

Tackling heat: the importance of liquid cooling in hybrid solar-storage projects

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EUROPE



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- 02** BESS Challenges
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The World's Most Bankable Inverter Brand

No.1 bankable for 3 consecutive years

No.1 supplier in financed projects

Source : BloombergNEF



HAVE A POSITIVE RECORD OF SOCIAL RESPONSIBILITY



NIRIM IN THE MOUNTAINS

Reaching out to youth at high risk



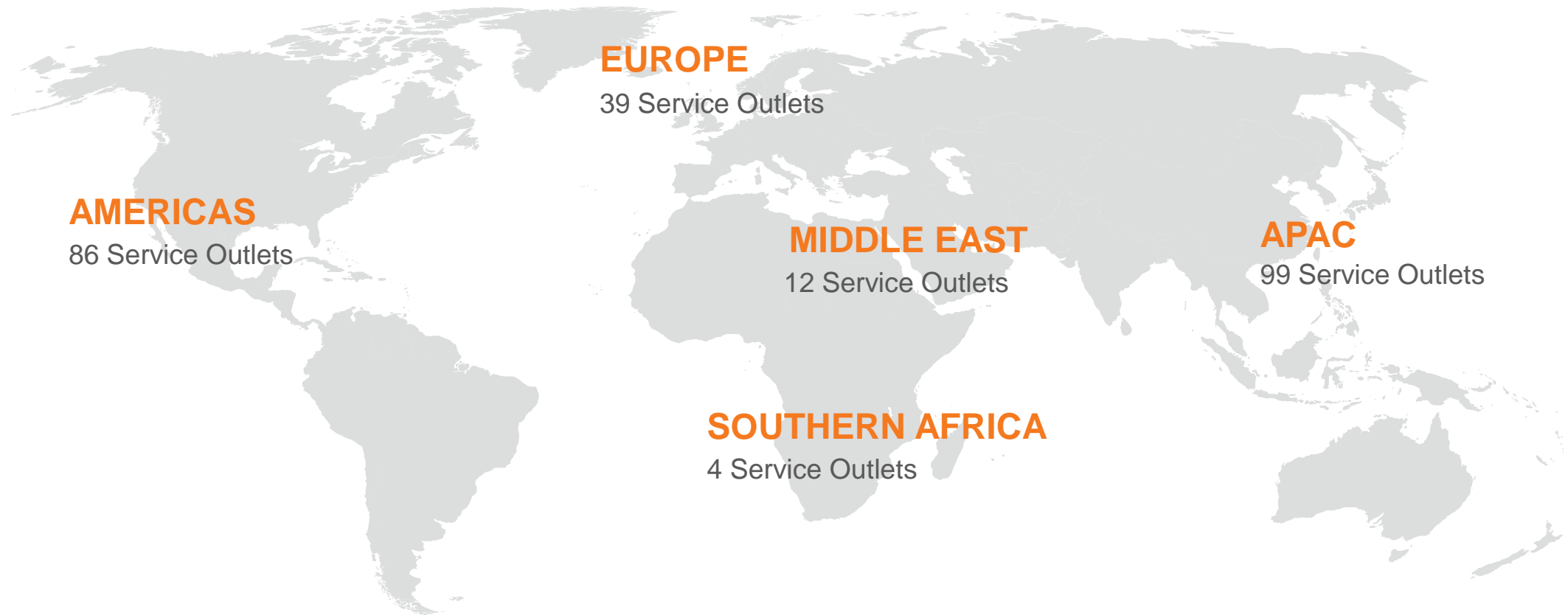
Global Layout

150+ Countries

240+ Service Outlets

20+ International Subsidiaries

224GW+ Installed



Israel's Largest Standalone Energy Storage Project

Sungrow together with Afcon will supply the company's latest liquid cooled energy storage system solution to a 16 MW/**64 MWh** project in Israel.

As Israel's largest standalone energy storage plant, the project is set to be integrated with the "**Dalia Power Station**" - the largest privately contracted Power Plant in the country.



Sungrow and Enlight sign the largest ESS agreement in Israel

Sungrow's **430 MWh ESS** supply to Enlight is made up of a combination of a contracted 230 MWh for stage 1 and a locked 200 MWh battery for stage 2, maximizing profitability, flexibility and safety.

With a modular DC/DC converter, the battery rack can be fully charged and discharged, with the system's safety performance also optimized due to a standout anti-leakage design and integrated aerosol fire fighting system.



Sungrow signs a 253 MWh ESS agreement with Doral - the first Liquid Cooled system in Israel

Signed in March 2022, this 253 MWh supply serves as **Israel's first DC-coupled liquid-cooled energy storage project** and will further enhance the stability and reliability of Israel's electricity grid in view of the increasing market growth of PV based plants.

The 4-hour liquid cooled ESS slashes capital and operating expenses due to its pre-assembled and easy installation design as well as a more effective cell working environment which substantially slows down the capacity loss rate. Meanwhile, the DC-coupled design is streamlined and doesn't need an additional power conversion system (PCS) and a medium-voltage station, which is cost-saving for the project.



The logo for DORAL, featuring the word 'DORAL' in a bold, dark teal, sans-serif font. The letter 'O' is replaced by a stylized circular graphic consisting of two overlapping semi-circles, one dark teal and one light teal.

Three ‘COOL’ things that you didn’t know about ESS Liquid Cooling



To increase electrical generation, the liquid cooled ESS innovatively uses the modular DC/DC converter, enabling the battery to be fully and flexibly charged and discharged, ensuring the **optimized plant performance**.

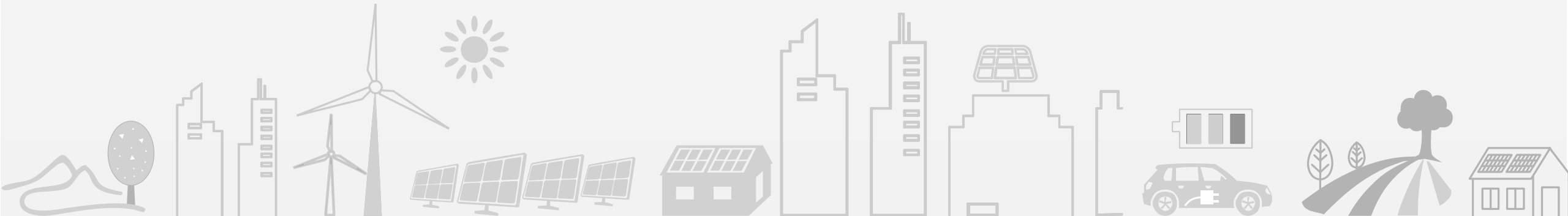


Safety: Sungrow has ZERO safety accidents



Sungrow’s energy storage division has been involved in battery energy storage system (BESS) solutions **since 2006**. It shipped 3GWh of energy storage globally in 2021.

