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Battery Storage Solution - By Sineng Electric

Sineng Electric Co., Ltd

Sineng Electric (India) Pvt Ltd: Bangalore, India

www.si-neng.com

Content

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SINENG ELECTRIC

2009

Sineng Electric Established

2011

Largest supplier for state owned power generation groups

2013

Top 2 in China

Inverter Shipment with 1.8GW

2014

Shipment 3GW inverter

Acquired Emerson PV Business

2015

No. 5 inverter shipment globally, 3.5GW

2016

Highest efficiency in Top Runner Project,25% of 1GW

2017

Indian 2GW factory

2018

80MW shipment to India

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Global Presence

Headquarter, Wuxi, China

R&D center, Shenzhen, China

Bangalore factory, India

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Strength

- Sineng Electric was awarded with Laboratory Accreditation Certificate by China National Accreditation Service for Conformity Assessment in Oct, 2017.
- R&D department accounts for 35% of total employees.
- 10GW annual manufacturing capacity in China , 2GW annual manufacturing capacity in India

Headquarter，Wuxi

R&D Lab ,Shenzhen

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Bangalore Factory

Bangalore factory，India

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Reference in China

Accumulated over 20GW inverters in operation :

Extreme low temperature
(-53 ℃)
Qinghe, Xinjiang

Extreme high temperature (48 ℃)
Turpan, Xinjiang

Desert (high intensity sand)
Zhongwei, Ningxia

Salt corrosive atmosphere
Dongtai, Jiangsu

High altitude (4500m)
Ali, Tibet

3.9GW@ 2016, 4.2GW @2016

10%+ China market share

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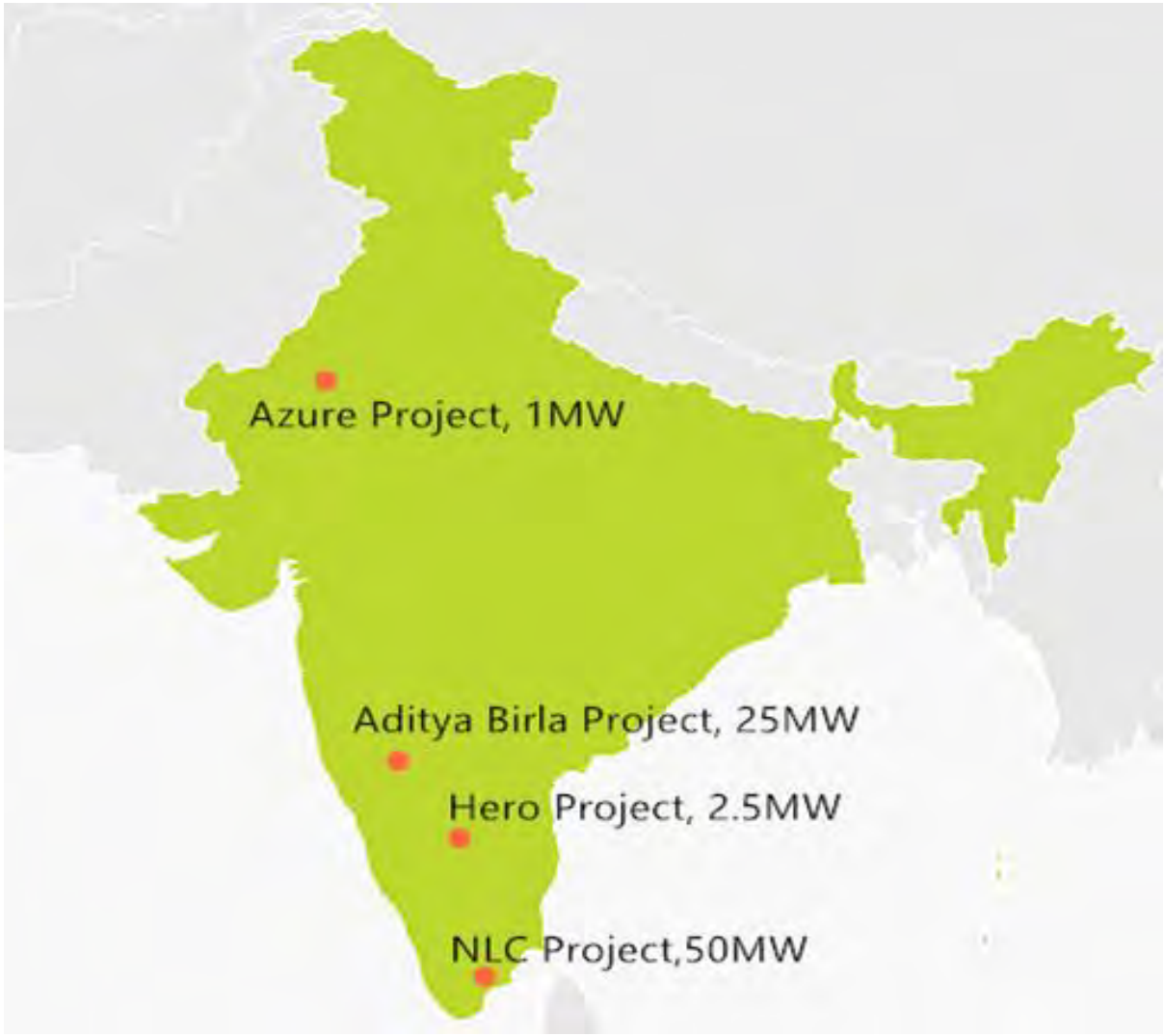
Reference in India

accumulated 80MW inverters supply to Indian market up to Mar, 2018.



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Reference in India

By IHS Research (UK)

FIGURE: Top 10 Global PV Inverter Vendors by Shipments and Revenue, 2015

Ranking by Total PV Inverter Shipments (MWac)

Rank	Company
1	Huawei
2	Sungrow
3	SMA
4	ABB
5	Sineng
6	TMEIC
7	TBEA
8	Schneider Electric
9	Power Electronics
10	SolarEdge

World three-phase high power (>201 kW) PV inverter supplier market share estimates
Shipments (MW)

Rank 2016	Supplier	2015	2016
1	Sungrow	19.9%	19.7%
2	SMA Solar Technology	11.2%	12.1%
3	TMEIC	8.4%	11.0%
4	Wuxi Sineng	5.7%	7.3%
5	TBEA Sunoasis	10.0%	7.3%
6	ABB	8.1%	7.1%
7	General Electric	3.6%	4.3%
8	Schneider Electric	4.5%	4.3%
9	Power Electronics	4.1%	4.1%
10	Kstar	2.8%	3.3%
11	Hitachi	3.1%	2.9%
12	Chint Power	2.3%	2.3%
	Others	12.1%	14.3%
	Total MW Shipped	**35,205**	**40,859**

Source: IHS Markit

By GTM Research(USA)

Top Ten Global Solar PV Inverter Vendors by Shipments, 2017 (MWac)

Rank	Company	2016-2017 Δ
1.	Huawei	-
2.	Sungrow	-
3.	SMA	-
4.	ABB	-
5.	Sineng	+1
6.	TBEA SunOasis	+1
7.	Power Electronics	+1
8.	TMEIC	-3
9.	Schneider Electric	+1
10.	SolarEdge Technologies	+2

Source: GTM Research *The Global PV Inverter and MLPE Landscape 2018*

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Project Reference

No.	Customer Name	Project size(MW)	Contract time
1	Tata Power Solar Systems limited	25	2017.11
2	NLC India Limited	50	2017.11
4	Hero Future Energies Pvt Ltd	2.5	2017.10
5	Azure Solar Power Ltd	1	2017.12
6	Cleanmax	2	2018.4
7	State Power Investment Corporation Limited(SPIC)	968	2017.5
8	Mingyang Electric Group	200	2017.7
9	China Sinogy Electric Group Co.,Ltd	115	2017.10
10	Beijing Energy Investment Holding Co.,Ltd	165	2017.2
11	Inner Mongolia Energy Engineering Co., Ltd	136	2017.8
12	Luneng Group Co., Ltd	105	2017.9
13	China Huadian Corporation LTD	195	2017.11
14	China Development Bank Energy	240	2017.6

