



# Sungrow ESS: Technology to stabilise the grid

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2022



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European System Solution Senior Manager

**SUNGROW**

Clean power for all



**Moderated by  
Andy Colthorpe**  
Editor

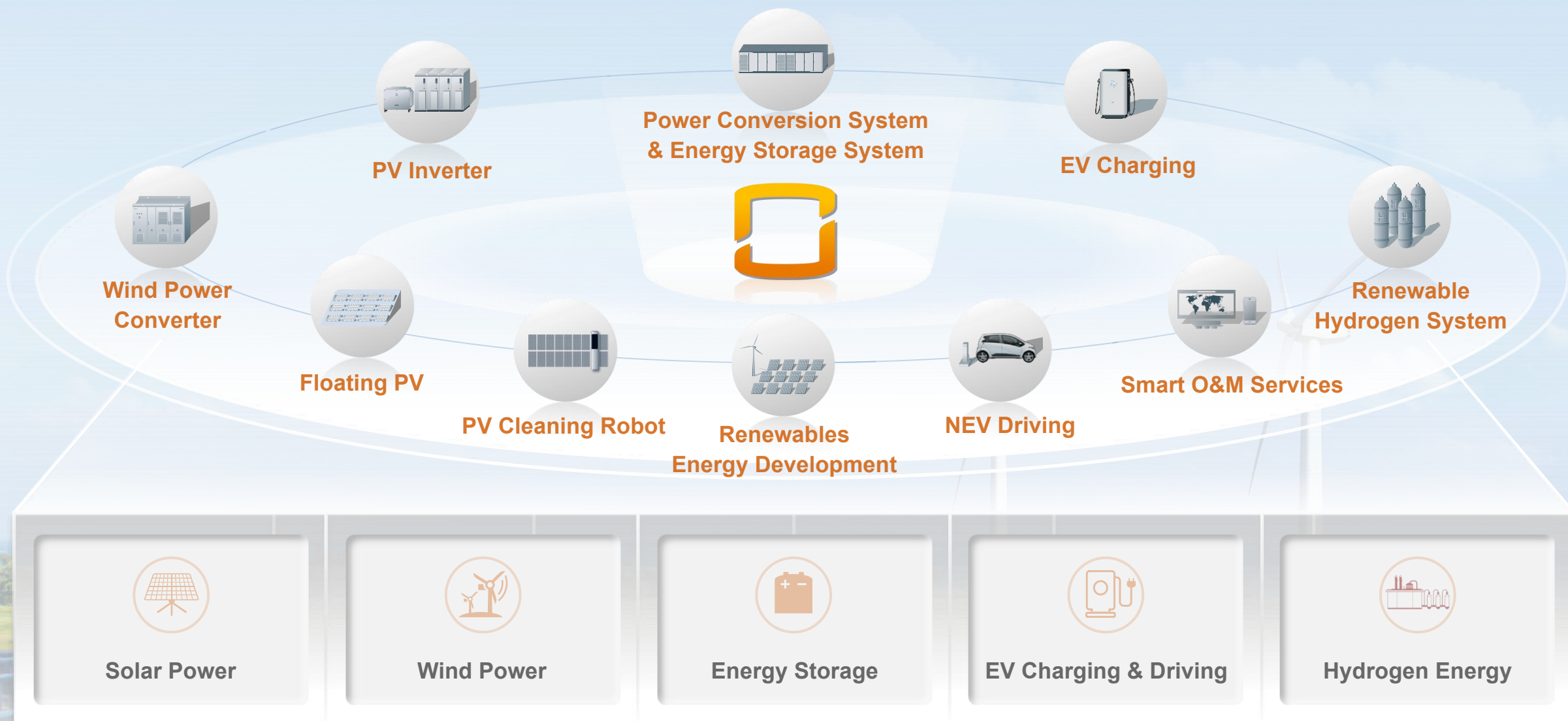


# Sungrow ESS: Technology to stabilize the grid





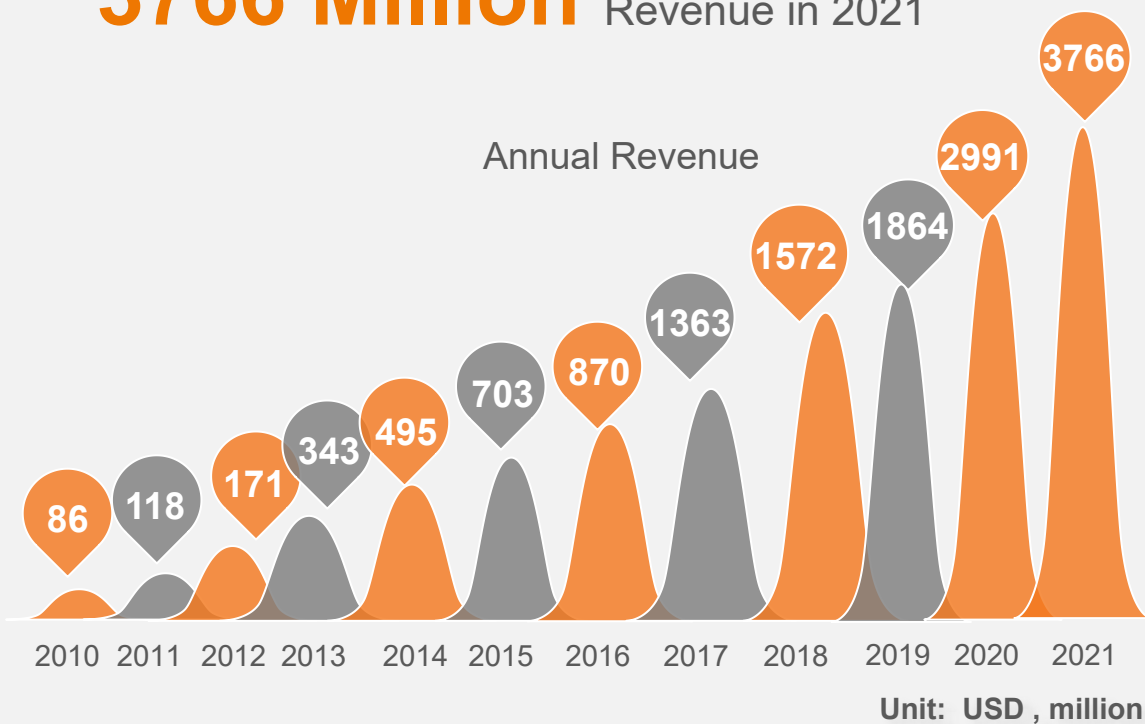