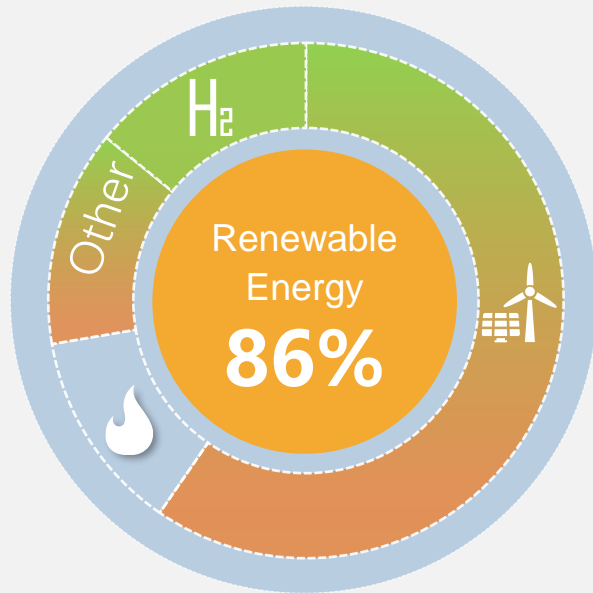
BESS Challenges



Renewable Energy + Energy Storage Becomes a Trend

Renewable Energy Becomes Mainstream

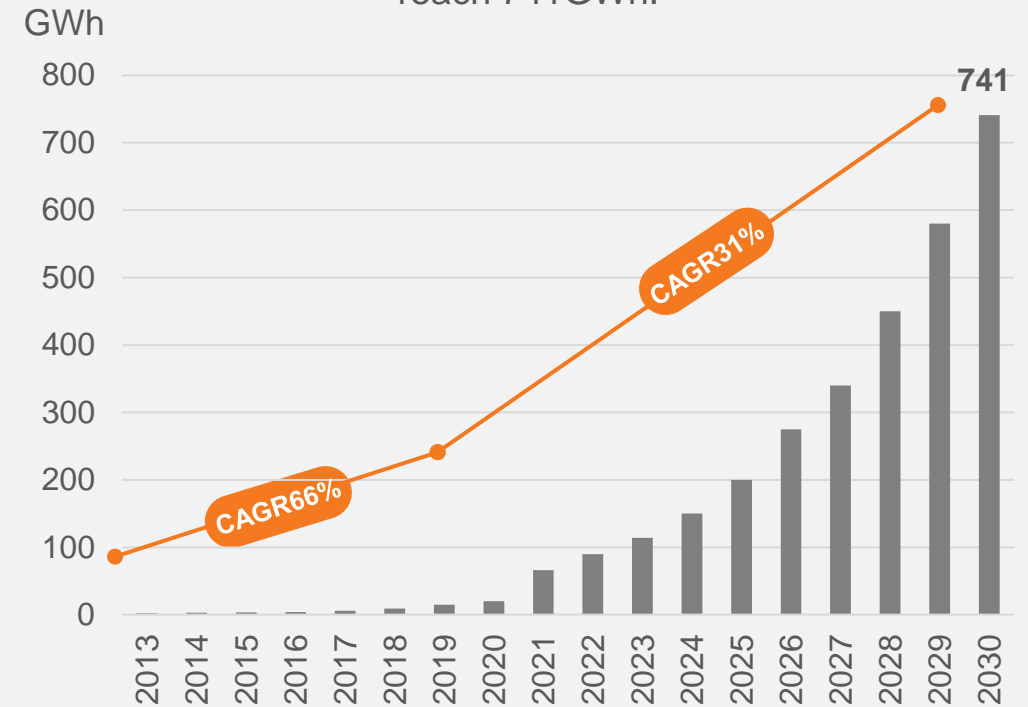
In 2050, the global wind and solar installed capacity will exceed 145 TW.



Source: Sungrow, IRENA_Global_Renewables_Outlook_2020

Rapid Development of BESS

In 2030, the global installed capacity of energy storage will reach 741 GWh.

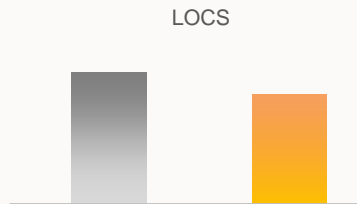


Source: Wood Mackenzie

BESS Challenges



CAPEX



OPEX



SAFETY



Sungrow Liquid Cooling ESS





CAPEX



OPEX



SAFETY

Pre-installation Design, Installation Cost Reduced by 0.02\$/Wh



1 Liquid cooling unit



2 Cluster controller

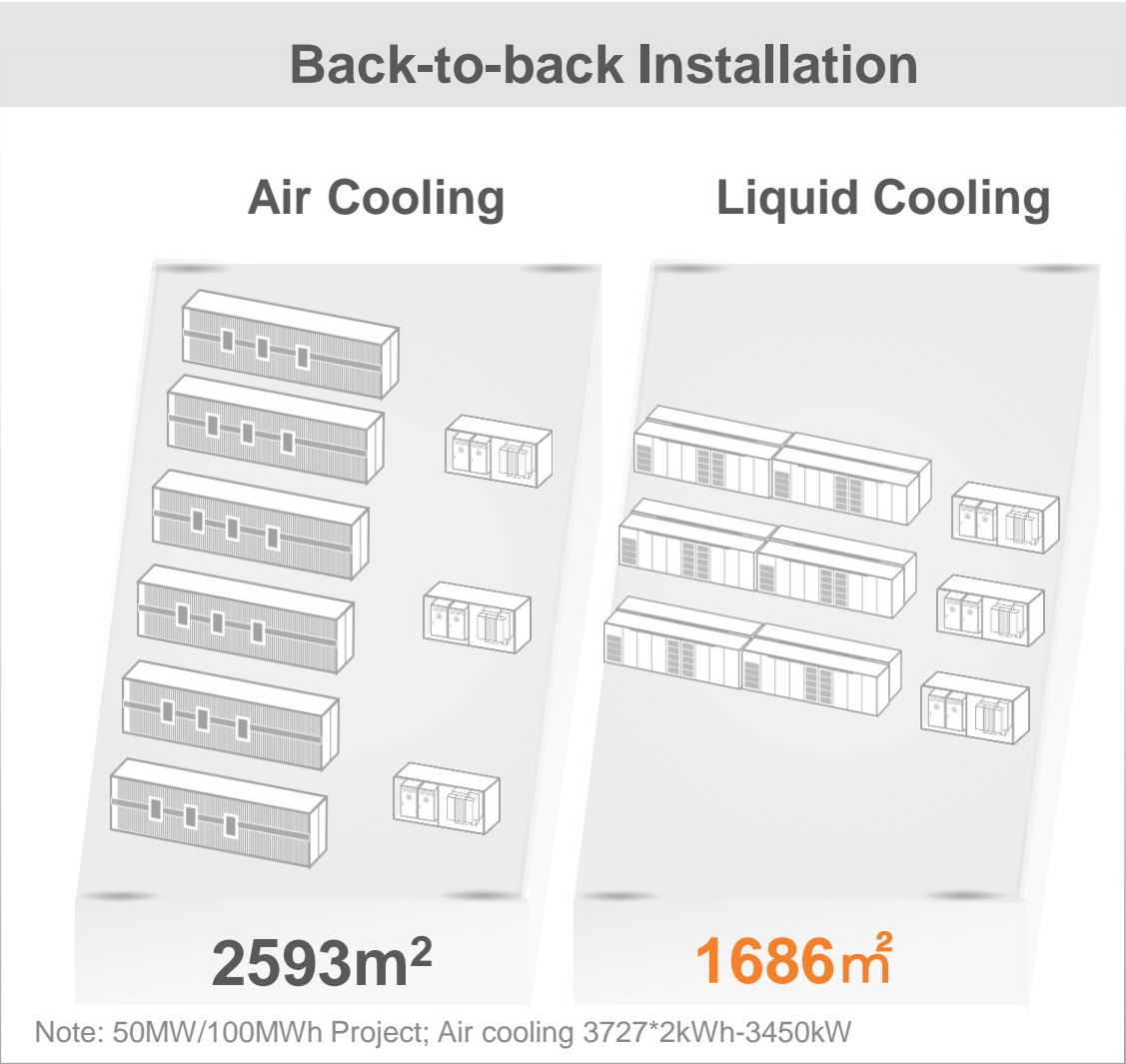
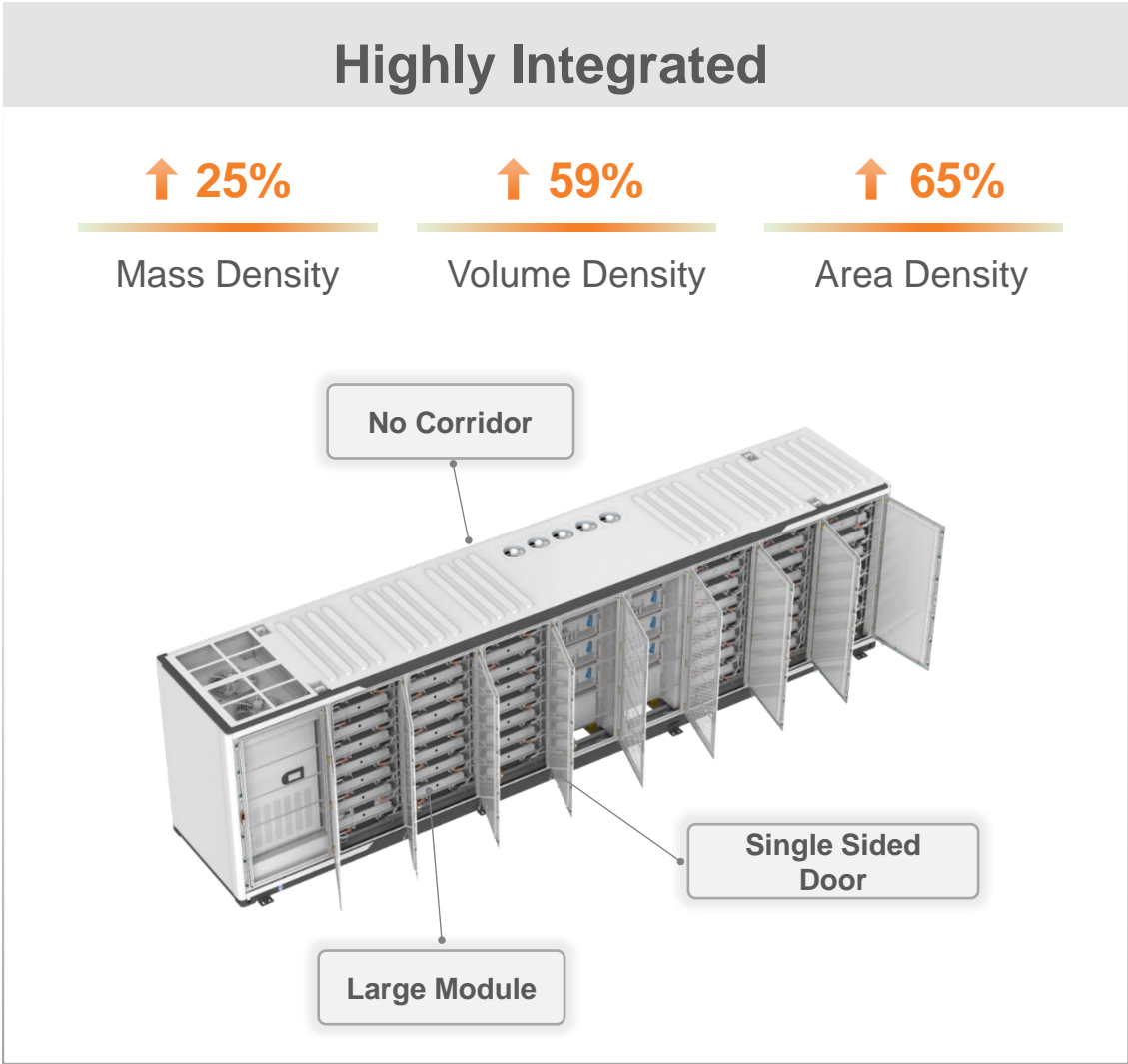