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Product

We can provide clean energy power products:

- ***Solar power inverter***
- ***Battery storage system***
- ***APF , SVG***
- ***EV charger...***

Content

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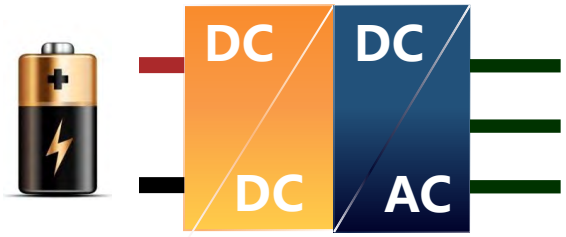
Sineng Power storage solution Introduction

Modular PCS solution, Easy for the EPC company to design flexible storage system



- **Wide DC voltage range, compatible for most type of batteries ,especially for EV degraded battery**
- **19-inch standard rack mounted design ,compact and flexible;**
- **Hot-swappable, easy for maintenance;**
- **Easy to construct different kinds of energy storage systems**

AC Side	
Max. AC Power（KW）	55
Rated Power（KW）	50
Rated AC Voltage（Vac）	400（380、400、415 settable）
Max. AC Current（Aac）	80
Rated AC Current（Aac）	72.5
Power Factor	＞0.99（Above 50％ Loading） ＞0.95(Above 20% Loading)
DC Side	
Max. Charging Voltage(Vdc)	745
Min. Charging Voltage(Vdc)	0
Max. Discharging Voltage(Vdc)	745
Min. Discharging Voltage(Vdc)	80
Max. Absolut Current（Adc）	118
Demension（W×H×D）（mm）	440×132×750

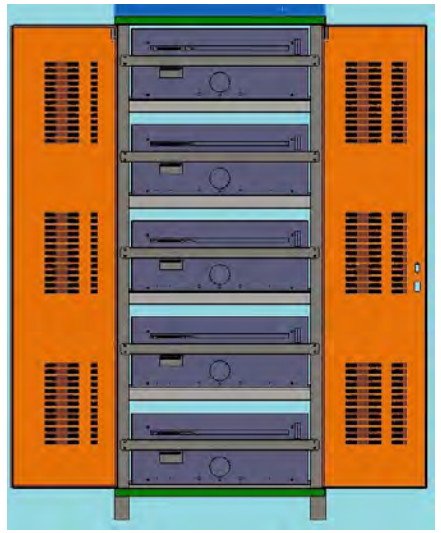
Typical Application Case

Golden Electronic-Pride-Power 250kWh degraded battery energy storage system
EPC： Hangzhou Gold Electronic
Project Location： Hangzhou, Tianjin

Sineng PCS Module

PCS system (Transformer, Power Distribution, Monitoring)

Storage System Container solution



Battery rack

EV Bus degraded Battery from Pride Power

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Typical Application Case

CBC(Dongguan) 150kWh Distribution storage system
EPC: Power Combo
Project Location: Dongguan, Guangdong

Sineng PCS Module

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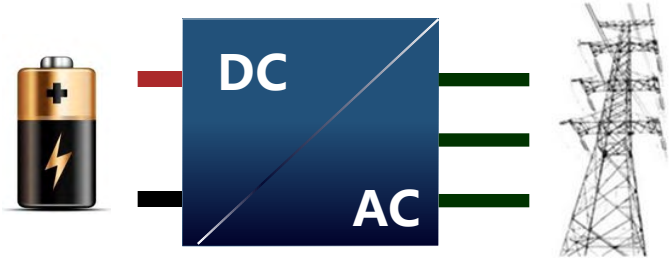
Sineng Power storage solution Introduction

Tower type modular energy storage system ---Industrial Storage system solution

PCS:125kW~625kW



- Modular Design, Flexible Application
- Can be paralleled up to 10pcs max.
- Supporting individual battery string input, increasing the battery life span and decrease BMS cost;
- Three Level Topology applied, higher efficiency / performance and reliability;

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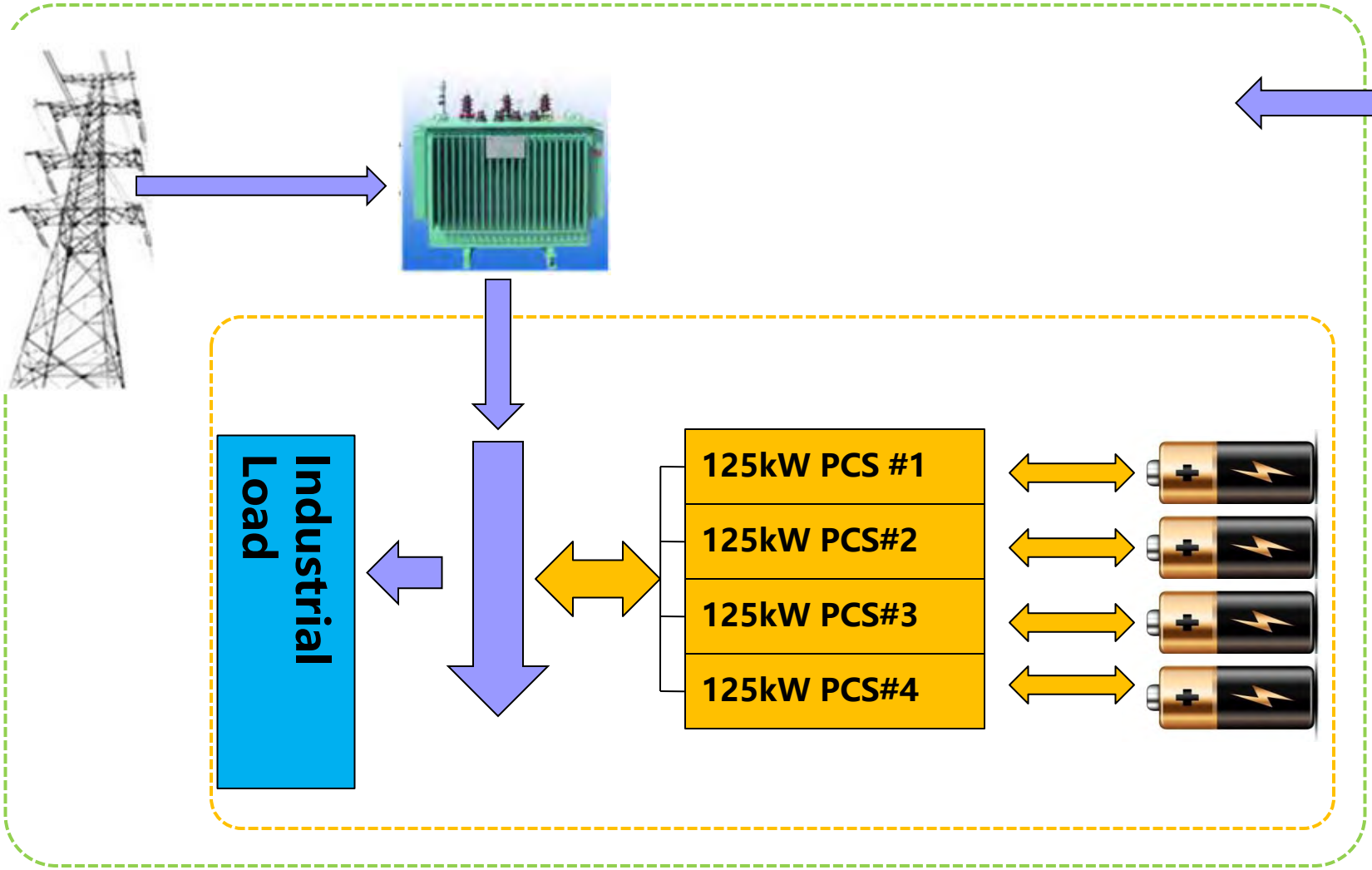
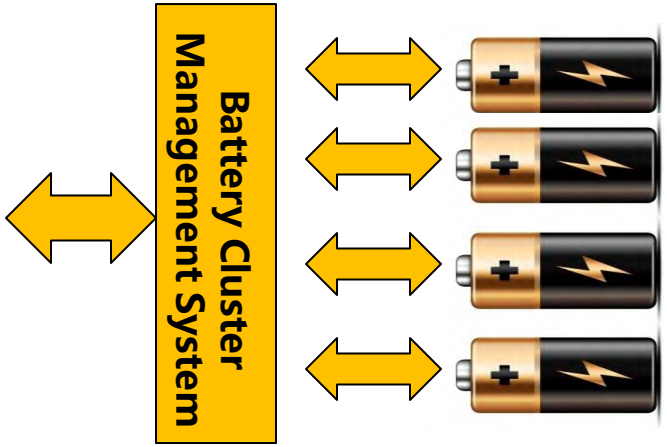
Sineng Power storage solution Introduction