# A BUSINESS PRESENCE IN GREEN ENERGY MARKET



# ROBUST PERFORMANCE OVER THE PAST DECADE

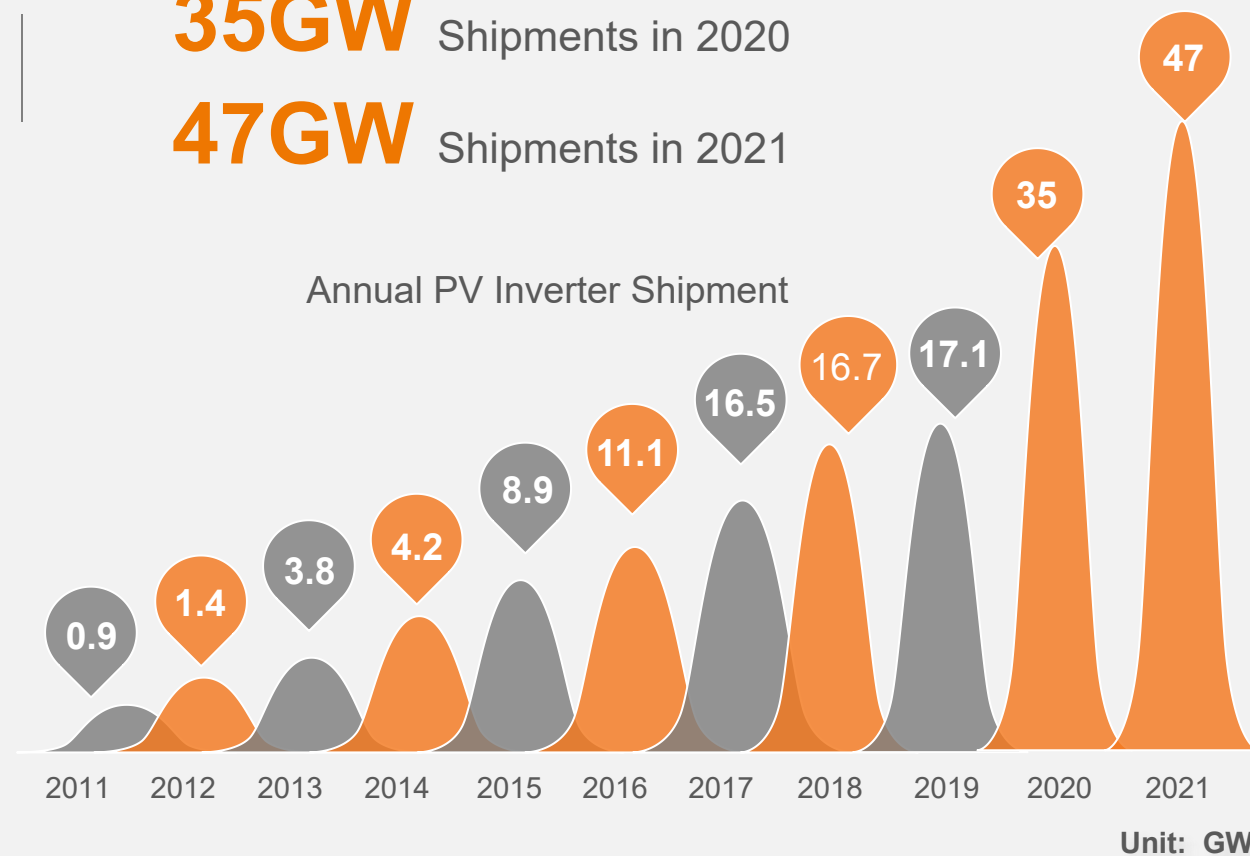
**36%** Compound Annual Growth Rate

**3766 Million** Revenue in 2021



**35GW** Shipments in 2020

**47GW** Shipments in 2021





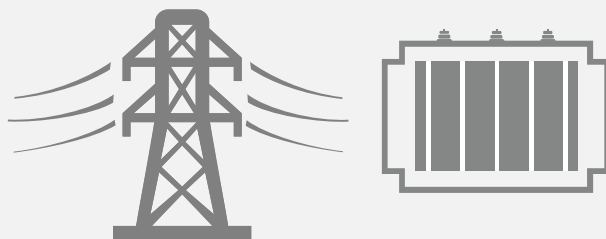
# ESS Application Scenarios

## Front the Meter



- Ramp rate control of new energy
- Energy shifting, reduce photovoltaic power generation limit
- Thermal power/Hydropower/PV/fuel/storage energy combined frequency regulation
- **Black start**