3 Module

The system weight is about **26 tons** and can be transported as a whole.

Save **50%** installation time and save **0.02\$/Wh** installation cost.

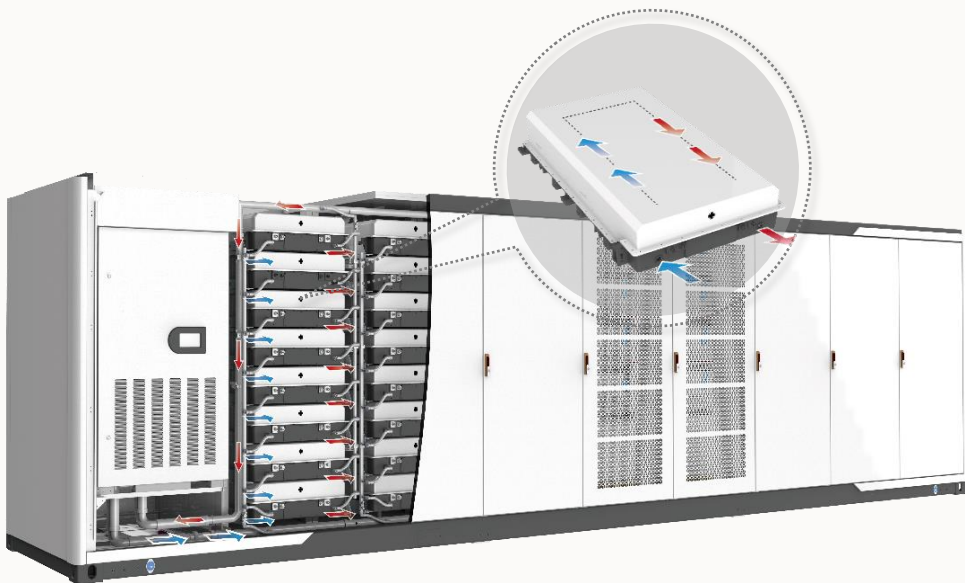
Highly Integrated, Land Area Reduced by 34%



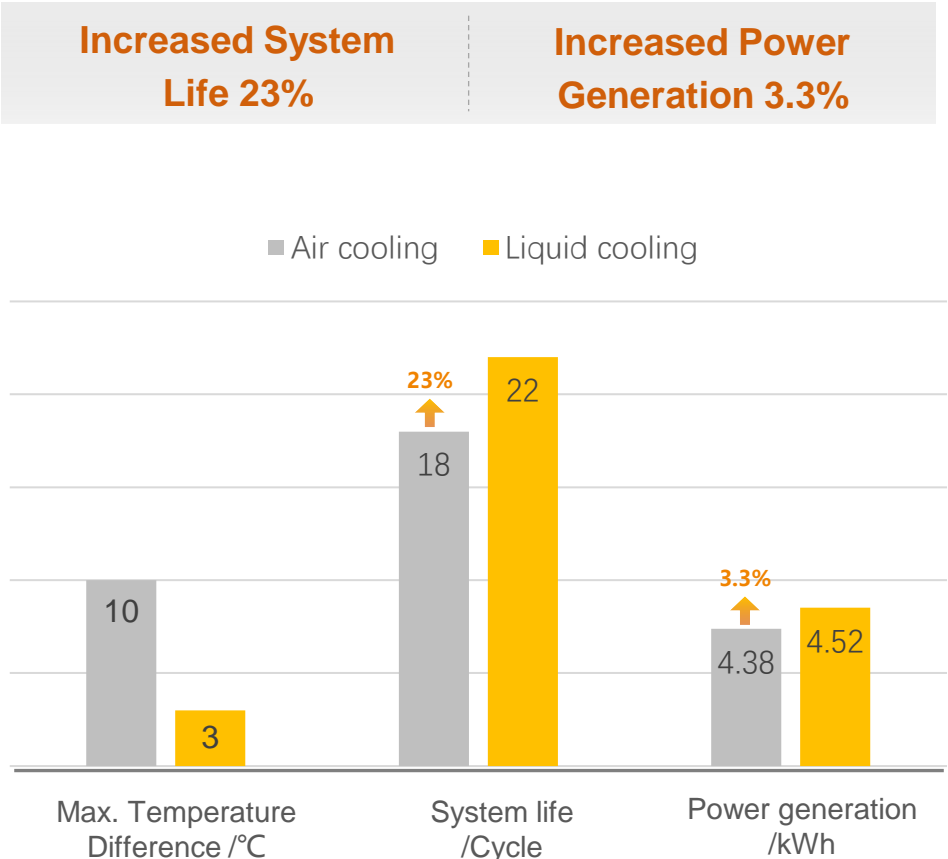
Precise Thermal Design, System Life Increased by 23%