Tower type modular energy storage system ---Industrial Storage system solution



- Supporting common input or
- Individual battery strings



- PCS inbuilt BCMS,
- Saving BCMS cost

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Typical Application Case

Hisense_Yangzhou1200kWh/375kW Distributed storage system
EPC：Combo Power
Project：Yangzhou, Jiangsu

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Sineng Power storage solution Introduction

Large-scale Solar Plant Distributed Storage solution—Modular Bidirectional DC PCS

Charging/Discharging Power: 250kW

Charging/Discharging Current: 0~220A

Charging/Discharging Voltage: 0~850V

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Sineng Power storage solution Introduction

Large-scale Solar Plant Distributed Storage solution—Modular Bidirectional DC PCS

- High efficiency with DC coupled battery storage system
- Lower system investment/ Higher converting efficiency

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PV+BSS-----Ultimate solution for PV Power Plant

Difficulties for power predicting and scheduling in PV system

Power generation equipments can not operate at optimized zone, lower I/O ratio

Transmission Bottleneck of the power grid

Power generation equipment cannot operate in efficient intervals for long periods

- PV output power limitation, cause waste of electricity, decrease the profit, hurt the development of the PV power industry.
- With more and more PV energy connected to the grid, the power fluctuation/ difficult to predict of the output of PV /difficult to schedule , may cause the safe and stable issues for the whole power grid.

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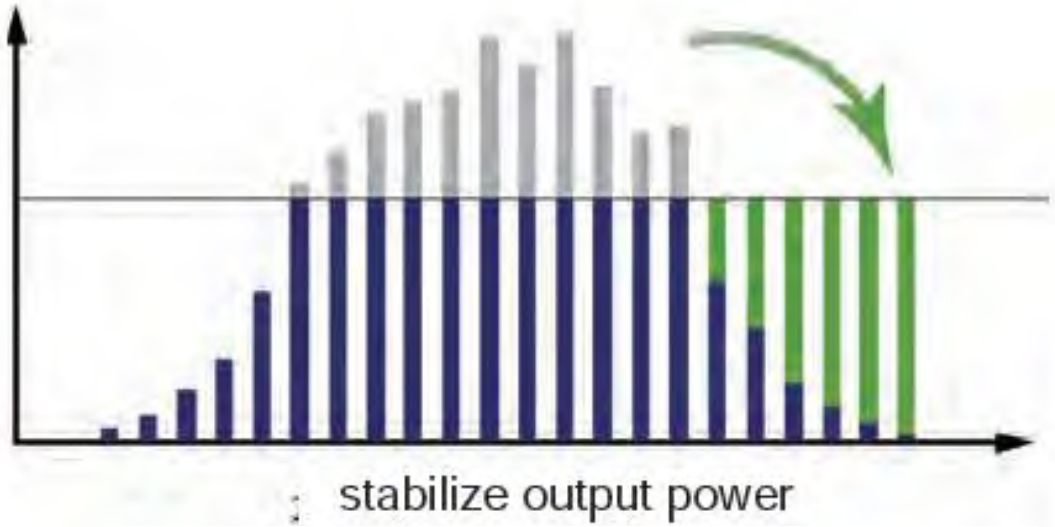
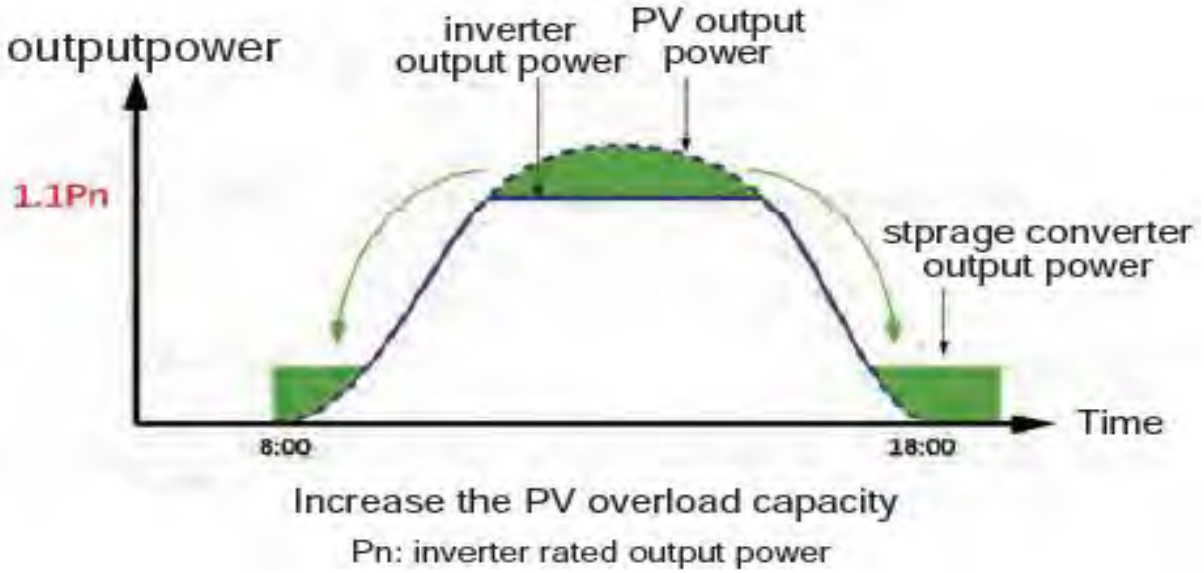
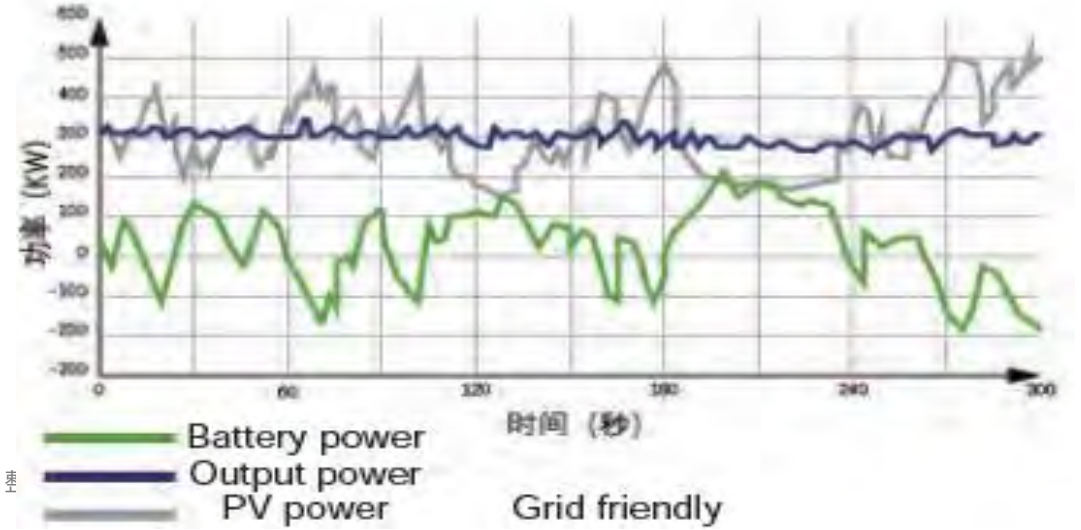
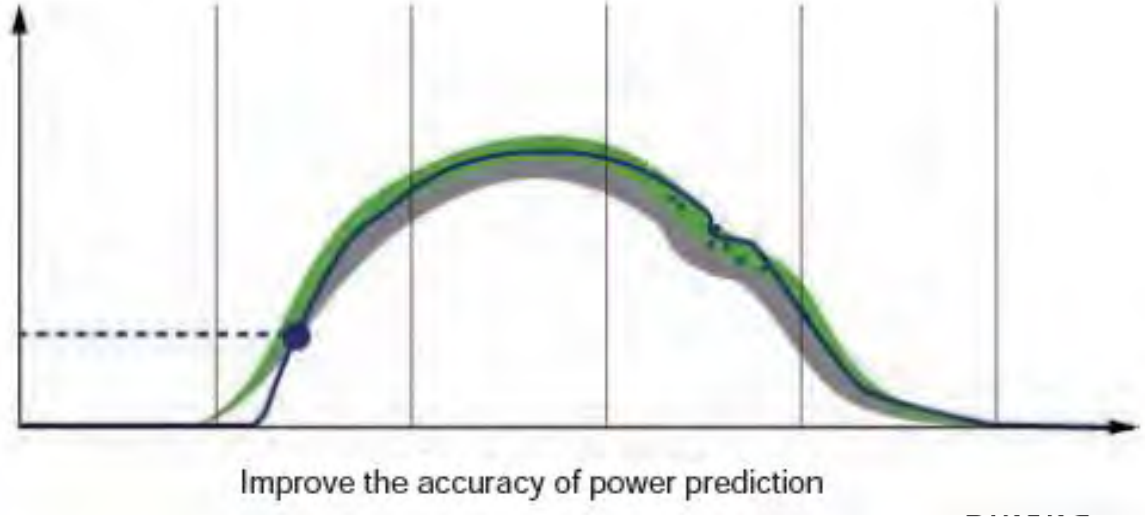
PV+BSS-----Ultimate solution for PV Power Plant

