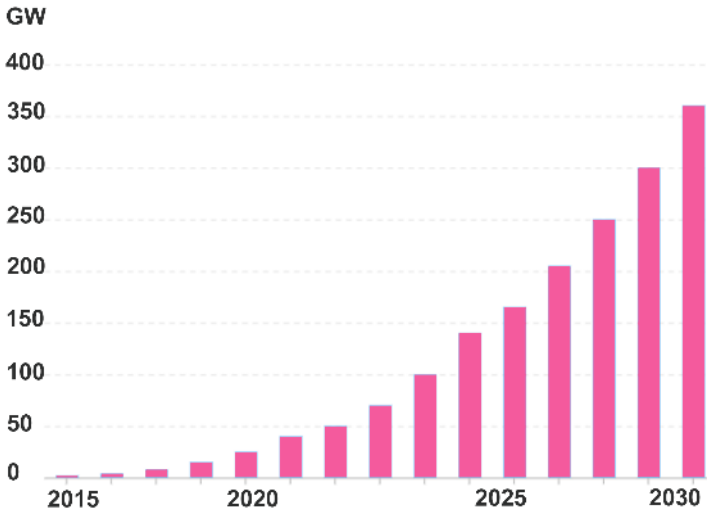
# More and more national governments are turning "Carbon Neutrality" into their national strategies