< 3°C

Max. Temperature Difference in the Cabinet



Precise Thermal Design

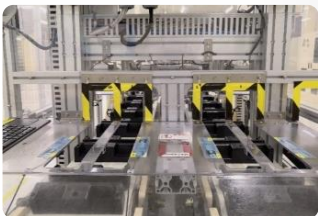


Note: 100MWh, 0.5CP, 1 Cycle / Day, 70%EOL

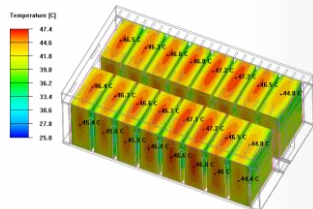
Cluster-level Energy Management, Available Power Increased by 6.4%

Different Internal Resistance of Cells

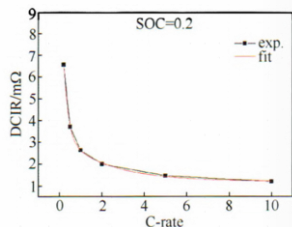
Initial
Cell Difference



Different
Temperature



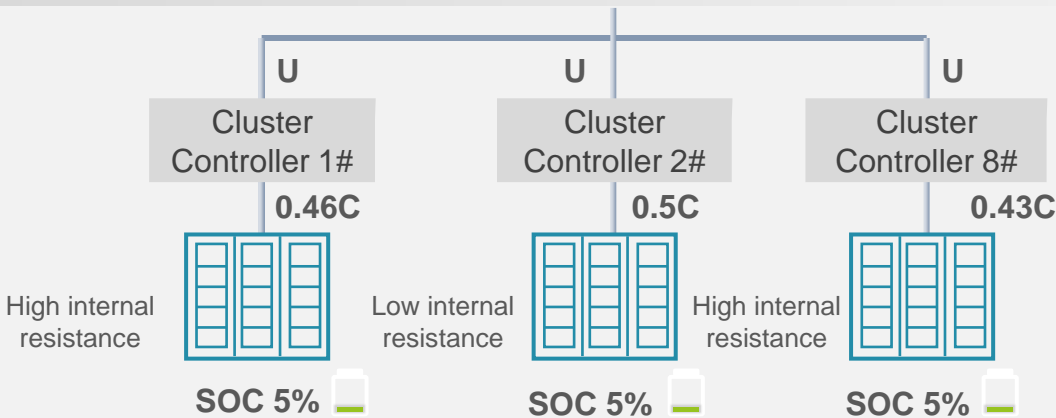
Different Charge
& Discharge Rate



Traditional: Only part of the rack power can be fully released



Sungrow: Each rack of electricity can be fully released





CAPEX



OPEX

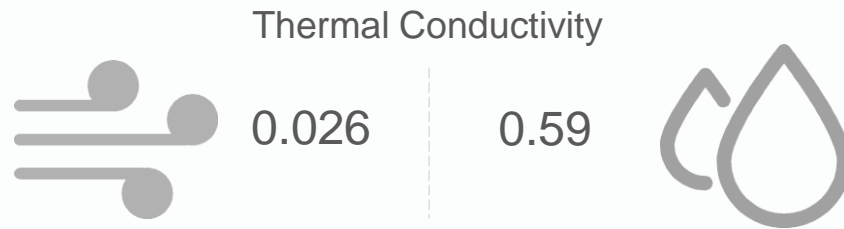


SAFETY

Liquid Cooling Technology, Auxiliary Consumption Reduced by 50%+

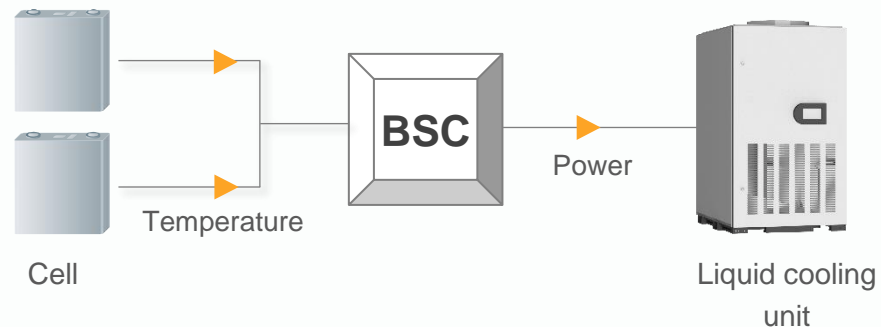
Easier to Dissipate Heat

- The thermal conductivity of water is higher.



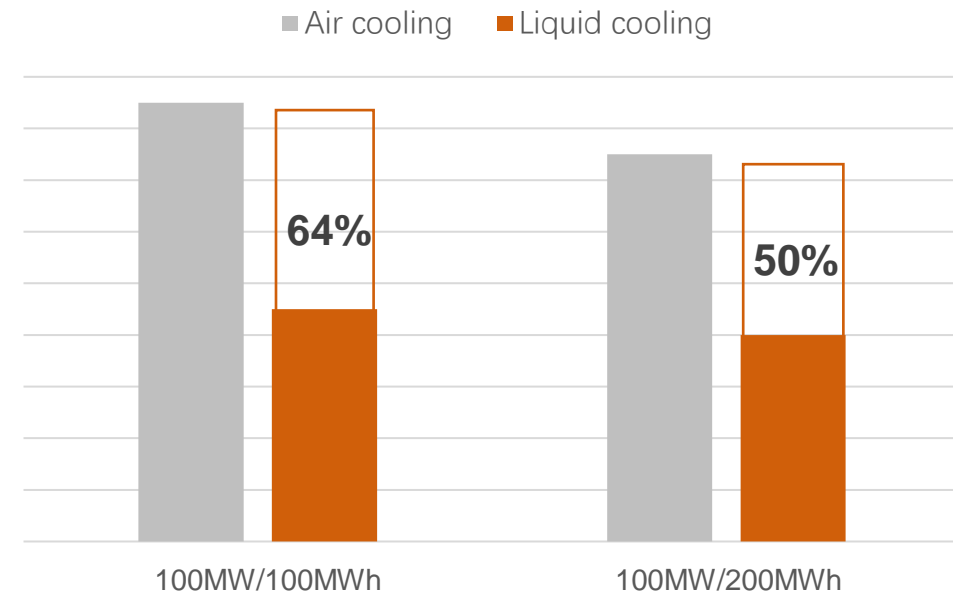
Intelligent Control Algorithm

- Adjust the power according to the temperature of cells.



Auxiliary Consumption Reduced by 50%+

Taking 100MW/200MWh as an example.