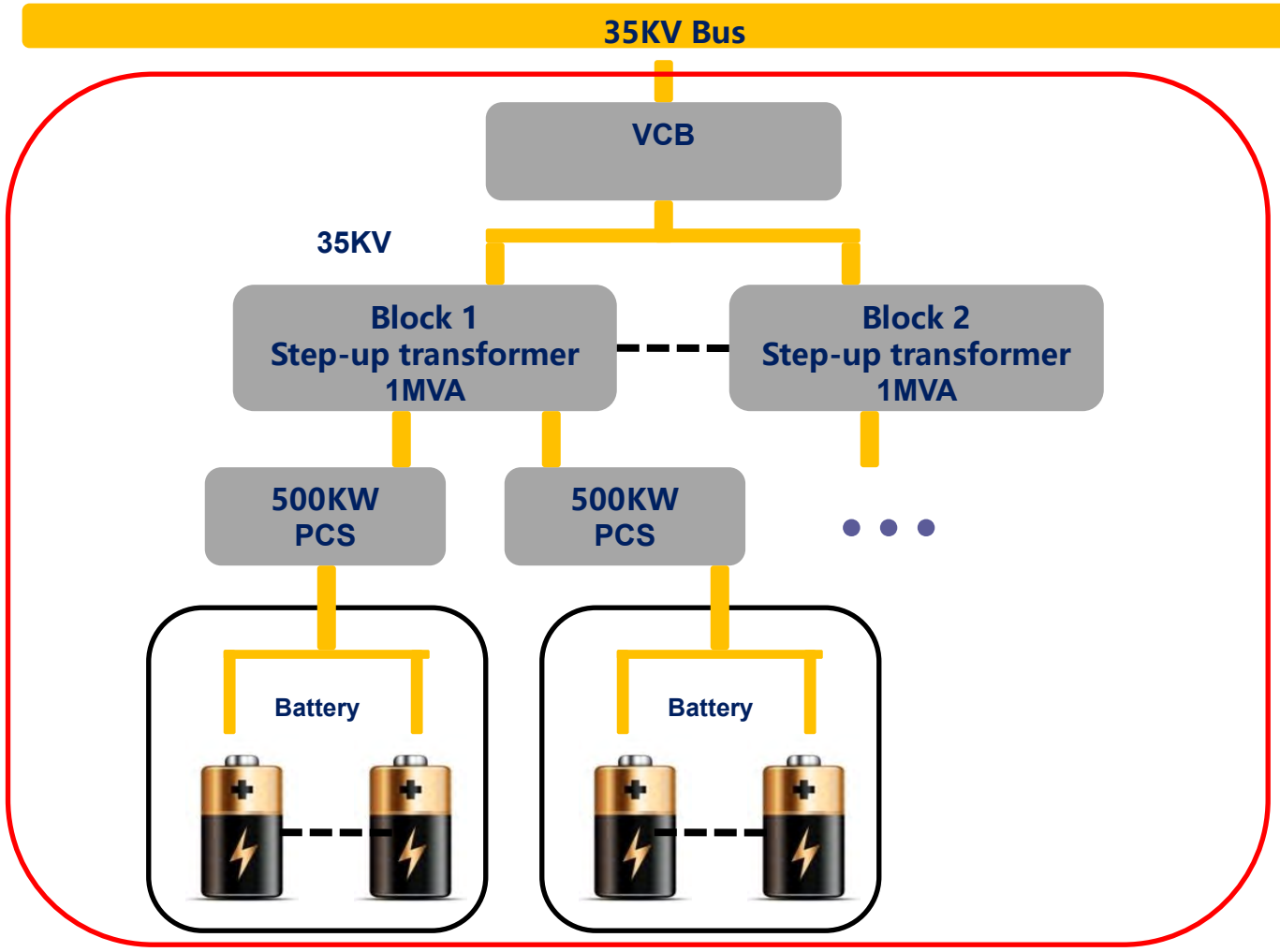








AC coupled storage system



Features:

- As a common application solution , can be met nearly all the requirement.
- Do not disturb the previous system , can be installed and work separately;
- PCS from several KW to 10MW possible;