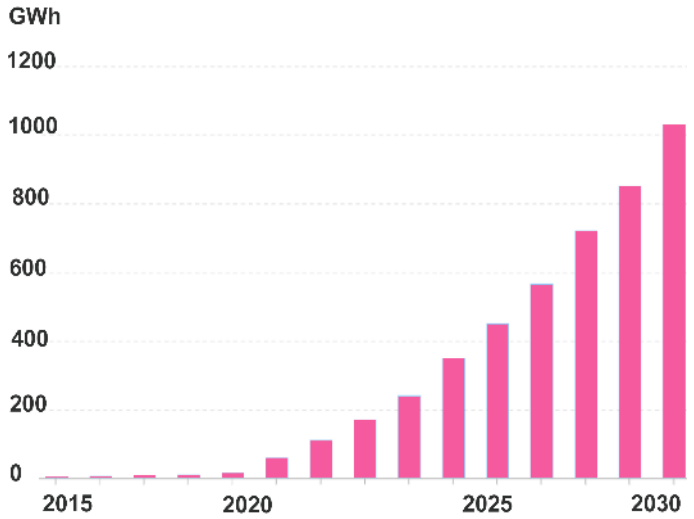

*Source: Governments, BloombergNEF. Note: Updated as of November 2, 2021.*

# The global energy storage market will achieve rapid growth in the next decades

## Based on Power Output

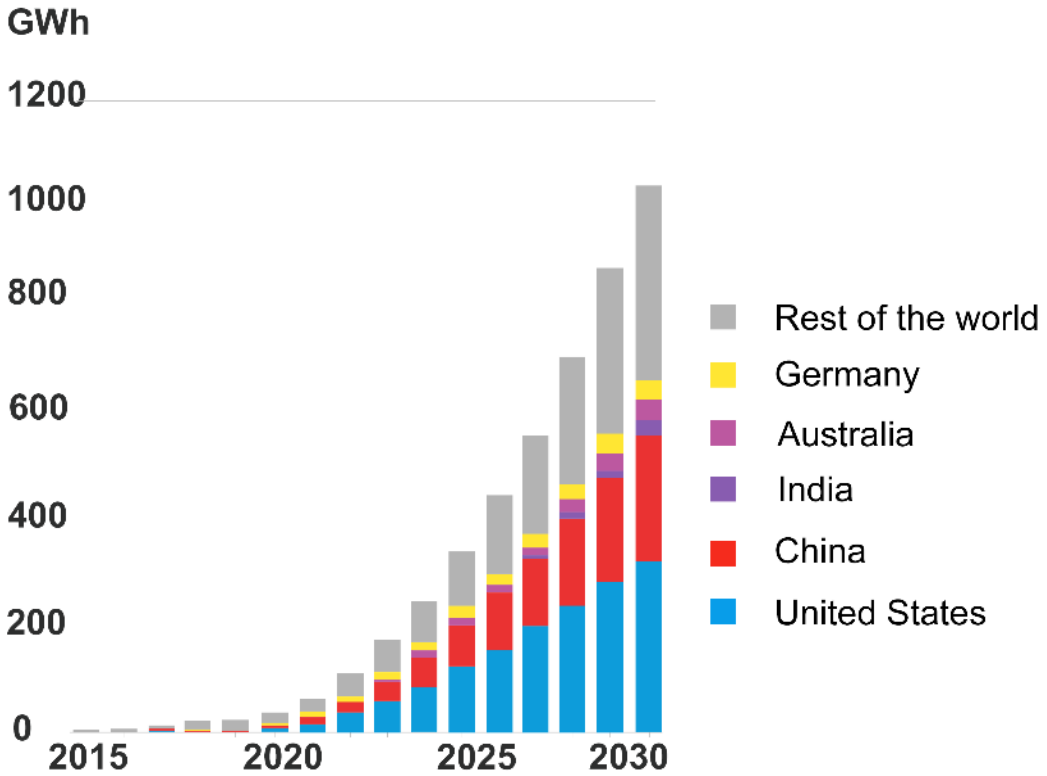



## Based on Energy Output




Source: *BloombergNEF*

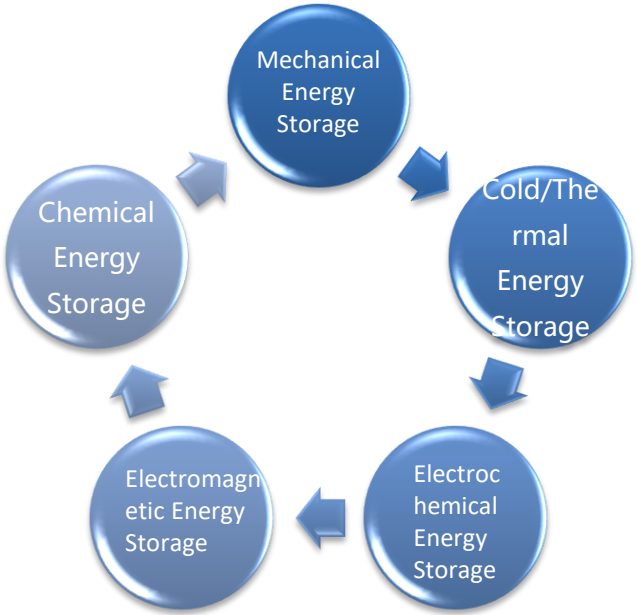
# The United States and China will be the major installed markets in the future

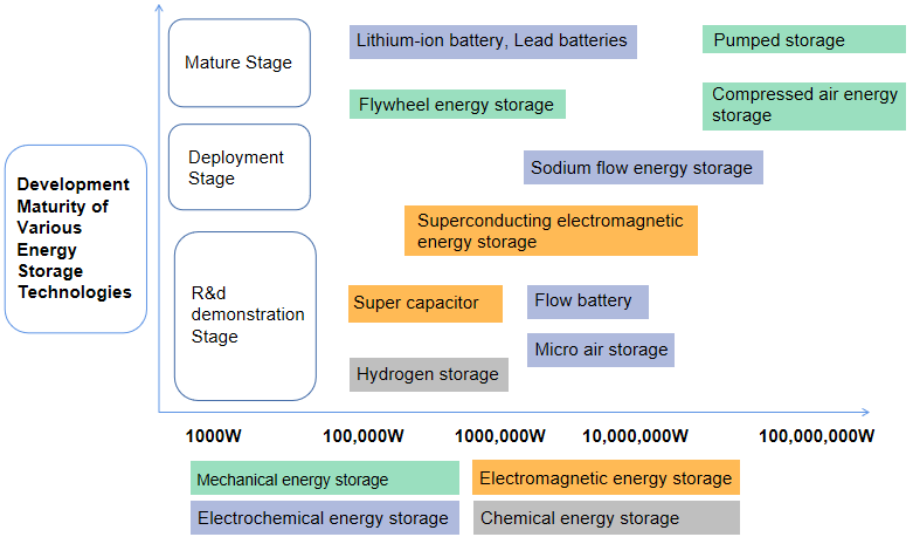



Source: *BloombergNEF*

# Energy Storage and Technology Classification and Development

- Energy storage refers to the process of storing energy through media or equipment and releasing it when needed.
- Energy storage methods include batteries, inductors, capacitors and so on. The role of energy storage is to realize the transfer of energy in time and space.
- The ultimate value of energy storage is to reduce the life cycle cost of energy transfer




Source: International Energy Agency *"Energy Storage Technology Research Report"*, *"Electricity Storage in Renewable Energy: The Cost of 2030 in the Market* " Chemical Industry, LEK. Research and Analysis

# Application of Energy Storage System

## Power Generation Side

- The load regulation
- Smooth intermittent energy
- High-tech energy consumption
- Increase grid reserve capacity
- Frequency modulation

## Transmition and Distribution Side

- Improve power quality
- Reduce line loss
- Increase the reserve capacity of the grid
- Improve the efficiency of transmission and distribution equipment
- Delay the demand for capacity expansion

## The user side

- Improve energy consumption on the user side
- Peak shaving & valley filling, load transfer
- Suppress load and demand
- Reduce power cost
- Provide power supply reliability and quality

PART 2

# Electrochemical storage and system Introduction

# The reasons for choosing electrochemical energy storage

## Advantages of electrochemical energy storage

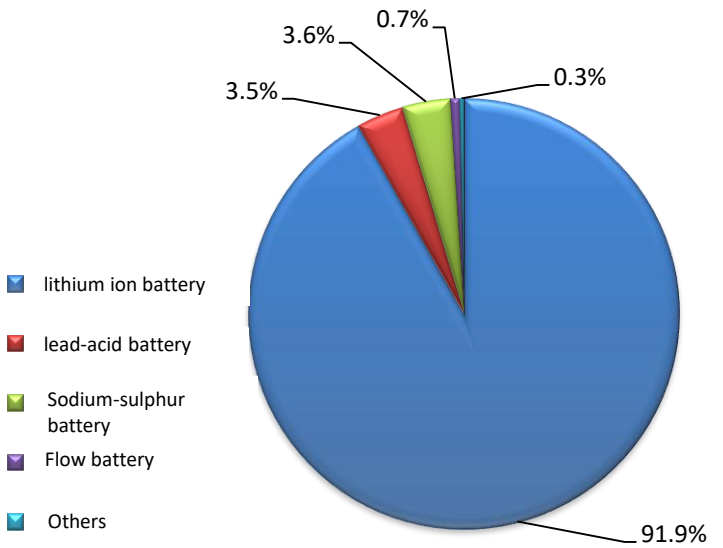
- Fast response
- Flexible configuration
- Precise control
- Wide range of applications

-Covering all aspects of generation, transmission, distribution, delivery and use