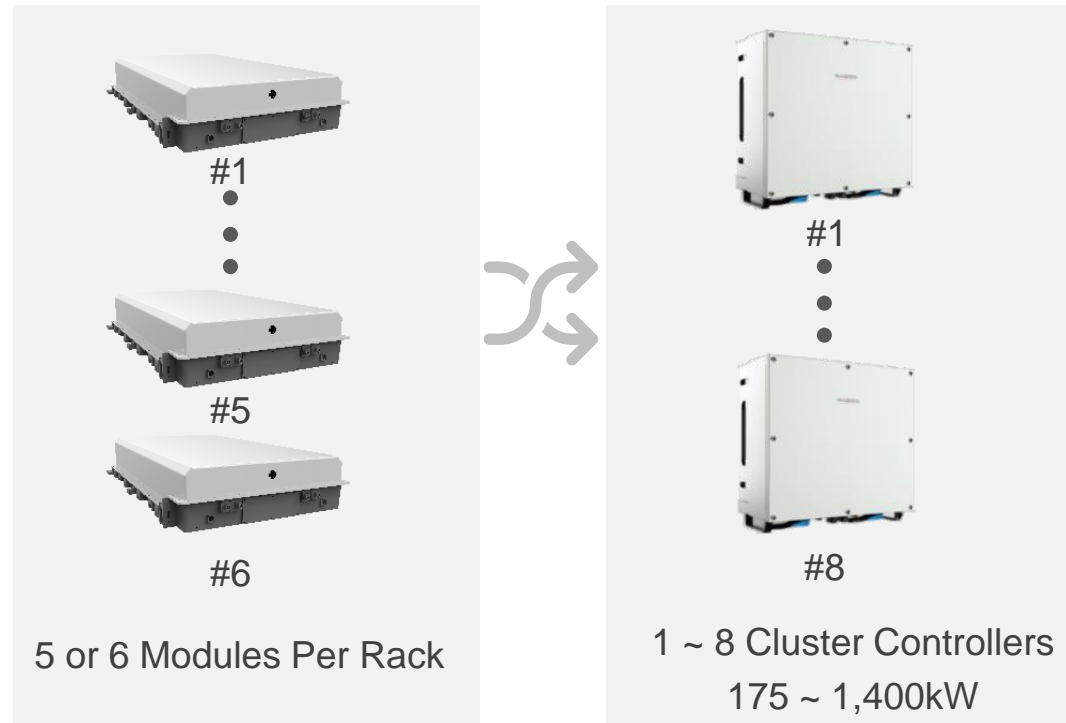


Note: 1. charge and discharge cycle per day & only operation loss
2. The electricity price range is 0.3 USD per kilowatt hour

Cluster Level Energy Management, Easy to Configure, O & M

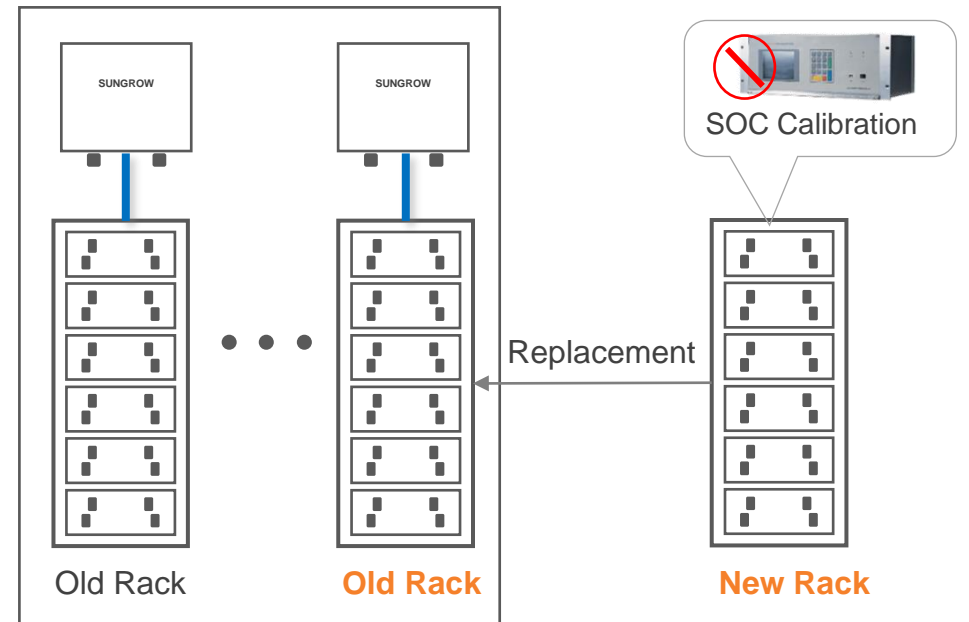
Multiple Configurations

- Racks with different number of modules can be mixed.

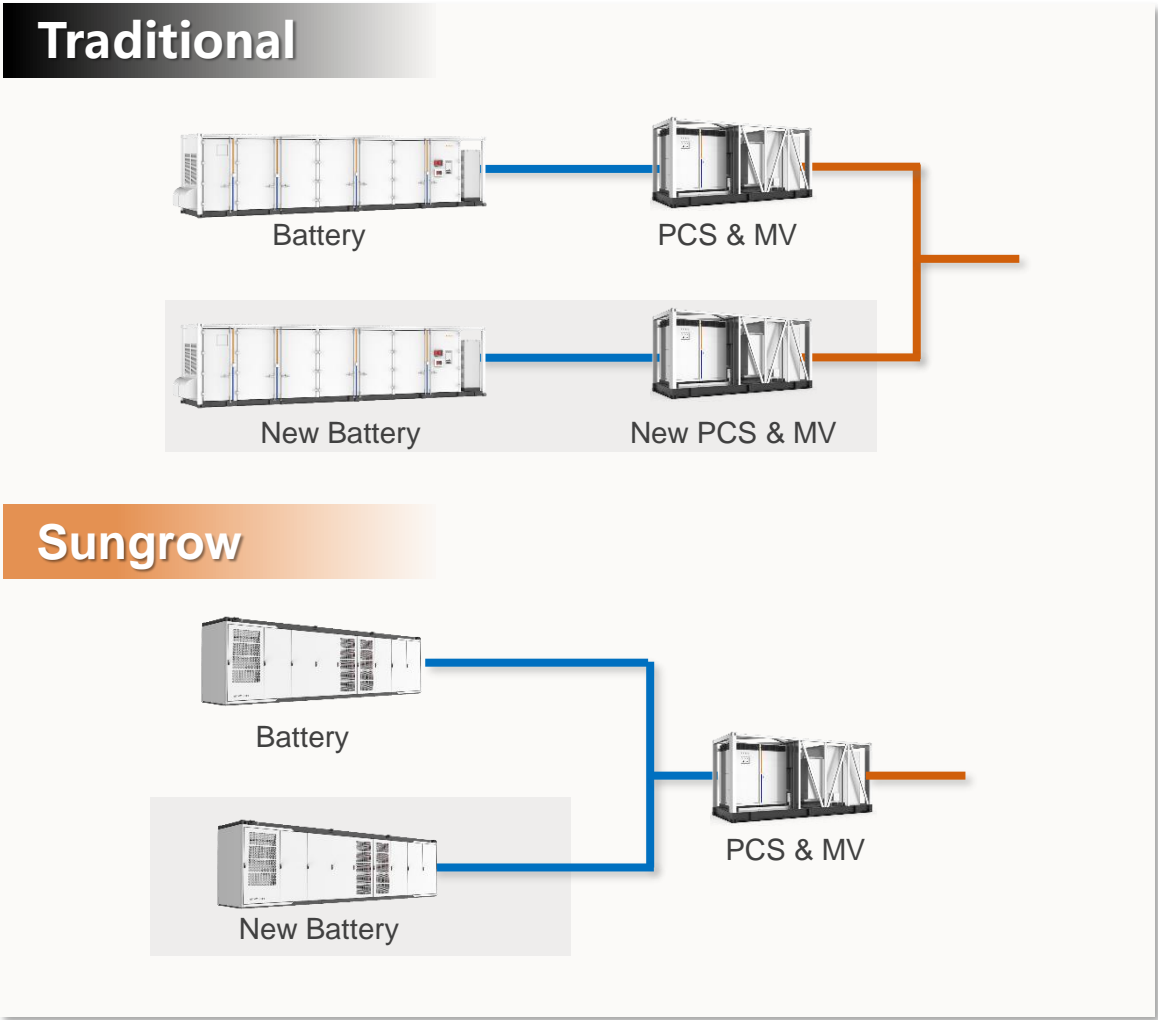


Cluster Level Replacement

- No need for SOC calibration before replacement or during maintenance.