## Utility Side



- Delay transmission and distribution investment and upgrade
- Relieve electric power circuit congestion
- **Frequency and voltage regulation**
- **Ensure stable power supply when grid failure**

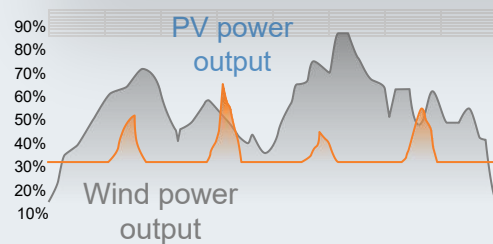
## Behind the Meter



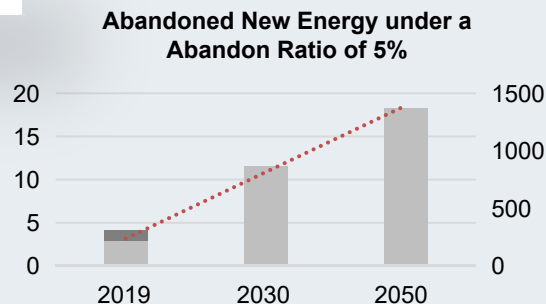
- **Peak & Valley Arbitrage**
- Micro-grid
- Increase self consumption rate
- Demand Management

## Innovative Power Systems Have Higher Requirements for Grid-connection of ESS

### Power Generation Side

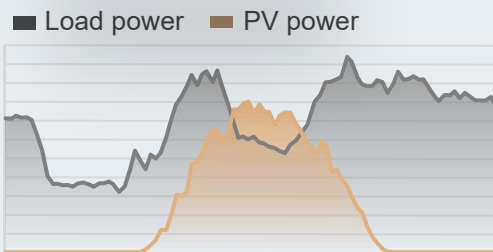


The unpredictability and fluctuation of new energies bring **challenges to the power balance and safety of electricity systems.**

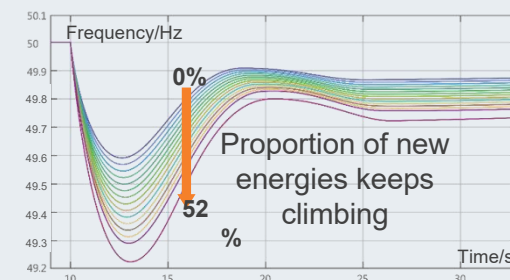


Increasing proportion of new energies is **making power consumption more and more challenging.**

### Grid Side



Increasing gap of peak and valley load **requires higher current-carrying capacity and adds to the peak regulation pressure of grids.**



New energies are causing **greater fluctuation to the grid voltage and frequency.**

## Meet Requirements of Innovative Power Systems

1

### High grid adaptability

- LVRT, HVRT, without disconnecting from the grid
- Stable operation in weak power grids with an **SCR = 1.018**

2

### Active Support for Grid

- **20 ms** quick response
- VSG technology

3

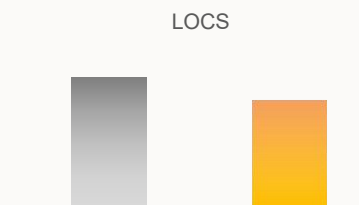
### Off-grid Support

- Black start (MW level)

# BESS Challenges



CAPEX



OPEX



SAFETY





# Liquid-cooled ESS

Lower LCOE

ST2752UX

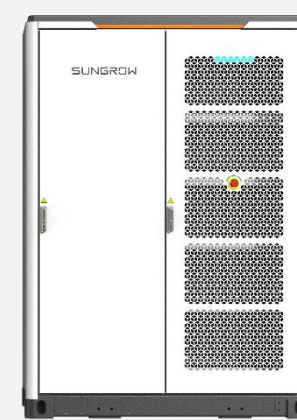
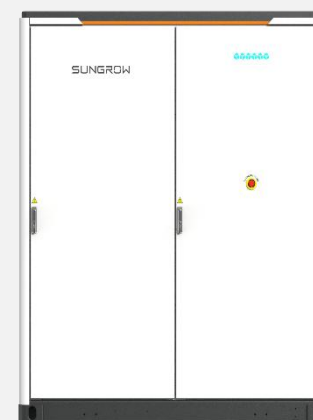
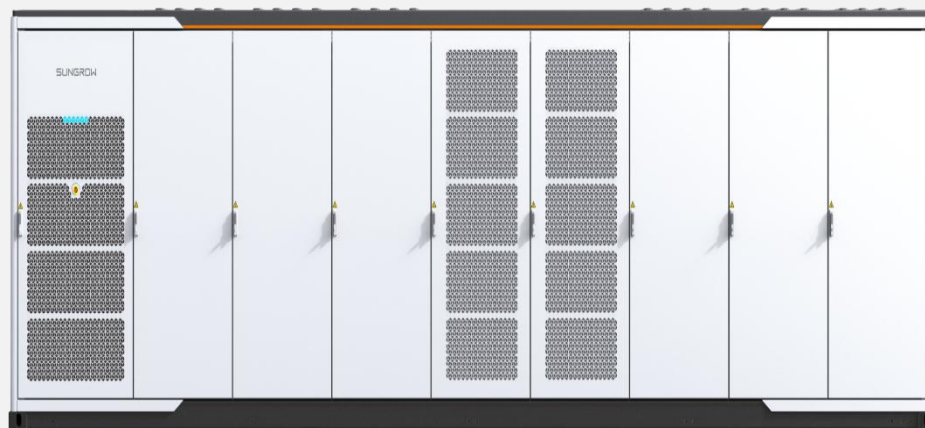
ST500CP