## The cost performance of energy storage batteries has improved in recent years

- The decline in battery prices, LFP battery:$0.16~0.23/WH
- Improved cycle life, LFP: 6000-10000 times

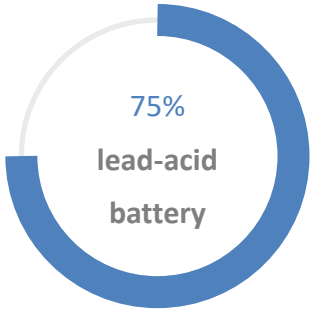
**Types and market share of global electrochemical energy storage (%)**

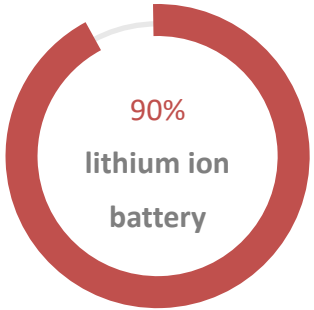


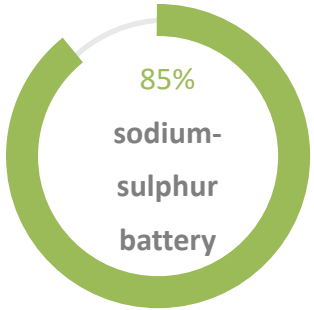

Electrochemical energy storage is a relatively mature technology type. Compared with mechanical, thermochemical, and chemical energy storage, electrochemical energy storage has been widely used in the energy storage market due to its mobility and ease of operation.

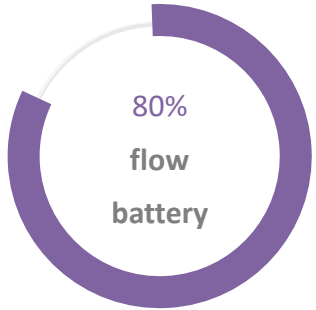
# Comparison of Electrochemical Energy Storage Batteries

- Chemical batteries for energy storage mainly include lead-acid batteries, lithium-ion batteries, liquid flow, sodium-sulfur batteries, etc.
- Considering energy density, cost, life cycle, safety and other factors, lithium ion battery is the mainstream technology at present




S

- Mature technology
- Simple in structure
- Low cost
- High efficiency

- High energy storage density
- high power density
- High efficiency；
- Rapid technological progress
- Relatively complete industrial chain

- High energy density
- Easy to get raw materials

- Long battery life
- High capacity
- Mature technology
- High safety performance

W

- Low energy density
- Short lifespan

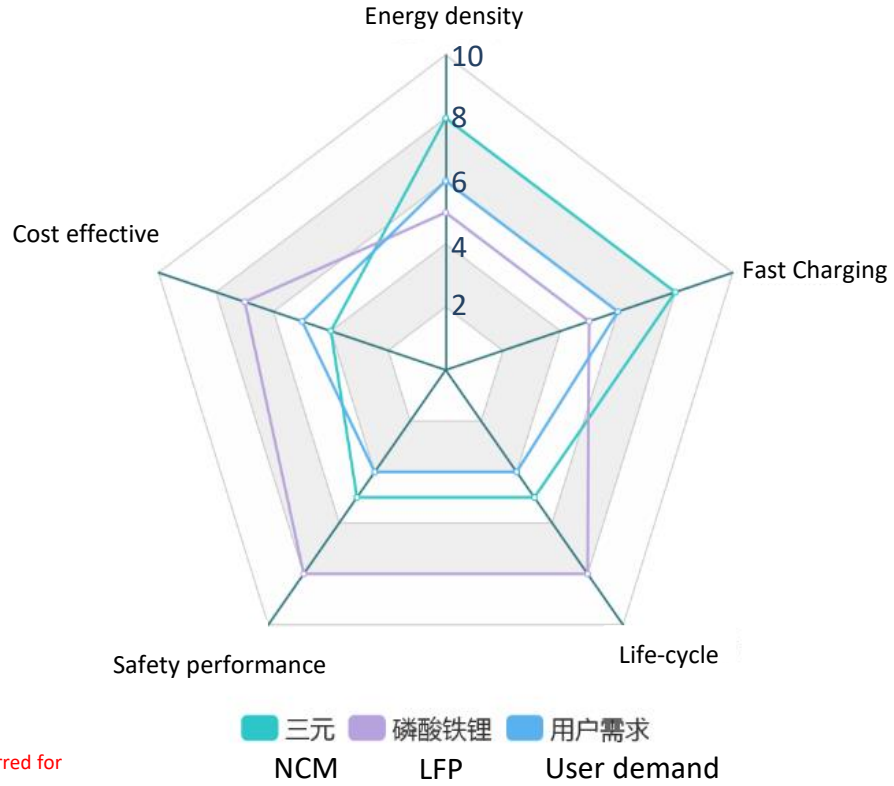
- Heating problem
- potential risk on safety

- Potential risk of flammability
- High cost

- Low energy efficiency
- High requirements for ambient temperature
- Low reliability

# Comparison of Battery Material Properties

| Material | Lithium iron phosphate | Ternary lithium electricity |
|---|---|---|
| Abbbreviation | LFP | NCM |
| Battery cell gauge voltage（V） | 3.2 | 3.6 |
| Energy density (Wh/kg) | 120-170 | 160~200 |
| Operating tempreature（°C） | -20-75 | -30-65 |
| Environmental issues | N | Y |
| cycle life（Times） | >5000 | 800~2000 |
| Safety | High | Lower |
| Cost | Lower | Higher |
| Strength | High safety，enviromental and long-life | Stable electrochemical performance, good cycling performance |
| Weakness | Poor low temperature performance,<br>Low discharge voltage | Part of the metal cobalt is used, which is expensive |
| Application | Energy storage battery,Power battery | Power battery |




Conclusion: Based on the above performance comparison, lithium iron phosphate batteries are preferred for electrochemical energy storage.