Mixture of Old and New Batteries, Easy to Expansion



No Additional AC Equipment

Initial Investment Reduced by 25%

Year	One-off arrangement	Traditional	Sungrow
1	50MW/149MWh	50MW/111MWh	50MW/111MWh
2	\	5MW+10MWh	10MWh
4	\	5MW+10MWh	10MWh
6	\	5MW+10MWh	10MWh

Note: 15 years, DOD 100%, AC Usable Capacity ≥100MWh



CAPEX



OPEX



SAFETY

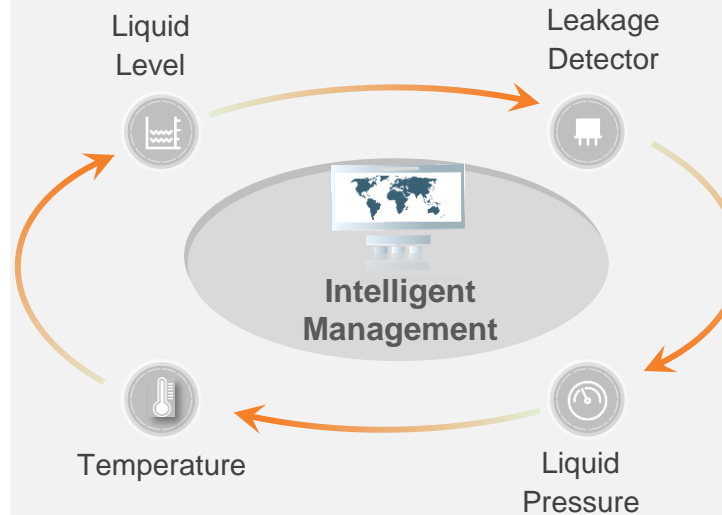
Three-level Anti-leakage Design, Ensure The Safety of System Operation

Leak-Proof Connection



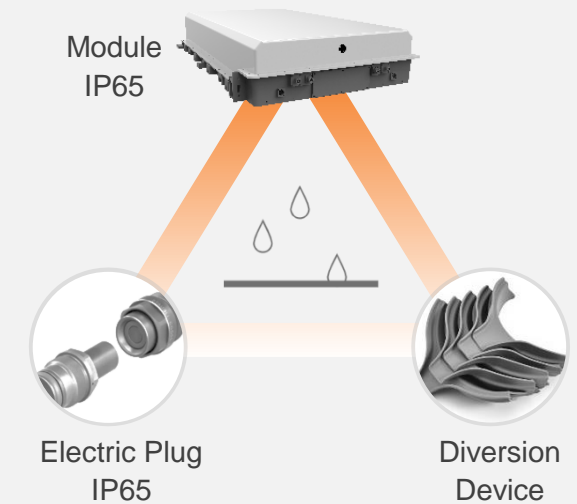
Patented Connector,
Application **100,000+**, Faults **0**

Real Time Detection



Intelligent leakage faults
identification and location

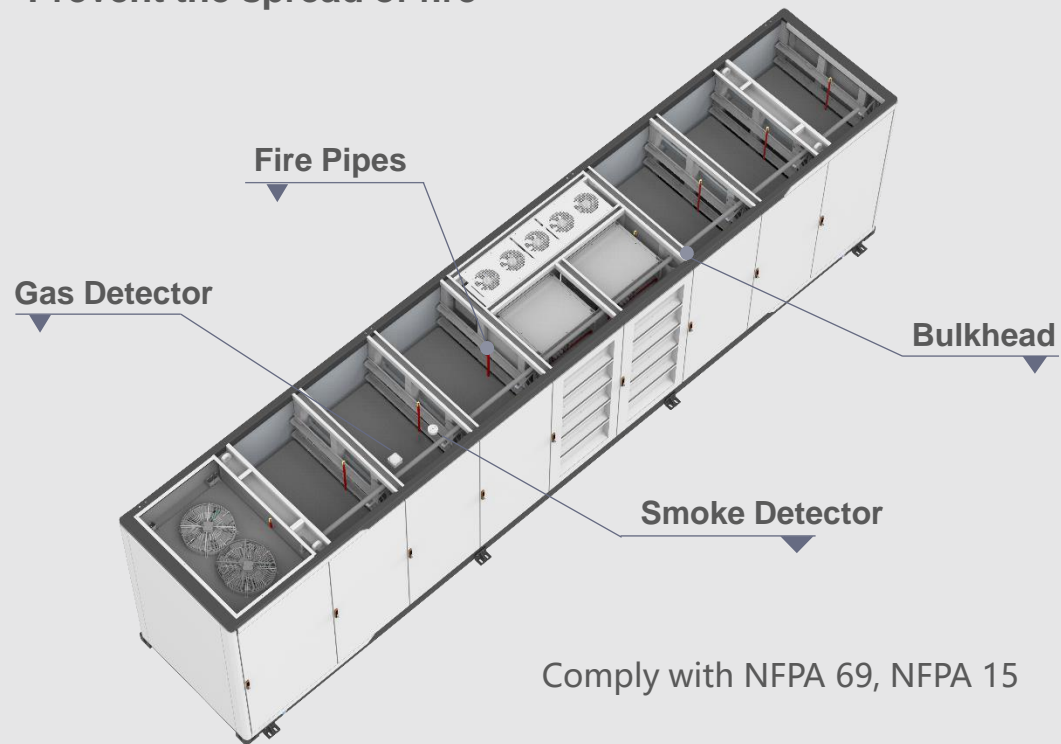
Waterproof Design



Avoid electric shock and short
circuit caused by leakage

Complete FSS, Ensure System Safety

- Gas Detector, Ventilation System + Water FSS
Early detection, continuous cooling, prevent re-ignition
- 1 Hour Fire-resistant Bulkhead
Prevent the spread of fire



FSS Action Logic

CO concentration > 20%

H₂ concentration > 20%

Trigger gas detector

ESS shutdown

Exhaust system activated

Local & monitor display alarm signal

Sungrow Liquid Cooling ESS

ST2752UX [LCOS Reduced By 10%]



LOWER COSTS

- Pre-installation, installation cost reduced by 0.02\$/Wh
- Highly integrated, land area reduced by 34%
- Liquid cooling technology, auxiliary consumption reduced by 50%+

MORE FLEXIBLE

- Cluster-level energy management, easy to configure, O & M
- Mixture of old and new batteries, easy to expand

HIGHER DISCHARGE

- Max. temperature difference $< 3^{\circ}\text{C}$, system life increased by 23%
- cluster-level energy management, available power increased by 6.4%

HIGH SAFETY

- Anti-leakage design to ensure system operating environment
- Complete FSS, ensure system safety