SC50HV\*5

3000CP

Comprehensive  
Safety  
Protection

Reliably Support  
Grid



## Frequent Accidents

More than 50 fire issues have happened worldwide in the past 10 years.



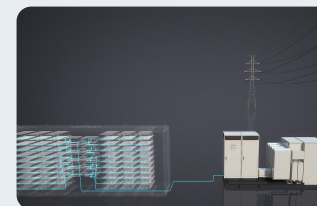
### Main causes



- System integration
- Protective design
- Alarm delay  
eg: cell failure
- Thermal runaway

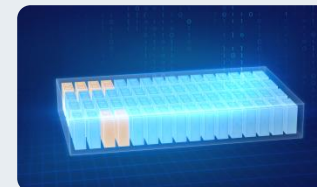
## Comprehensive Safety Protection

### Power Titan & Power Stack



#### Professional Integration

The entire system is independently designed and manufactured by Sungrow, with unified design, unified safety standards, and unified control logic, providing end-to-end guarantee.



#### Cell Health Monitoring

Calculate the voltage, SOC, lithium plating and other data during cell operating, monitor cell safety in real time, and give early warnings.



#### Electrical Safety Protection Design

Multi-level electrical breaking design, achieving current breaking within microseconds and reducing the overcurrent risk on the DC side.



#### System Fire Safety Design

Meet the North American NFPA855/69/68/15 design requirements, effectively preventing thermal runaway and reducing system loss.

\* Source: chuneng.bjx.com.cn

# Lower LCOE



## Efficient operations

- Low auxiliary power consumption  $P_{\text{aux}} < \sim 40\%$
- High efficiency temperature control  $T \leq 3^{\circ}\text{C}$
- Intelligent rack management, boost system discharge by 7%



## Smart O&M

- Support mixed use of old and new batteries;
- Saving O&M cost



## Easy installation

- Single side door design and back-to-back installation support
- Early installation and commissioning 50%



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## High LCOE

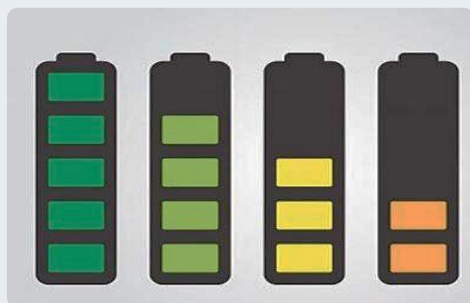
Large **area**, high installation **cost**



High thermal management **power consumption**, short battery **service life**



Inconsistent **charge and discharge**



Difficult **O&M**



## Innovative Integration, LCOS Down by 20%

**Occupied area down by 32%**



**Smaller area**

Single door and open from front  
Support back-to-back and side-by-side layout

**Service life extension**



**Auxiliary Power Consumption**



**Lower consumption, longer service life**

Intelligent liquid-cooling temperature control  
Extreme even heat dissipation

**Boost Discharge by 7%**



**High discharge capacity**

Cluster-level management  
Energy efficiency optimization with MEPT

**O&M cost**



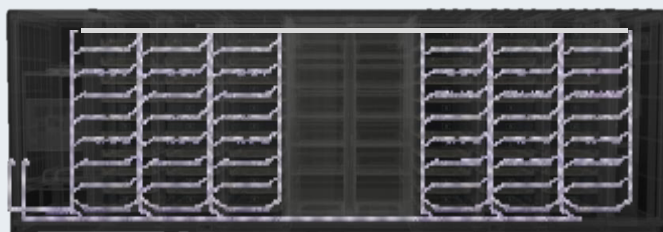
**Smart O&M**

SOC auto balancing  
Easy system upgrade

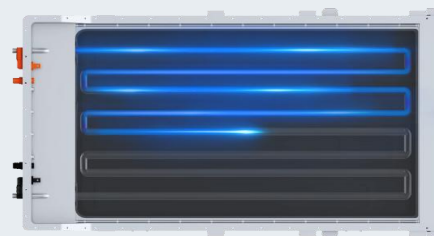
# 10% Longer Battery Service Life, 14% Higher Discharge Capacity