Stand-along AC coupled battery storage system

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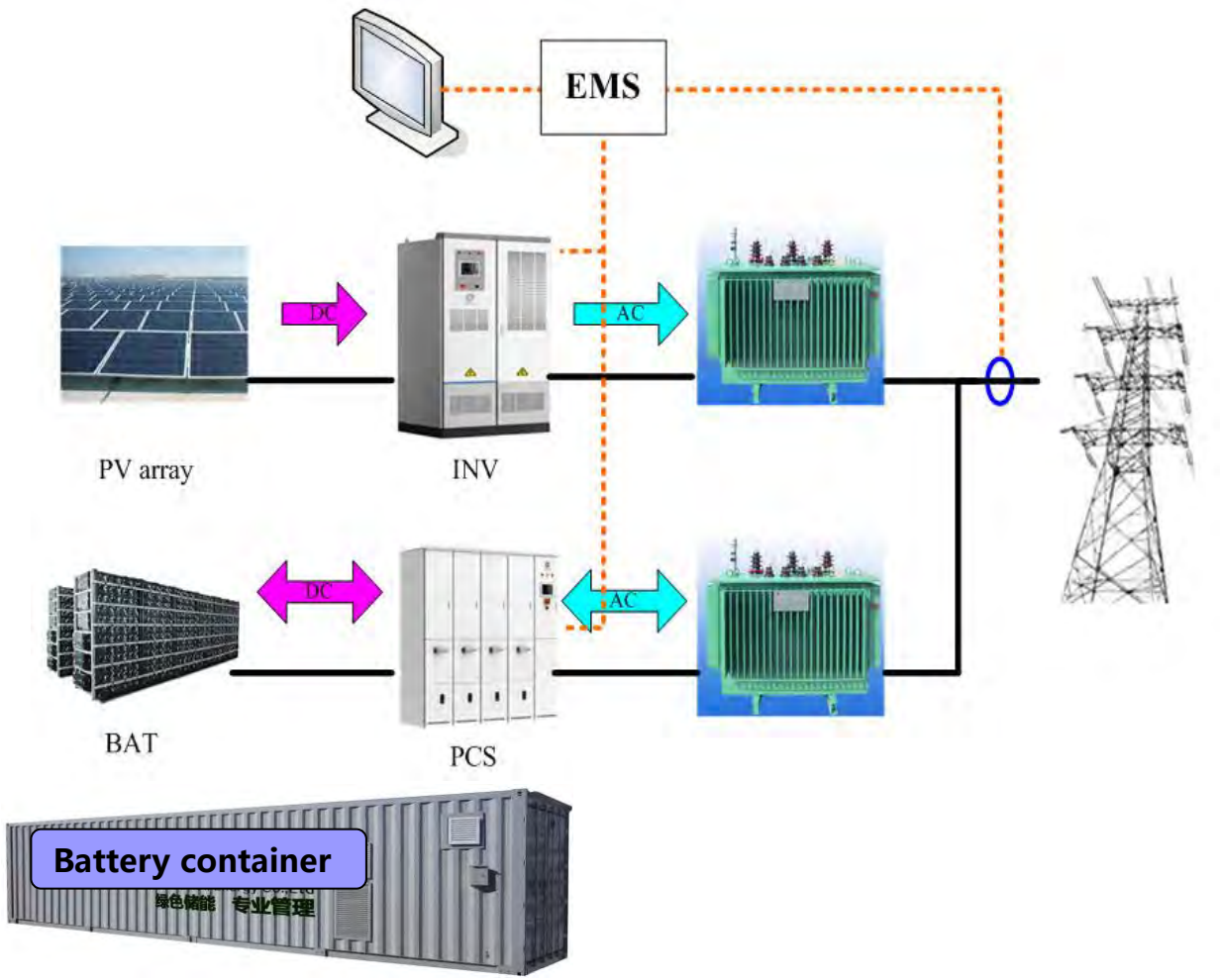
Limitations of AC Coupled Energy Storage System in Solar Plant



Longer Charge route, lower system efficiency

More equipments, duplicated investment，higher cost

Need a new set of grid connecting certifications/ procedures

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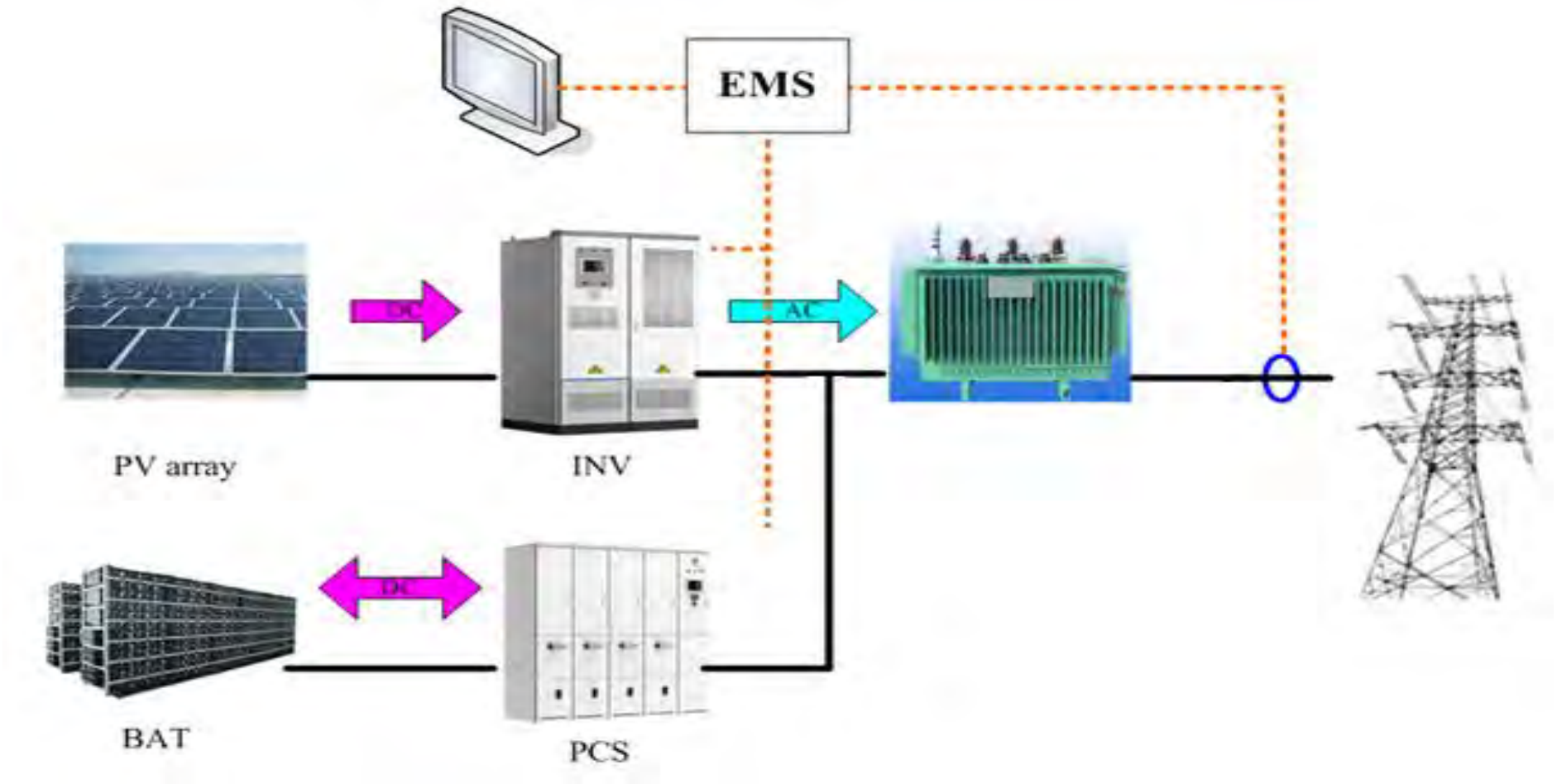
AC coupled storage system



Distributed tight AC coupled battery storage system

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DC Coupled Storage most Cost-effective scheme- By NREL

In NREL report/2018, with the continuous increase of the PV plant in the power Grid, PV+ Storage will be more popular, especially the DC Coupled storage system cost-effective mostly

Evaluating the Technical and Economic Performance of PV Plus Storage Power Plants

Paul Denholm, Josh Eichman,
and Robert Margolis
National Renewable Energy Laboratory