AC Coupled & DC Coupled System



Typical ESS Solution

DC-Coupling: Cost-effective

PV

PV

ESS

BESS+DC/DC

Bi-direction

PV inverter

Grid

USA 2019

DC/AC ratio 1.8 DC 1500V

Japan 2017

DC/AC ratio 7
24 hours power supply

AC-Coupling: Flexible Application

Other

PV

Wind

Traditional

Hydro

ESS

BESS

PCS

0.4~35kV

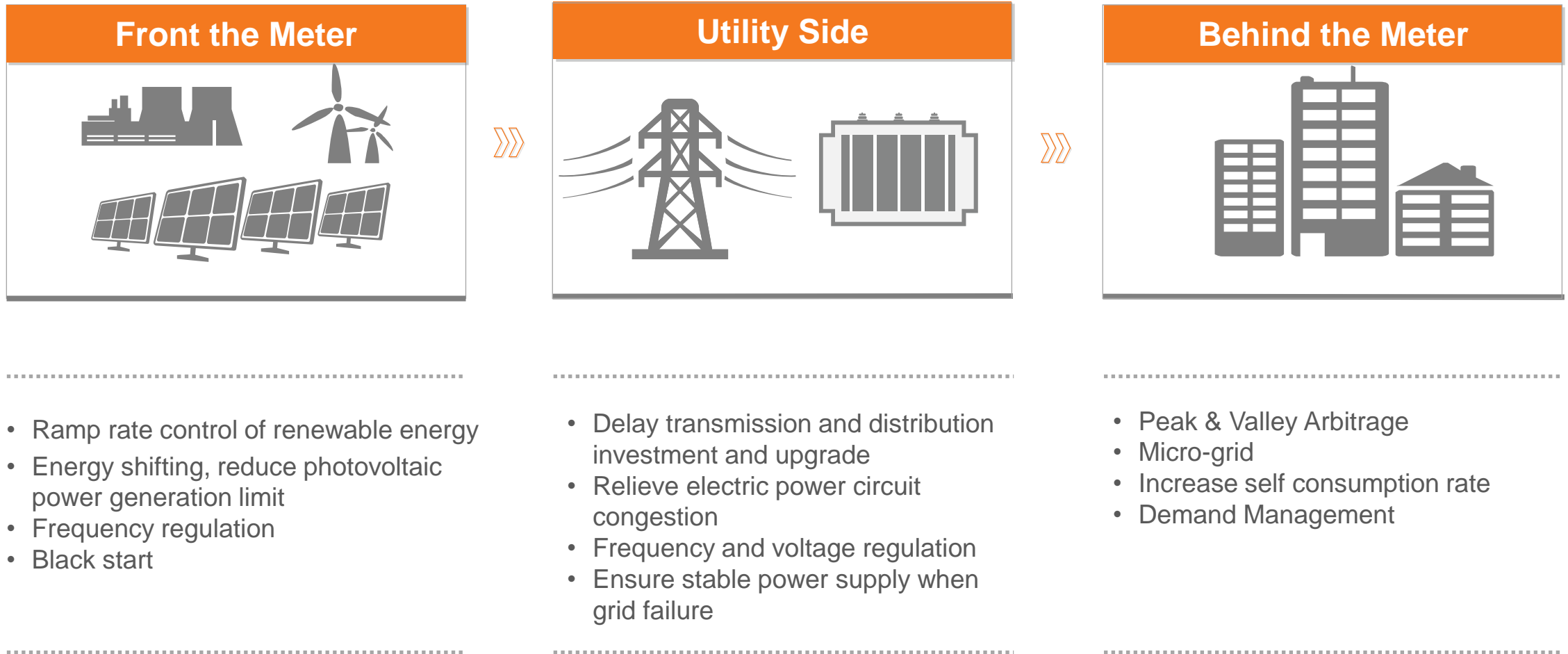
China 2019

PV-Wind-ESS

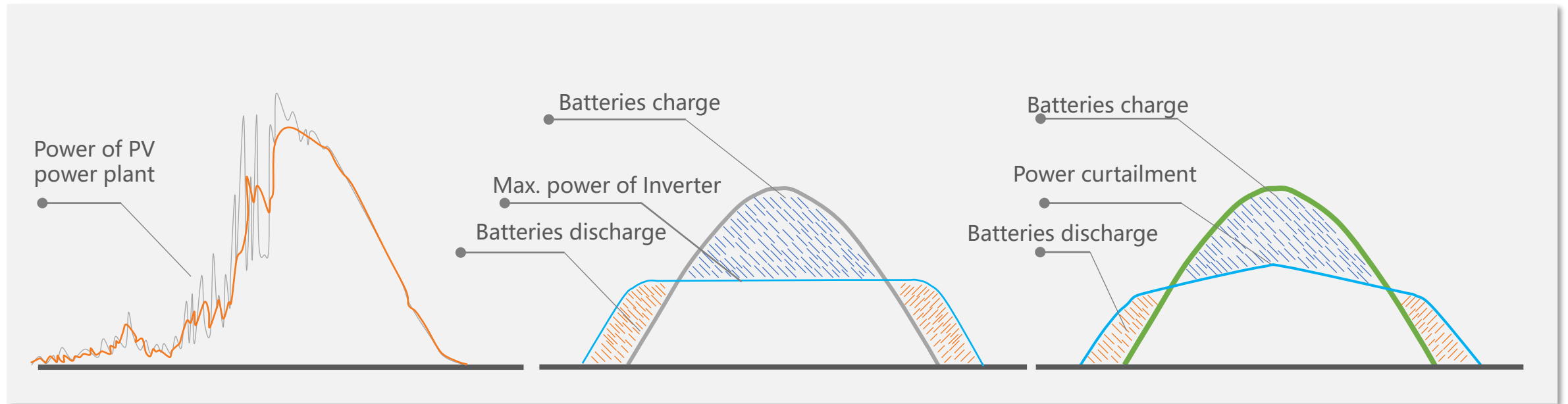
USA 2020

ESS FFR

Main Application Scenes of AC Coupled Solution



Main Application Scenes of DC Coupled Solution



Ramp Rate Control

Control the rate of power of PV power plant, reduce the impact on the grid.

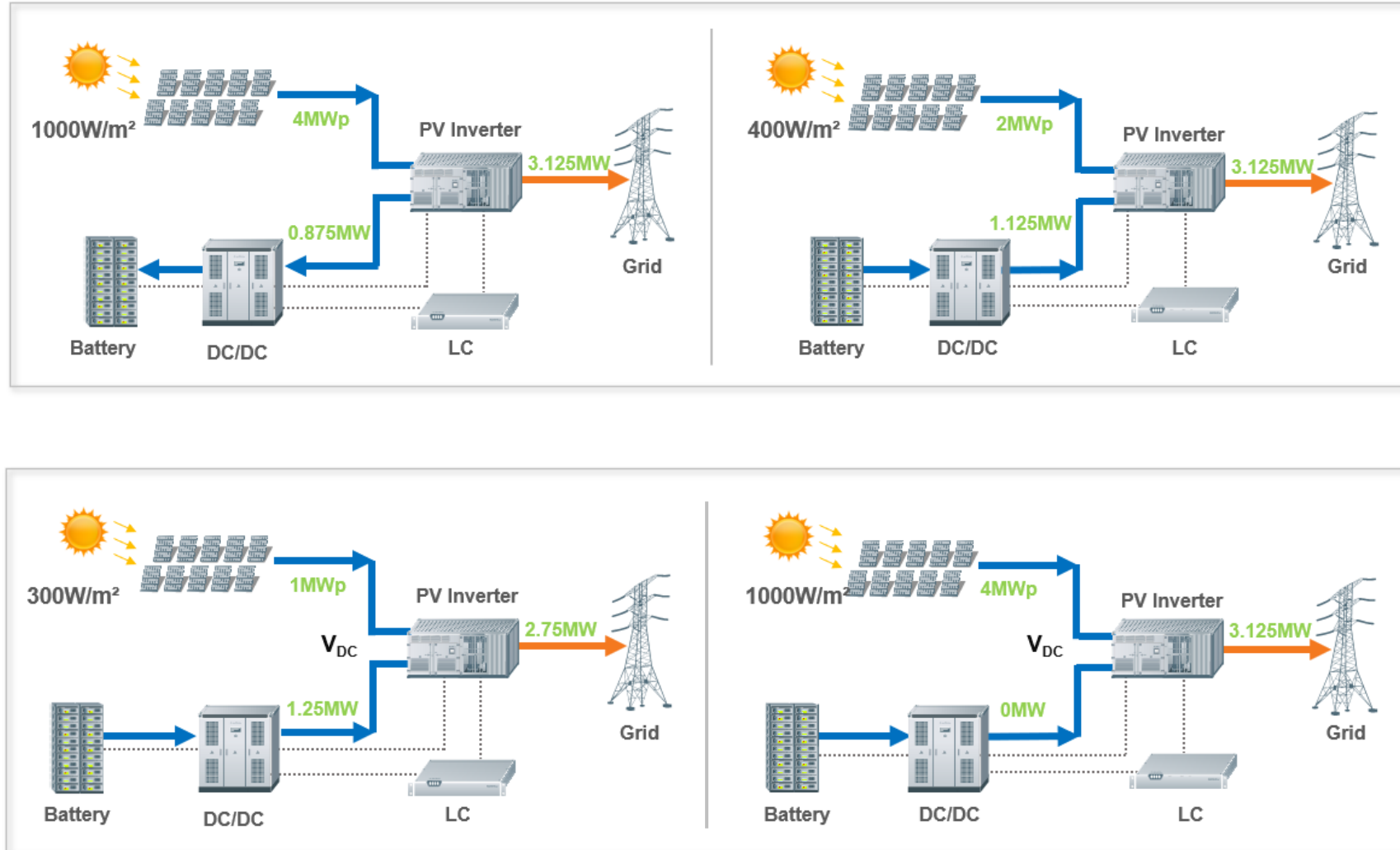
Clipping Recapture

Stores the excess energy that the PV inverter cannot use in higher DC/AC ration scenes, further increasing yields.