1

## Automated Flow Control



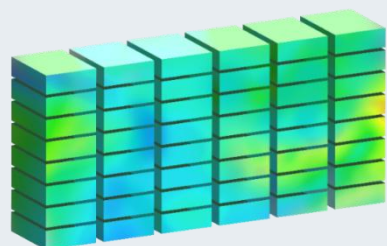
System-level pipe:  
automatically controls temperature on every rack



Pack-level pipe:  
even heat dissipation of all cells

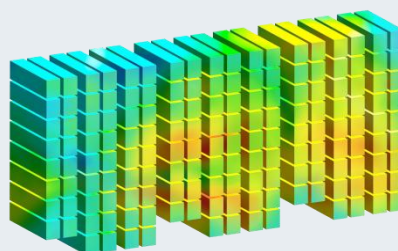
2

## Heat dissipation



Cell temperature difference of  
Power Titan& Stack  $\leq 3^{\circ}\text{C}$

VS.



Cell temperature difference of  
conventional ESS  $\leq 10^{\circ}\text{C}$

Battery service life

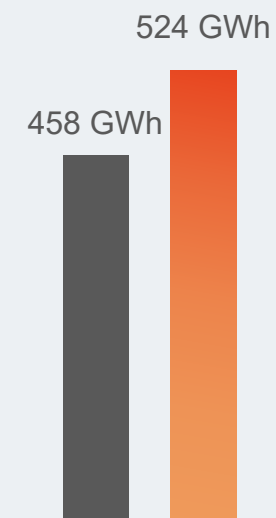
▲ 10%



Conventional thermal management    Intelligent liquid-cooling temperature control

Discharge capacity

▲ 14%

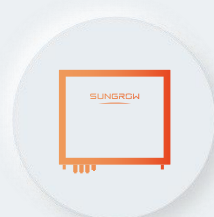


Conventional thermal management    Intelligent liquid-cooling temperature control

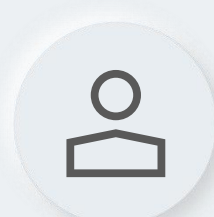
Remarks: 100 MWh, 0.5C, 1 cycle per day, 65% EOL

# Smart O&M, Cutting 80% of Manual O&M Workload

## SOC Auto Balancing: No Need for System Shutdown or Manual SOC Calibration

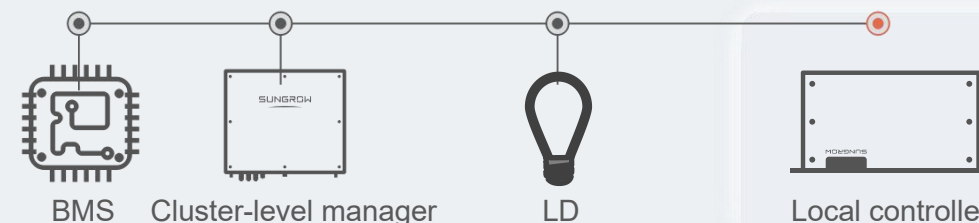


**PowerTitan:**  
Automatic SOC  
calibration



**Traditional:**  
Manual SOC  
calibration

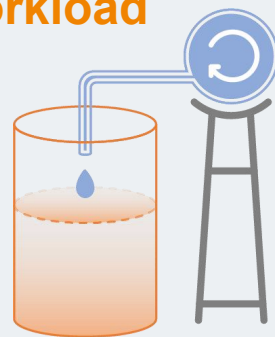
## Easy System Upgrade: 90% Less Upgrade Workload



- The local controller supports batch upgrade for all units of the ESS.

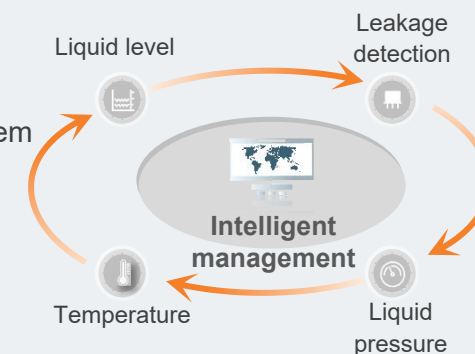
## Dynamic Coolant Replenishment: 60% Less Replenishment Workload

- No need for frequent manual coolant replenishment
- Keep the optimal heat dissipation



## Online Monitoring: 30% Less Inspection

- Online monitoring of liquid-cooling system
- Timely warning of liquid leakage



\*100-MWh project

Public



# Comprehensive Safety Protection

## ✓ Cell safety

- Prevent thermal runaway.

## ✓ Electrical safety

- Precisely identify and quickly break the faulty current.
- Short circuit current.
- Lower the arcing energy to reduce the personal safety risk.
- Separate battery compartments to avoid the spread of thermal runaway.

## ✓ System safety

- Detect fires at the earliest stages and activate fire suppression systems.
- Improve liquid-cooled ESS safety from multiple level.