# Concepts Related to Electrochemical Storage

## Related Concepts

Cell voltage

System voltage

Ah

0.25C/0.5C/1C

KWH

48V

1500V

100Ah

0.25C ESS

280Ah

0.5C ESS

1C ESS

125KW/500KWh

372KWh

2.8MWh

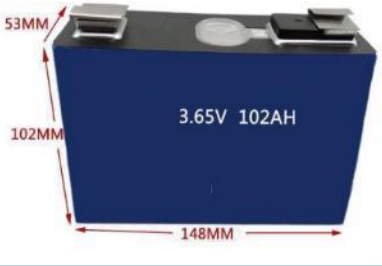
# Concepts Related to Energy Storage Batteries

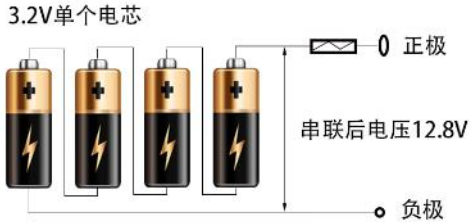
## Composition of battery system

**Cell** **Module** **Battery pack** **Energy storage cabinet**

Single cell voltage(V)：
LFP: Normal is 3.2V, higher is 3.65V, lower is 2V
NCM: Normal is 3.6~4.3V

Battery pack voltage(V) : The battery voltage is composed of the series cell voltage
For example, 12V is a series of four 3.2V cells
3.2V+3.2V+3.2V+3.2V=12.8V

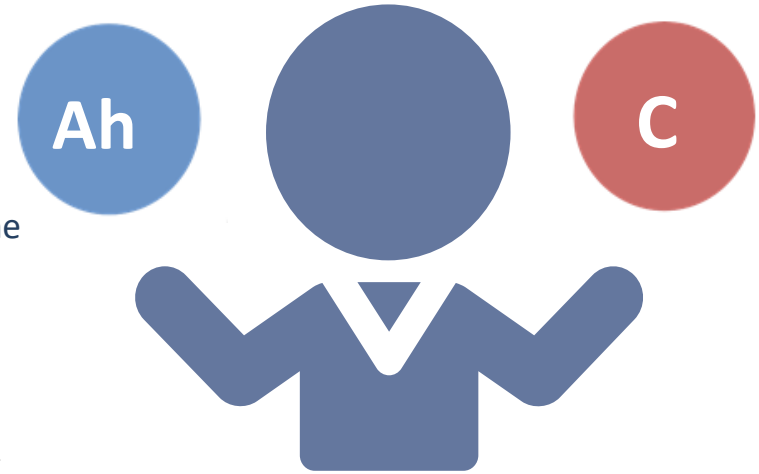


# Concepts Related to Energy Storage Batteries

**Ah： Ah is a unit of battery capacity**

It can be simply understood as: 1Ah refers to the amount of electricity, which means that the discharge with a current of 1 ampere can continue to discharge for 1 hour




**C：** Battery charging and discharging rate, a measure of how fast the battery is charged and discharged

**1C** means that the capacity of the battery is fully charged or discharged in 1 hour

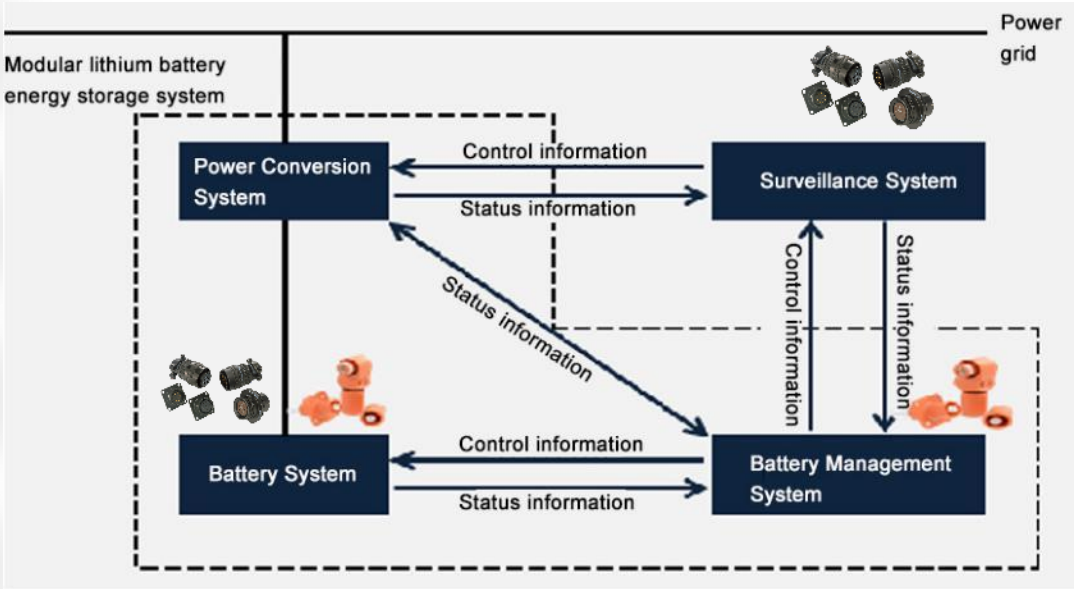
**0.5C/1C** charging and discharging refers to 0.5 times or 1 times the battery capacity, such as the battery is 300Ah, 1C current is 300A, 0.5C current is 150A

| Cell Type | Residential ESS | Commercial&Industrial ESS |
|---|---|---|
| Typical cell Ah type | 30 Ah<br>50 Ah<br>100 Ah | 100 Ah<br>150 Ah<br>280 Ah<br>300 Ah<br>320 Ah |