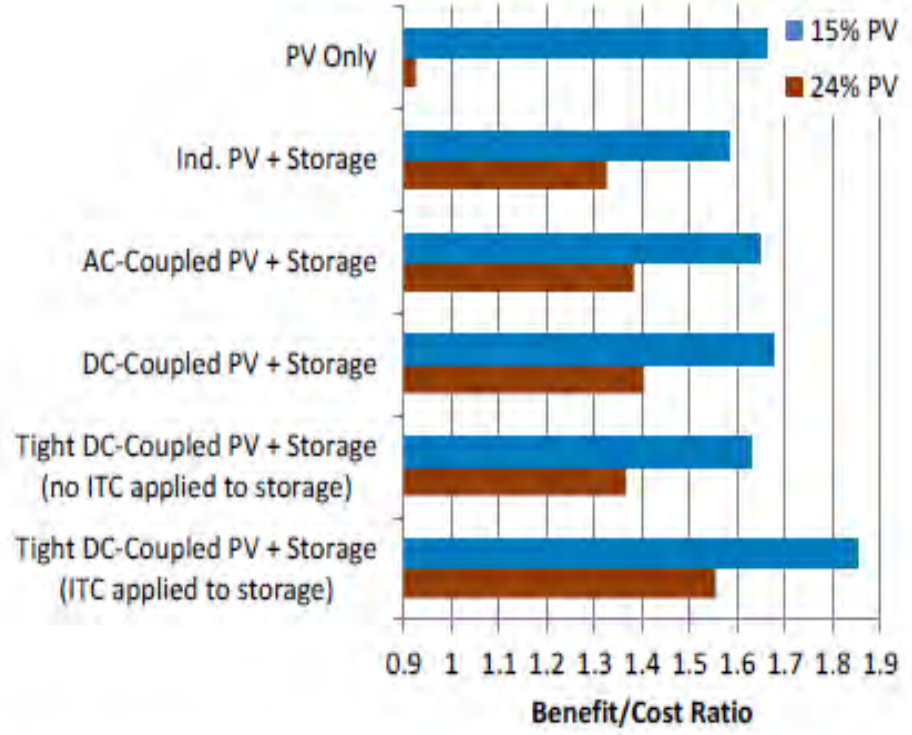
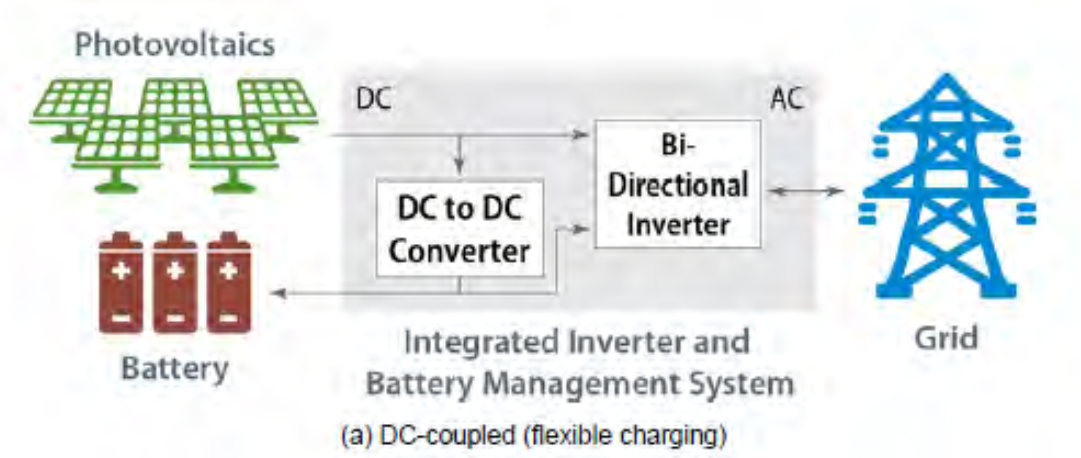


Figure ES-2. B/C Ratio for PV plus storage in California in a 2020 scenario with two different levels of PV penetration and the 30% ITC

DC Coupled Storage—Sineng Distributed DC Storage system

DC Coupled Distributed Storage system features higher efficiency and lower investment advantage.



DC Coupled storage system

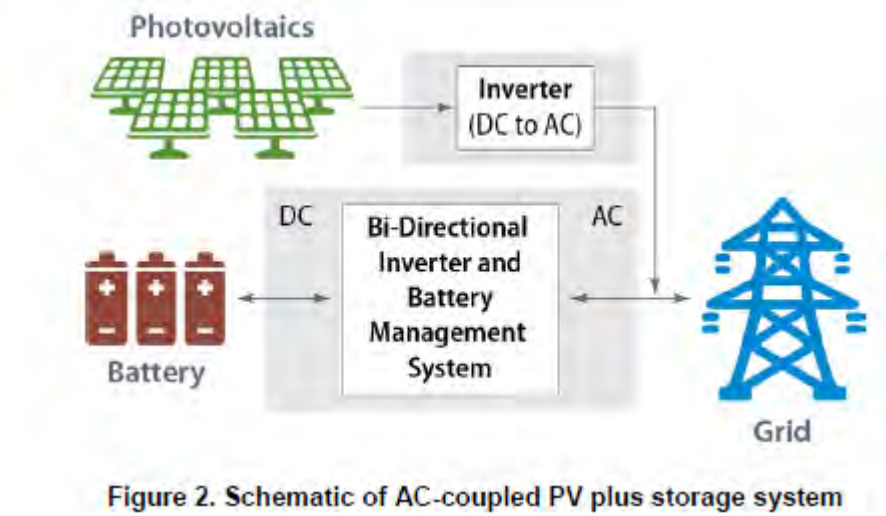


Figure 2. Schematic of AC-coupled PV plus storage system

AC coupled storage system

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The above picture is taken from the evaluation report of photovoltaic energy storage system technology of the US National Renewable Energy Laboratory

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DC Coupled Distributed Storage Solution----Bidirectional DC PCS

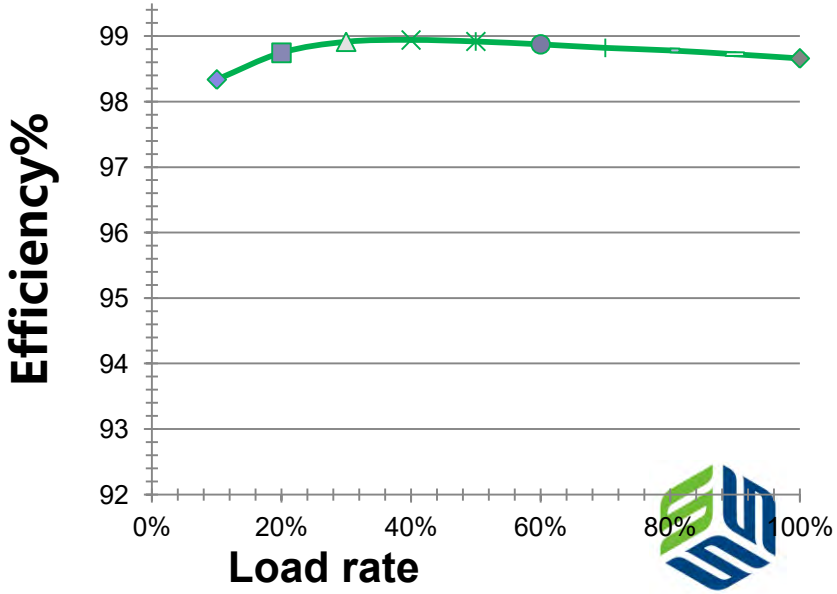
Modular Design Bidirectional DC PCS

Charge/Discharge Power: 250kW

Charge/Discharge Current: 0~440A

Charge/Discharge Voltage：0~1000V

Max. Efficiency： 99%



- All kinds of Battery compatible, support individual battery string input connection;
- AC&DC input Redundancy for Aux. power supply;
- Inbuilt EMU(Energy Management Unit);
- SiC Device inside, higher efficiency and lower ripple C/D current;
- Four-quadrant power flow control, bidirectional fully protection;

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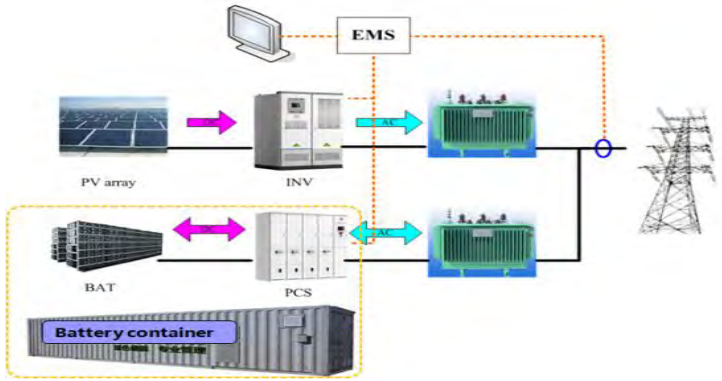
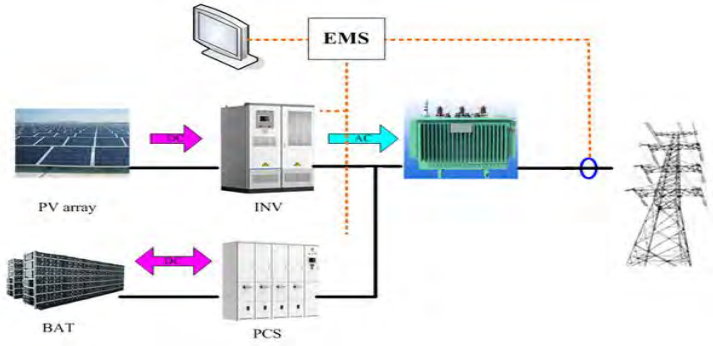
DC Coupled Distributed Storage Solution----Bidirectional DC PCS