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# Precisely Identify and Quickly Break Fault Current to Reduce Damages



## Multi-level Current Control

Lower short circuit current by 2/3



## Multi-level Protection

Quicker and more sensitive



## Less Loss

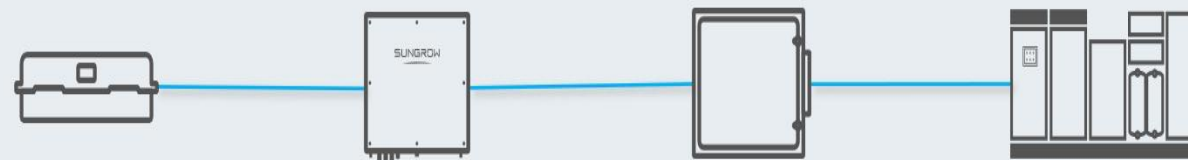
Reduce fuse damages

  
Break the busbar in the pack  
Quick isolation

  
MEPT built-in fuse  
Short circuit protection for connection lines

  
Combiner box fuse  
Busbar short circuit protection

  
DC-side fuse of PCS  
Own short circuit protection



Corrosion

Damp

Insulation damage

Insulation aging

Loosened connection

Poor contact

High temperature

Hard to extinguish

Open flame

**Extremely high risk of fire**

Insulation damage  
Loosened connection



 Paired expert database data

 Abnormal current analysis

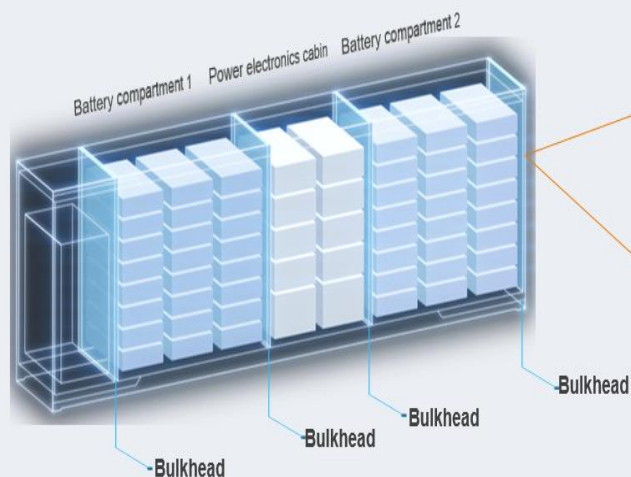
Abnormal resistance

**Shutoff circuit**



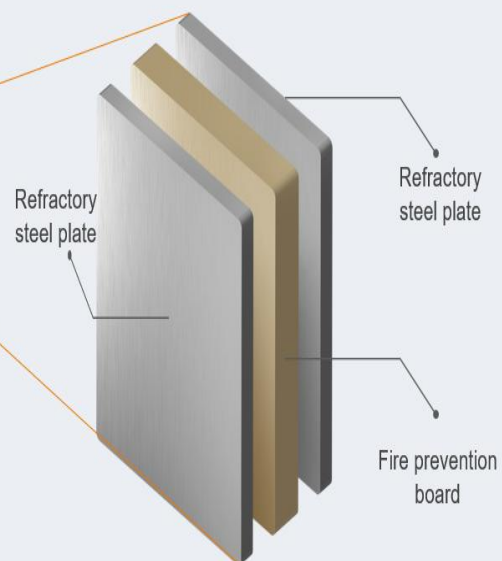
# Prevent Fire Spread and Reduce System Loss

## 1 Battery Compartments Separately Placed



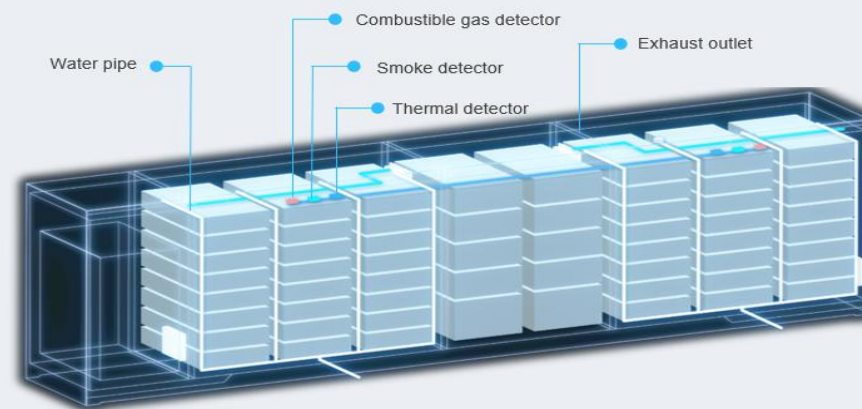
- Avoid thermal runaway caused by arcing
- Prevent chain reaction of fire

## 2 Fireproof Bulkhead



- 3-layer bulkhead with one-hour fire resistance

## Combustible Gas Detection + Auto Start of Fire Suppression, Reducing Losses

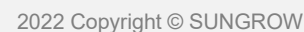
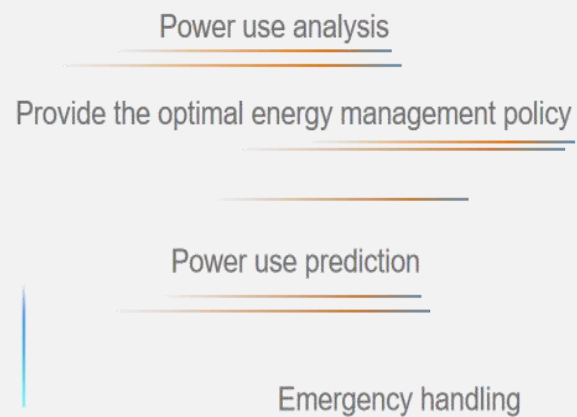