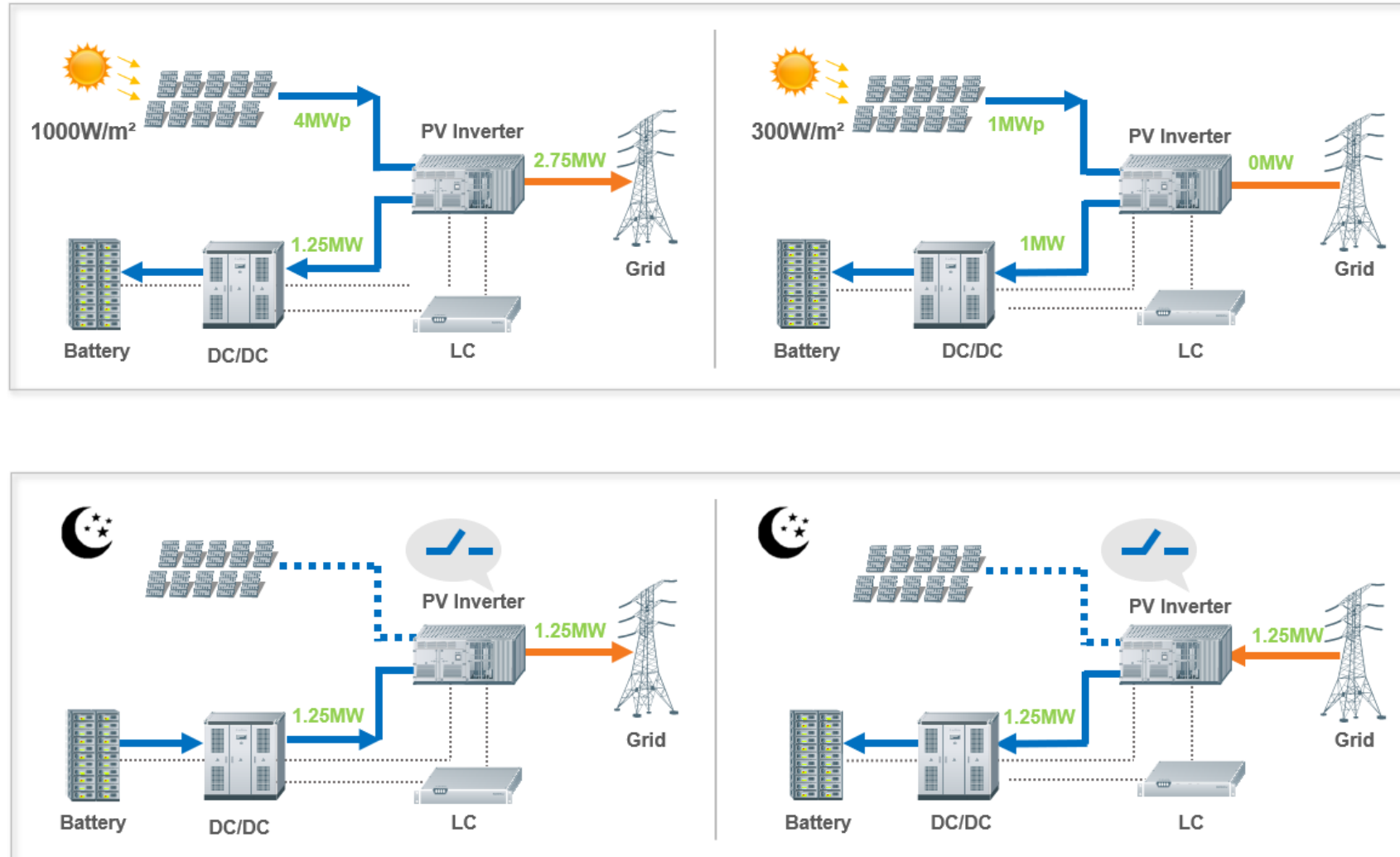
Curtailment Recapture

When the PV inverter is offline or is scheduled, the excess energy from the PV panel can still flow to the batteries.

Operating Principle of DC Coupled Solution



Operating Principle of DC Coupled Solution



Global References



Global ESS Applications

2021 ESS Shipments **3GWh+**

Safety Accidents **0**

10MW/42MWh
AC coupled



○ **North America**

100MW/117MWh
Energy shifting



100MW/100MWh
Frequency regulation



16MW/8.5MWh
Frequency regulation



○ **Europe**

27MW/30MWh
Frequency regulation



100MW/100MWh
Frequency & Peak regulation



9MW/4.5MWh
Thermal power combines with ESS to regulate frequency



○ **China**

202MW/202MWh
AC coupled



1.1MW/3.3MWh
DC coupled



○ **APAC**

500kW/1.2MWh
Photovoltaic and energy storage micro-grid



250kW/548kWh
C & I



○ **Australia**

USA 100MW PV & 25MWdc/117MWh DC Coupled Energy Storage Project in Nevada



COD time	2021.6
Location	Nevada
Capacity	PV: 100MWac, ESS: 25MW/117MWh
Feature	<ul style="list-style-type: none">• DC coupled PV&ESS energy transfer application• The largest DC coupled project application

UK-ESS:100MW/100MWh Project in Minety



COD time	2020
Location	UK
Capacity	ESS: 100MW/100MWh
Feature	<ul style="list-style-type: none">• Europe's largest battery energy storage power station, which can provide emergency support power in the event of an accident on the main grid, effectively improving the level of grid security• Sungrow provides integrated solutions such as battery, PCS, etc.

USA - 15MW/5.5MWh BESS Black Start Project in Indiana



COD time	2019.12
Location	USA
Capacity	ESS: 15MW/5.5MWh
Feature	<ul style="list-style-type: none">• World's largest project using battery energy storage as a black start power source;• Replace diesel black start, more environmentally friendly and economical.

Global references (part of contracts signed 2020-2021)

Location	Project	Capacity	Contract signature
USA	KCE TX-13	50MW/100MWh	2021
USA	KCE TX-19	50MW/100MWh	2021
USA	KCE TX-21	50MW/100MWh	2021
Thailand	Super SPP	45MW/136.24MWh	2021
USA	DeCordowa	296MW/320MWh	2020
USA	Flower Valley II	110MW/220MWh	2020
USA	Crossett BESS project	210MW/227MWh	2020
USA	Crossett BESS project	214MW/231MWh	2020
USA	Road runner	57MW/86MWh	2020
USA	High Lonesome	57MW/86MWh	2020
USA	Chisholm	111MW/140MWh	2020
USA	Battle Mountain	25MW/100MWh	2020
UK	BSR	60MW/60MWh	2020
UK	STATERA	350MW/350MWh	2020

THANK YOU!



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