# Battery Energy Storage System

BESS

- Battery System
- Power Conversion System
- Energy Management System
- Monitoring System



PART 3

# Amphenol Connectors Applicatoin

# Energy Storage System Application

Residential ESS


Industrial/ Commercial ESS

Mobile ESS

Datacom ESS

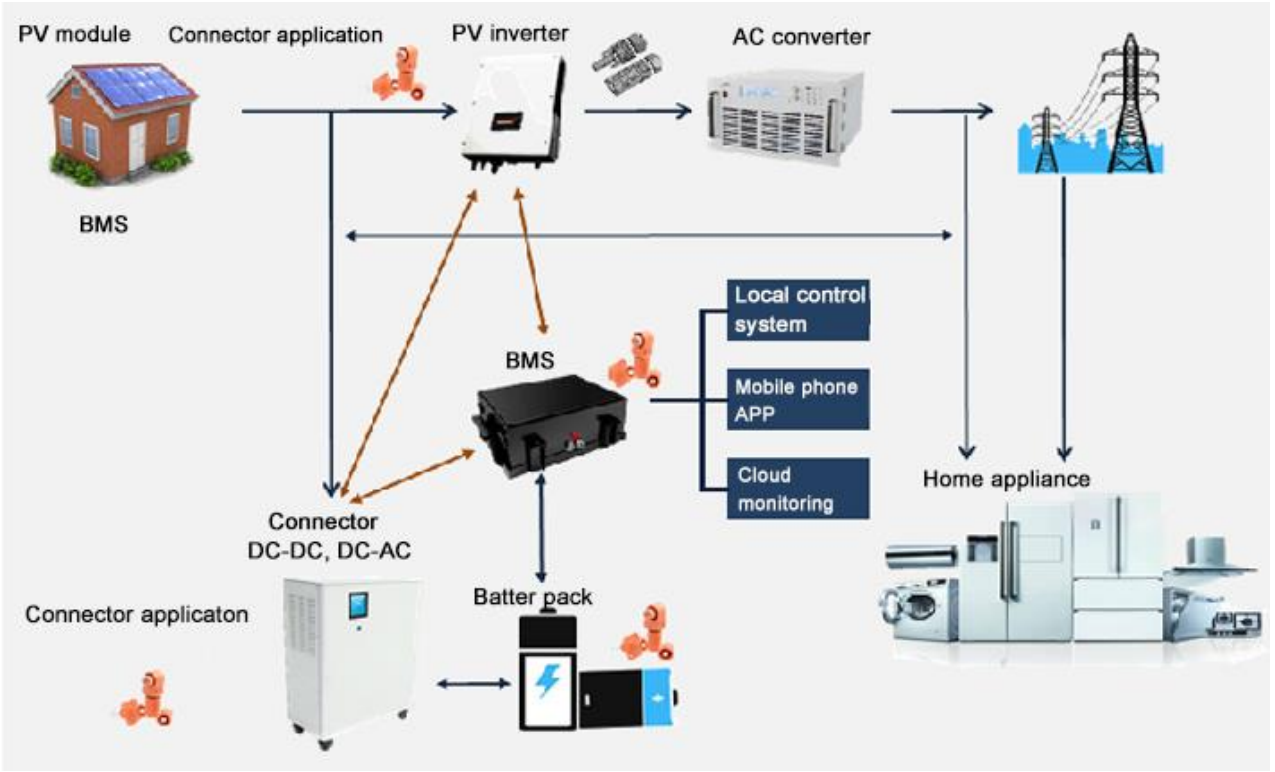


# Residential ESS Application

H4/H4+

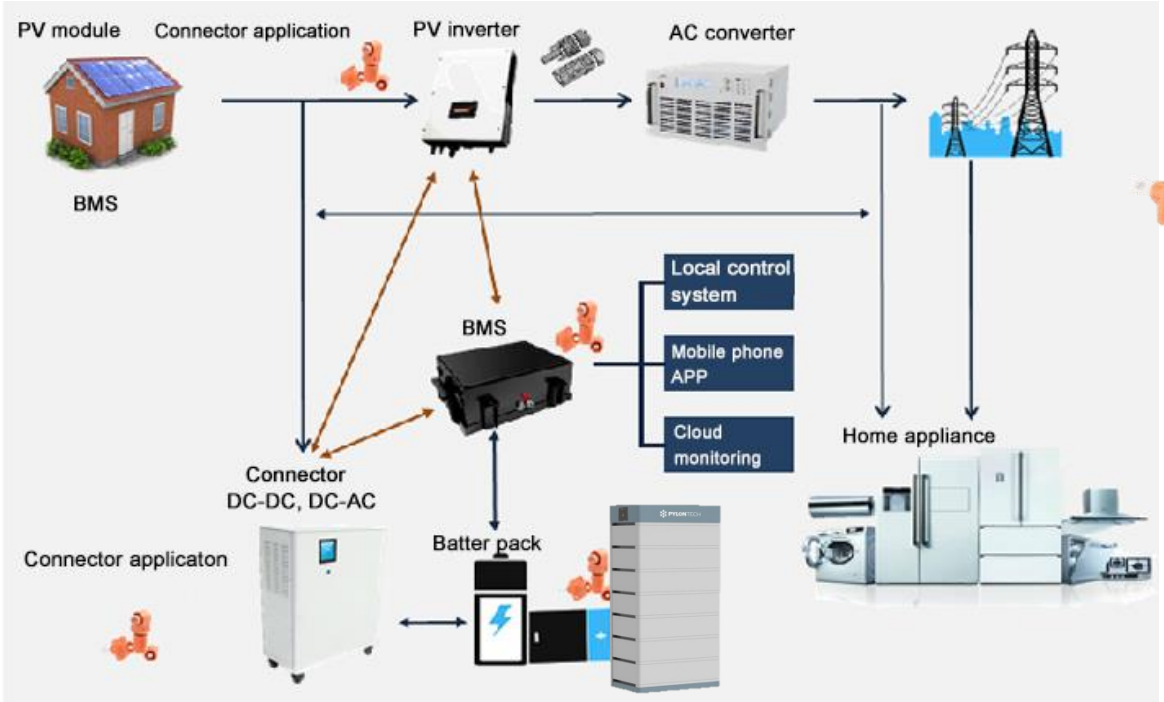
Surlok Plus




Amphe-PRB

Gland

# Residential ESS Application




55A MAX.(2.5-10mm2)

70A MAX.(6-10mm2)

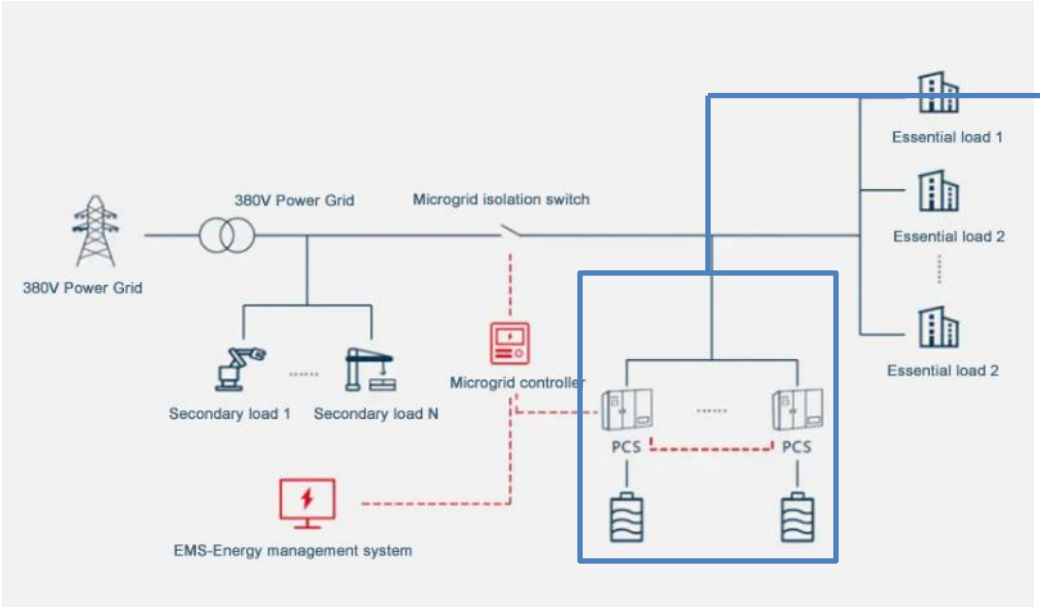
120A MAX.(16-25mm2)

Straight 180°

120A MAX.(16-25mm2)

Right angle 90°

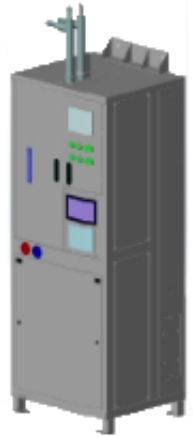
# Industrial/Commercial ESS Application





Battery cluster

PCS



Liquid cooling system