Early detection, continuous cooling, prevent re-ignition

**Compliance with NFPA855/69/68/15**

\* UL9540A safety certificate





# Reliable Grid Support

- Stable operation in weak power grids .
- Continuous LVRT and HVRT, without disconnecting from the grid.
- Fast active/reactive response.
- Reliable grid support

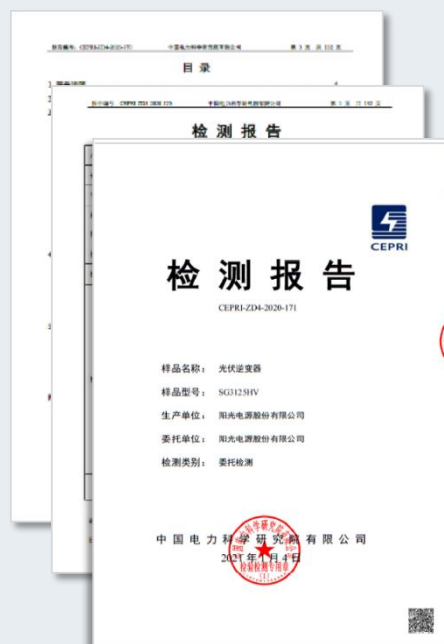


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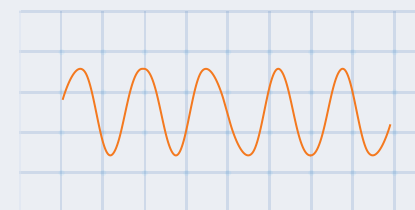
# Stable Operation in Weak Power Grids with an SCR 1.018

**SCR=1.018**

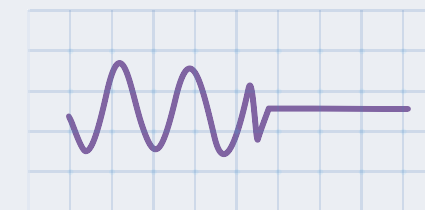
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- Low (zero) Voltage Ride Through ✓
- High Voltage Ride Through ✓
- Active Power Control ✓
- Current Harmonic Detection ✓

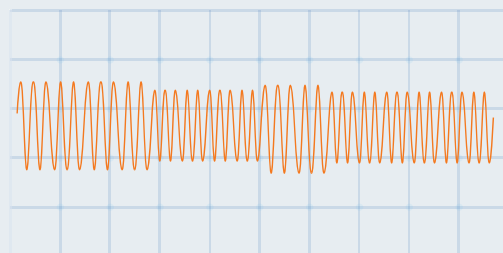


**Stable grid connection  
with these technologies**

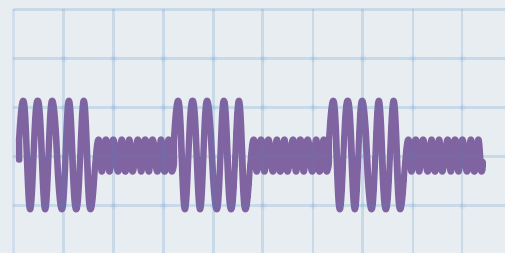


Oscillated shutdown  
without these technologies

# Continuous LVRT and HVRT, without disconnecting from the grid



Stable operating during continuous HVRT and LVRT with this technology



Unstable operating and oscillated shutdown without this technology

1

## Above-standard electric power quality

- Grid connection current harmonic **<1%**
- DC component **<0.15%**
- Voltage imbalance for grid connection/disconnection **<0.5%**
- Charge/discharge current ripple **<2.8%**