Efficiency	Stand-alone AC coupled	Tight AC Coupled	DC Coupled
	Average Eff	Average Eff	Average Eff
Inverter Efficiency	98.50%	98.50%	98.50%
PCS Efficiency	97.50%	97.50%	/
Transformer(INV) Efficiency	99.00%	99.00%	99.00%
Transformer(PCS) Efficiency	99.00%	99.00%	99.00%
Battery Efficiency	99.50%	99.50%	99.50%
other loss (Line)	99.20%	99.50%	99.50%
System Efficiency/Charge	92.91%	95.08%	97.52%
System Efficiency/Discharge	95.27%	96.04%	95.57%
System Efficiency/Total	88.52%	91.32%	93.20%

DC Coupled Distributed Storage Solution---- Standard Container solution

Industrial AC

RS485

Dry contact

〔20升〕
悬挂式七氟丙烷灭火装置安装示意图

Ethernet

Battery Pack1#

Ethernet

Battery Pack 2#

Optical fiber communication ring network

10 Feet 500KWH Storage container

20 Feet 1000KWH Storage container

Flexible modular design, : easy for Installation and commission, can be paralleled for larger capacity

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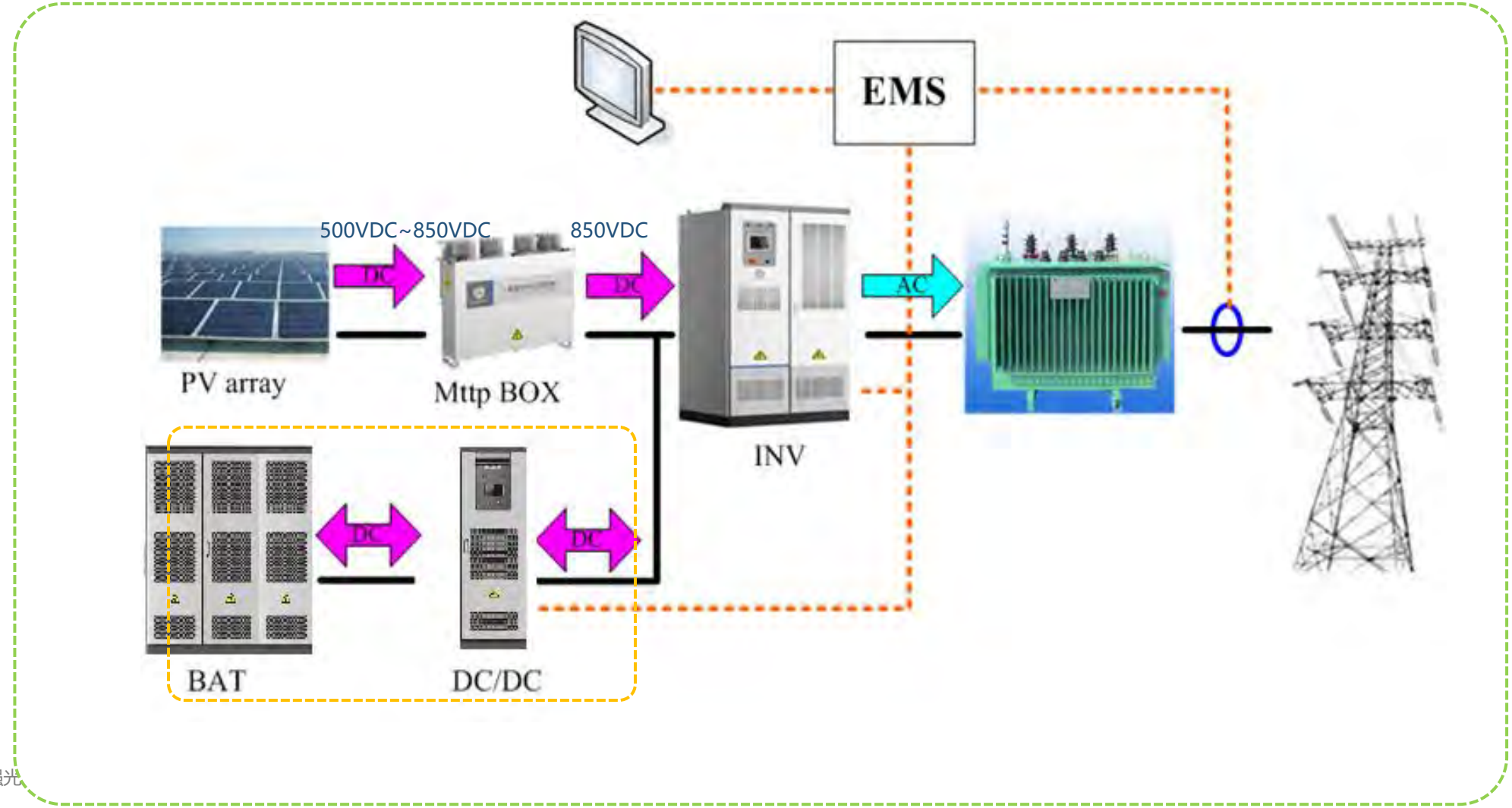
Central distributed system +DC Coupled Storage System -Perfect Solution

DC PCS connect to PV 850Vdc bus, no influence to the MPPT function



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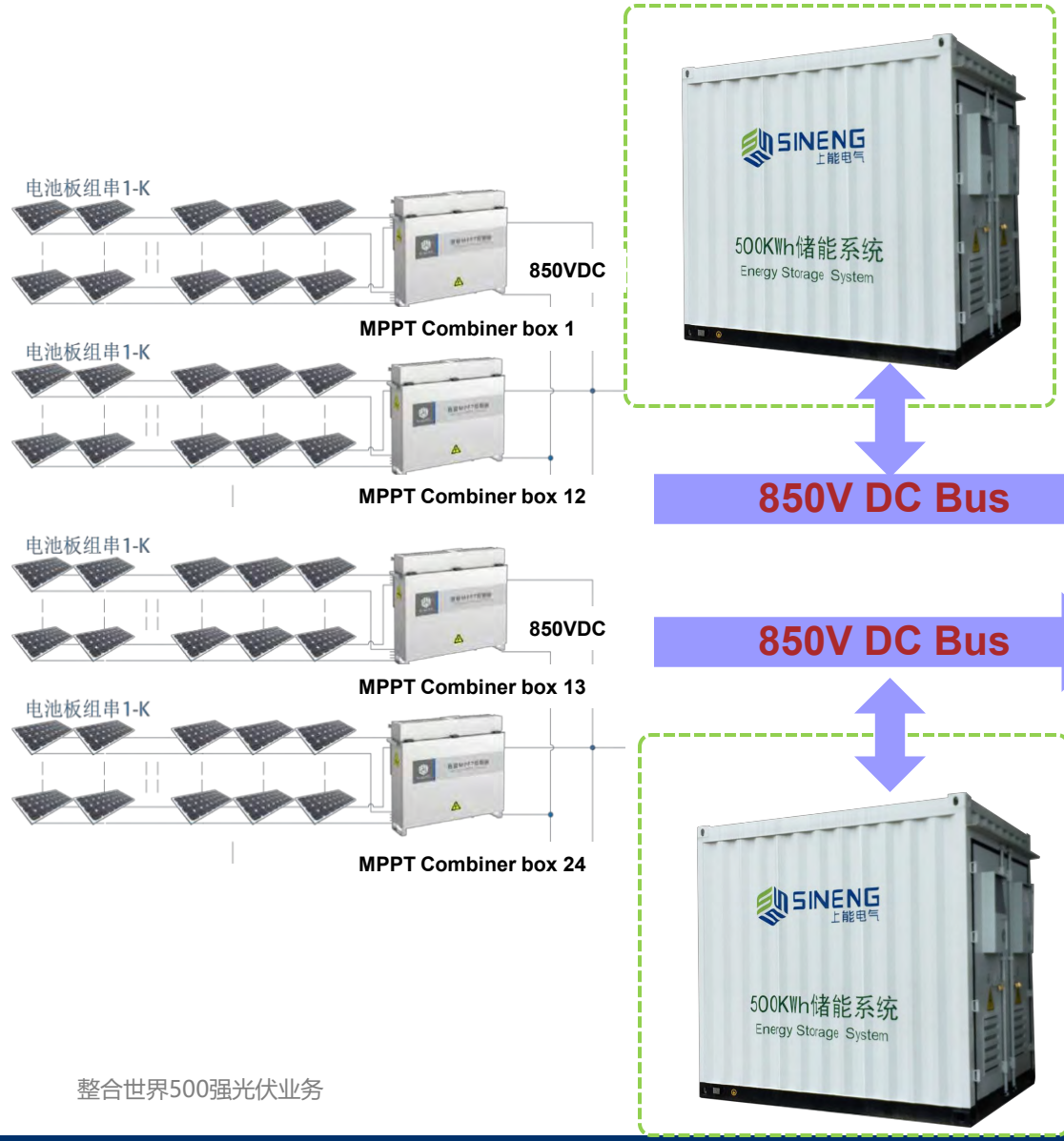
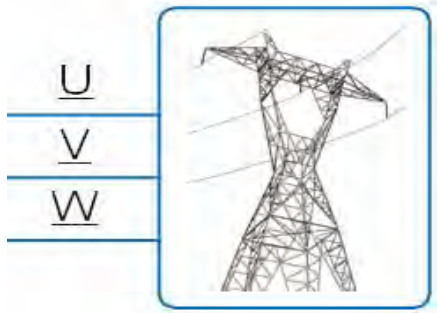
Central distributed scheme + DC Coupled Storage----Best solution