# Industrial/Commercial ESS Application

**Battery-Battery system**

High-voltage box

Surlok Plus

350A MAX.(35-120mm2)

ATC

Battery

Busbar

350A MAX.

LPT

PT



# Industrial/Commercial ESS Application

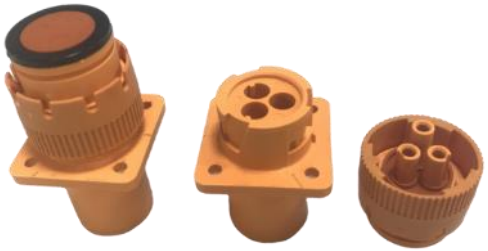
## PCS-Energy storage converter

POWER

Surlok plus 10.3

Surlok plus 8.0

SIGNAL

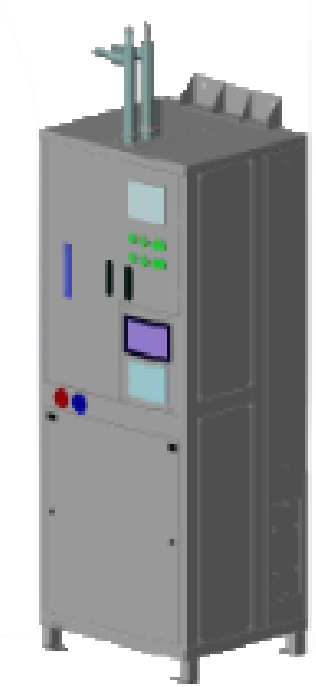


ATC

LPT

# Industrial/Commercial ESS Application

## Liquid Cooling System



PT

LPT

Tru-loc

Amphe-PD

# Industrial/Commercial ESS Application

## Application Trend Discussion

### 1000V VS 1500V

1500V

1000V

- PV：
  Lower cost per watt $ 0.02-0.03
- Energy Storge：
  System cost lowered down10%+
  Energy density improved 35%+
  Cycle efficiency improved 0.6%+
  Power density improved 38%+