2

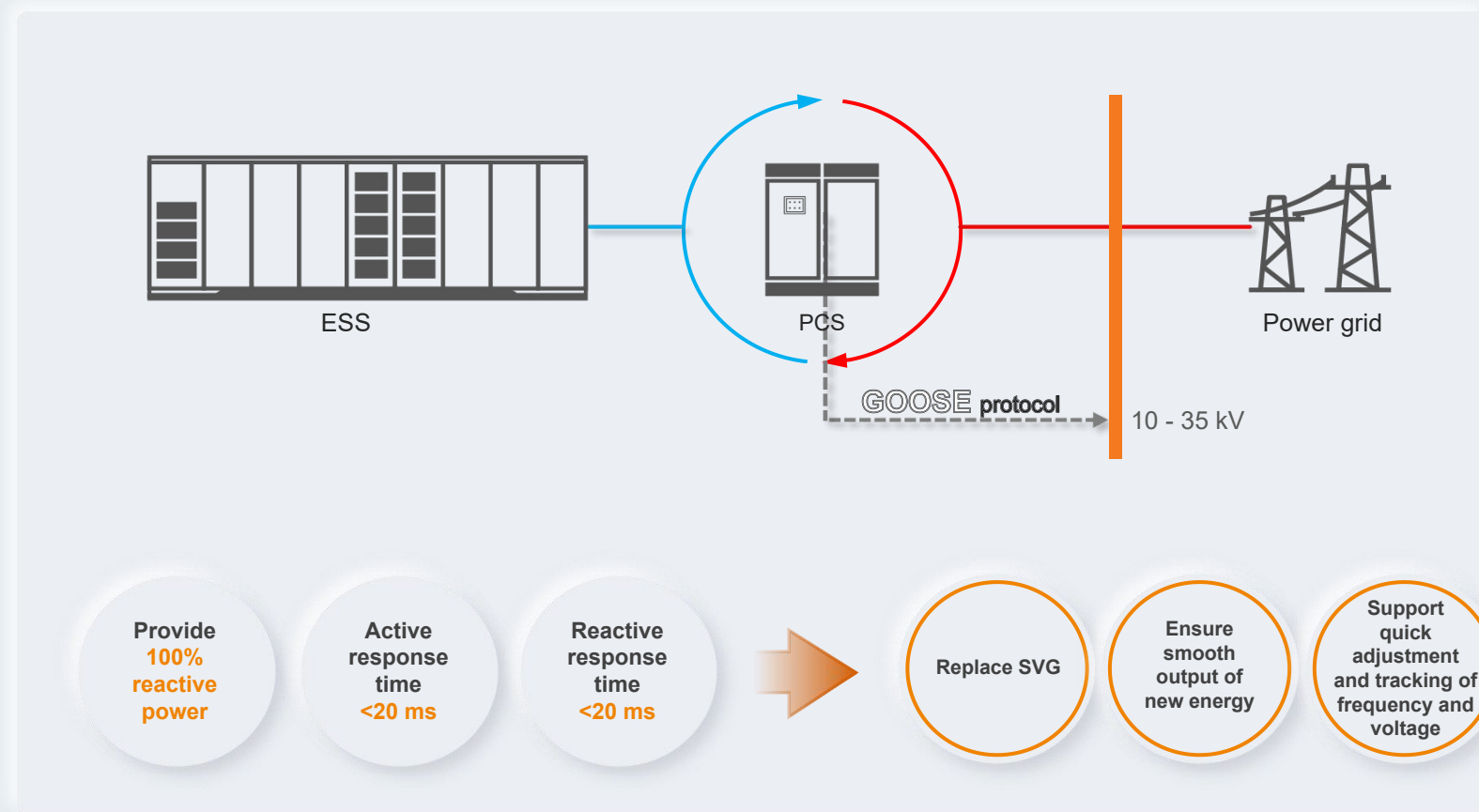
## Passed HVRT and LVRT tests during charge and discharge

- 2s for LVRT, and above 150 ms for Zero Voltage Ride Through
- $U \geq 1.2U_N$  **0.1s** no disconnection from grid;  
 $1.1U_N \leq U \leq 1.2U_N$  **10s** no disconnection from grid



# Active/Reactive Response Within 20 ms

The first supplier to pass the real power plant test



# Active and Reliable Grid Support with VSG

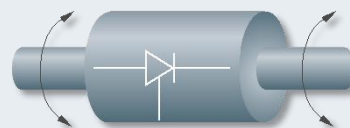
As the penetration rate of renewable energies increases, ESSs need to change the passive grid support mode to active.

**1** Penetration rate of renewable energies: 0% - 10%  
**ESSs need to adapt to grids**

**2** Penetration rate of renewable energies: 10% - 50%  
**ESSs need to adapt to weak power grids**

**3** Penetration rate of renewable energies > 50%  
**ESSs need to actively support grids**

## VSG technology

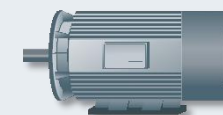


Mechanical character simulation  
Electromagnetic character simulation

- Virtual inertia and coefficient can be customized
- Grid frequency discontinuity and damping power oscillation can be suppressed

- ✓ Inertia control
- ✓ Output impedance control
- ✓ Droop control
- ✓ Self-balancing control

## Grid connection VSG



### Active support for grid

- Primary frequency and voltage regulation, and secondary frequency regulation
- MWh-level black start



- ✓ 15 MW/5.5 MWh black start project in Indiana, US

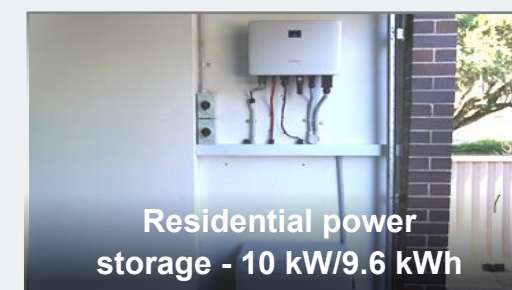
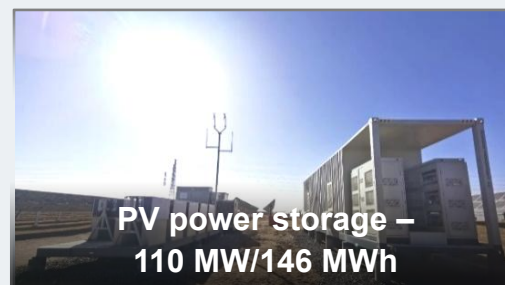
# Application Scenarios/Cases

- ✓ 5 GWh of global contractions for new liquid-cooled products with a total of 1 GWh shipment
- ✓ 3 GWh of global shipment of ESSs in 2021



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# 3 GWh of Global Shipment of SUNGROW ESS in 2021



# THANK YOU!