### Air cooling VS Liquid cooling

- Balance the internal temperature distribution of the system
- Increase battery cycle life

IP67

PART 4

# Amphenol Connectors Overview

## Amphenol Brand

Amphenol Industrial

**High Current Solutions**


RADSOK®
patent technology

**Harsh Environment Application**

Various of product series
Industrial harsh enviroment application

**High Reliability Solution**

High reliability solution

2rd

The world's second largest connector manufacturer

20Y+

More than 20 years serving for the new nergy industry

90Y

Established in 1932

37Y+

Global localization
Entered China in 1984

# Development History of Amphenol Energy Storage Connectors

## 2016

Patent Certificate gained for Energy Storage Connector

## 2020.9

Signed a Strategic Cooperation Agreement with TUV Rheinland

The world's first TUV Rhine Energy Storage Certification - 2PfG 2740

## 2006

The first ESS product Surlok lanuched

## 2020

SurLok Plus 1500V/300A

Product launched

More than **14 Millions** PCS sold up to now

## 2015

Surlok Plus 120A

was used on the customer side

## 2018

Gained UL1977 certificate

## 2021.6

1500V Surlok Plus

Gained UL4128 certificate

## 2021

350A product launched



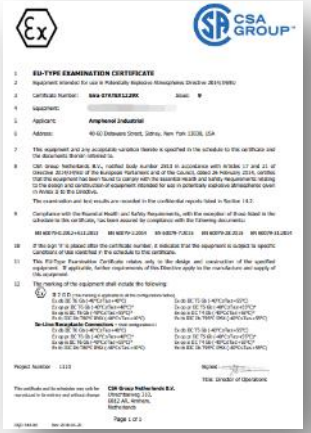
 

# Amphenol Globalization

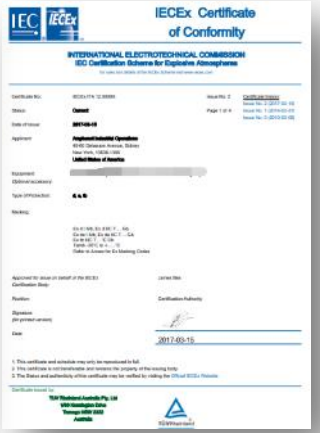

Amphenol provides energy storage solutions to global partners covering North America, Europe and Asia.

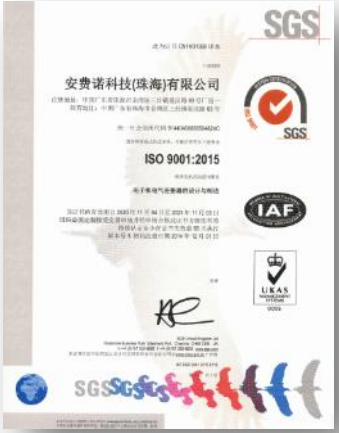
# Amphenol Industrial System Certificate


CERTIFICATE OF COMPLIANCE


EU-TYPE EXAMINATION CERTIFICATE


Zertifikat Certificate


IECEx Certificate of Conformity


ISO 9001:2015



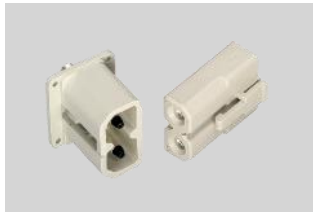
# ESS related connectors Overview


Surlok Plus™


RADSERT


Surlok


RadFlex


Amphe-PD

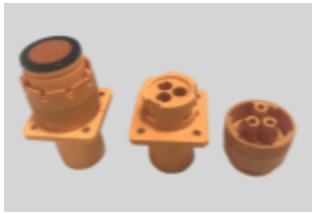

M12


Tru-loc Series


UPT Series


LPT Series


PT Series


ATC Series


5015 Series


RJ45


Terminal Block


H4 Plus

# Energy Storage System Connectors

## ESS Product Series -SL+ (SurLok Plus™)

1500 VDC

50-70A

**SL+ 3.6mm**

1000 VDC

1500 VDC

70-120A

**SL+ 5.7mm**

1000 VDC

1000 VDC

1500 VDC

120-200A

**SL+ 8.0mm**

1000 VDC

1500 VDC

1500 VDC

200-300A

**SL+ 10.3mm**

1500 VDC

300-350A

**SL+ 12mm**

1500 VDC

350-500A

**SL+ 14mm**



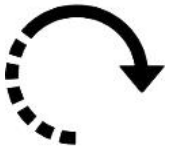
 

# Energy Storage System Connectors

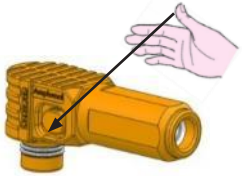
## ESS Product Series-SL+ (SurLok Plus™)

| | |
|---|---|
| Keyway | Multiple keyways |
| Lock | Quick lock and press-to-release design |
| Plug | 360°rotating plug optional |
| Receptacle | Various terminatio options(Thread， Crimp，Busbar) |
| Voltage | 1000VDC/1500VDC optional |
| Protection | Touch Proof |
| Design | Compact robust design |

- R4 RADSOK® high current patent
- Thermoplastic material housing, RoHS compliant
- IP67 waterproof (mated)
- UL 1977/4128/TUV 2PfG2740

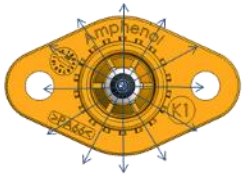


Rotation



Quick lock and Press-to-release

1000/1500VDC



Multi-directional outgoing

UL 1977
UL 4128

TUV 2PfG 2740

# Energy Storage System Connectors

## ESS Product Series-PT/LPT

| | |
|---|---|
| Current Rating | 20# contact 7.5A, 16# contact 13A, 12# contact 23A |
| Voltage Rating | 1500VDC+ |
| Working Temperature | -55º~+125º |
| Contact Type | Solder/Crimp |
| Voltage | 1000VDC/1500VDC optional |
| Durability | 500 cycles |
| Wire Guage | 24AWG-4AWG |

- Quick positive bayonet coupling
- More than 60 insert patterns
- UL certified for full series product
- Multiple shell plating options
- RoHS compliant
- Customized service






# Energy Storage System Connectors

## ESS Product Series-ATC

| | |
|---|---|
| Number of Contacts | 3/5/9 |
| Current Rating | 13A MAX. |
| Working Temperature | -55º~+125º |
| Receptacle | Various terminatio options(Thread，Crimp，Busbar) |
| Voltage Rating | 250VAC/360VDC |
| Mating Cycle | 100 cycles |
| Wire Guage | 24AWG-18AWG |

- Two colors optional，orange and black
- Reverse bayonet coupling - quick mating and unmating
- Environmentally sealed - sealed against moisture and contaminants
- Cost effective
- Jam nut and square flange mounting styles solution
- RoHs compliant

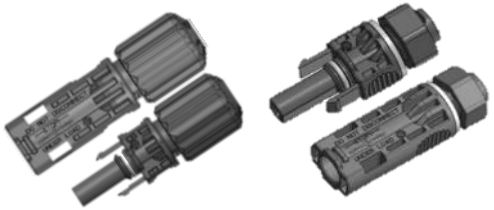




# Energy Storage System Connectors

## ESS Product Series-H4 PLUS

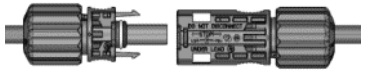
| Item | Spec. |
|---|---|
| Voltage Rating | UL6703 1500V DC / IEC62852 1500V DC |
| Current Rating( IEC @85℃) | 25A (2.5mm²/14AWG), 35A(4.0mm²/12AWG), 45A(6.0 mm²/10AWG), 55A(10.0mm²/8AWG) |
| Current Rating (UL) | 15A (14AWG), 20A(12AWG), 30A(10AWG), 50A(8AWG) |
| Rated Pulse Voltage | 16KV (IEC) |
| Contact Resistance | ≤ 0.25mΩ （stamped forming），≤ 0.2mΩ （cold heading forming） |
| Insulation | Thermoplastic plastics (PC/PA) |
| Contact Material | Copper alloy, tin plating |
| Contact Option | Stamped forming/Cold heading forming RADSOK® contact |
| Protection | IP68（1m, 24h） mated |
| Flammability | UL94-V0 |
| Wire Size Range | Ø5.0mm~Ø8.7mm |
| Ambient Temperature Range | -40℃ ~ +85℃ |
| Permissible Limit Temperature Range | 120℃ |
| Features | Compatible with UTX and H4; Long-term reliability and corrosion resistance; Stable withstanding voltage and Good insulation performance |



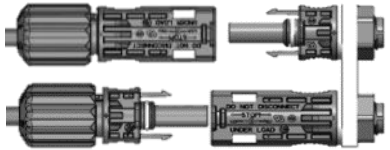
B 107201

E339277

Wire to Wire



Board to Board





# Energy Storage System Connectors

## ESS Product Series -RJ45 & M12

| Item | RJ45 Spec. | M12 Spec. |
|---|---|---|
| 孔位 | RJ45 8P8C | A-Code 8P |
| Transmission Rate | CAT5(100Mbps) CAT5e(1000Mbps) | |
| Standard | TIA/EIA 586B, IEC11801 | |
| Current Rating | 1.5A(Single pin) | 2.0A(Single pin) |
| Dielectric strength | 1kVdc | 0.8kVdc |
| Contact Resistance | < 10 mΩ | < 10 mΩ |
| Insulating Material | Thermoplastic plastics (PA/PC) | Thermoplastic plastics (PA) |
| Contact Matertial | 铜合金 镀金 | |
| Protection | IEC 60529 IP67 | IP 68(1米水深,24小时) |
| Flammability | UL94 V0(垂直燃烧) | |
| Anti-vibration | EIA 364-28 | EN61373 & SAE J2839 |
| Design Criterion | IEC 60603-7 | IEC 61076-2-101 |

# Energy Storage System Connectors

## ESS Product Series-Terminal Block

| Item | TJ 5.08 | V8 5.08 |
|---|---|---|
| Image |  |  |
| Pitch | 5.08 | 5.08 |
| Number of Pin | 2P-24P | 2P-24P |
| Rated Value | 300V 12A | 300V 12A |
| Wire Guage | AWG 12-24 | AWG 12-24 |
| Part Number | TJxx51530000G | V8xx51500000G |
| Certificate | UL, TUV, VDE | UL |


# Thank you!

Reach us via sales@amphenol-industrial.com or tech@amphenol-aio.com for more informaiton

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