Better performance and keep the low cost and higher system efficiency features

2MW central distributed inverter container



2MW PV+500kW/1000kWh system

Step by Step Investment possible

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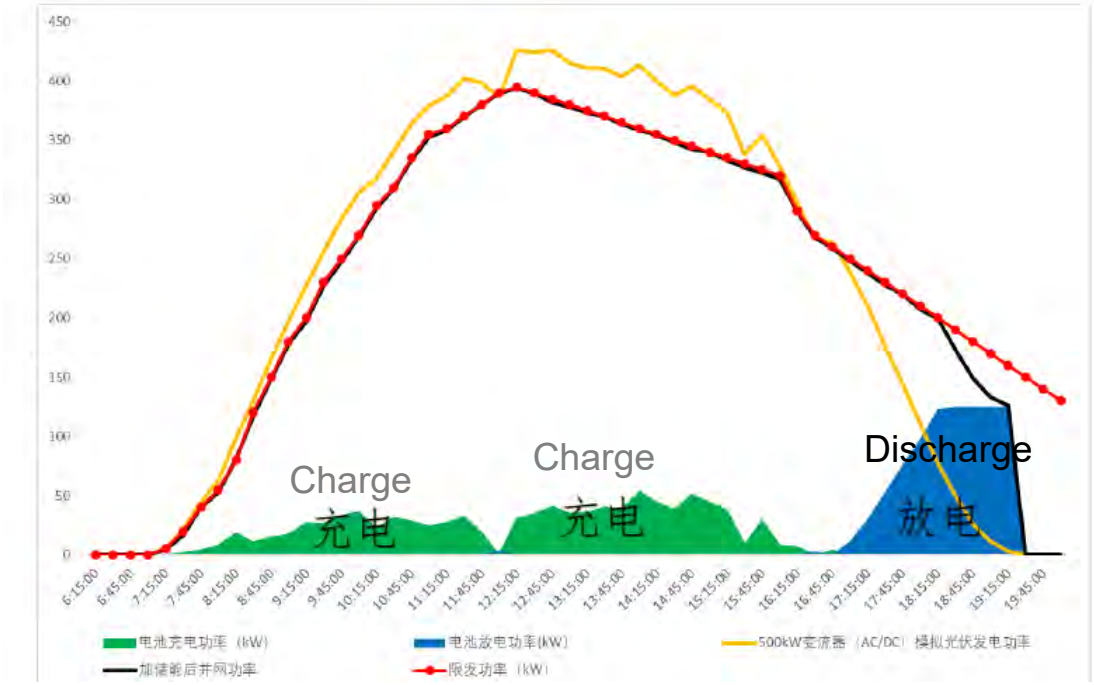
DC Coupled Distributed Storage Solution----Smooth output power curve

Sineng-Panosonic Storage solution



PV output power curve follow the setting value

PV output power curve settable and controllable

The output power generation curve can be programmed , system will automatically control the PCS charge / discharge the battery

DC Coupled Distributed Storage Solution----Reference

Huaneng Geermu solar project site----200KW/250KWh storage system
Container design-200KW DC PCS +250KW Lead Carbon battery

Pset is the inverter pre-set power curve
Pout is the inverter output power curve
P_ba is the storage system power curve

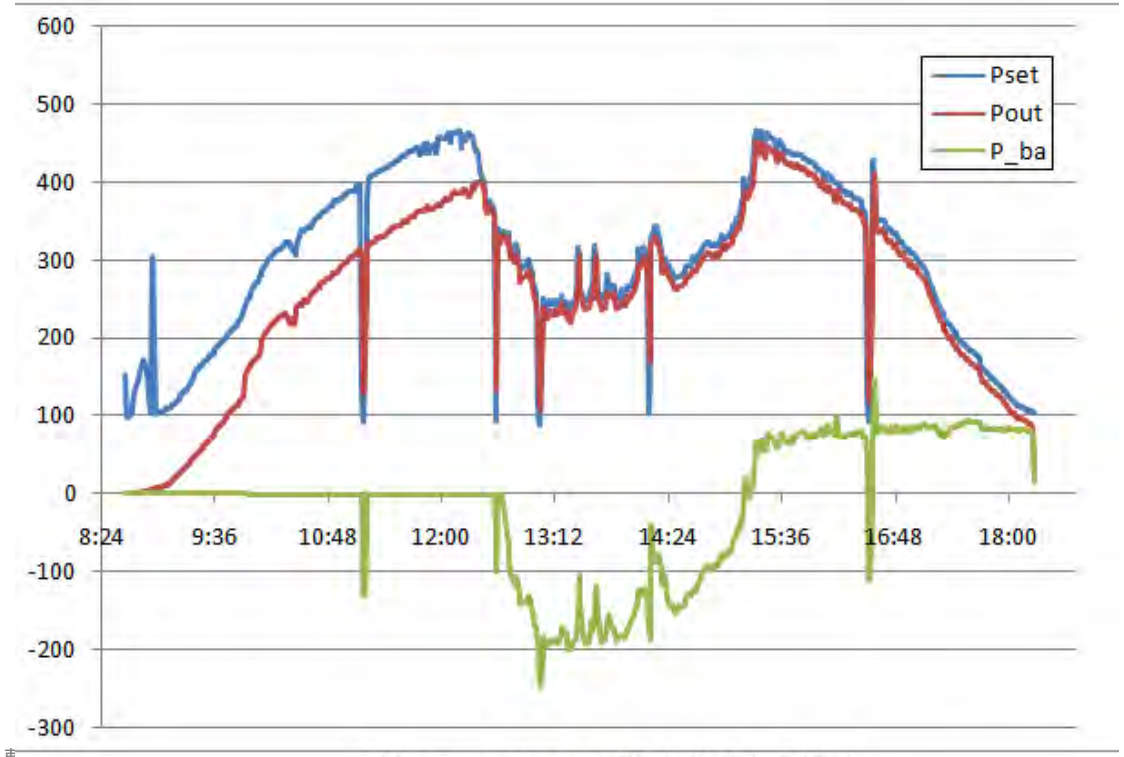


图 13 2017.12.17 南都集装箱功率时间图

Output power curve without storage system

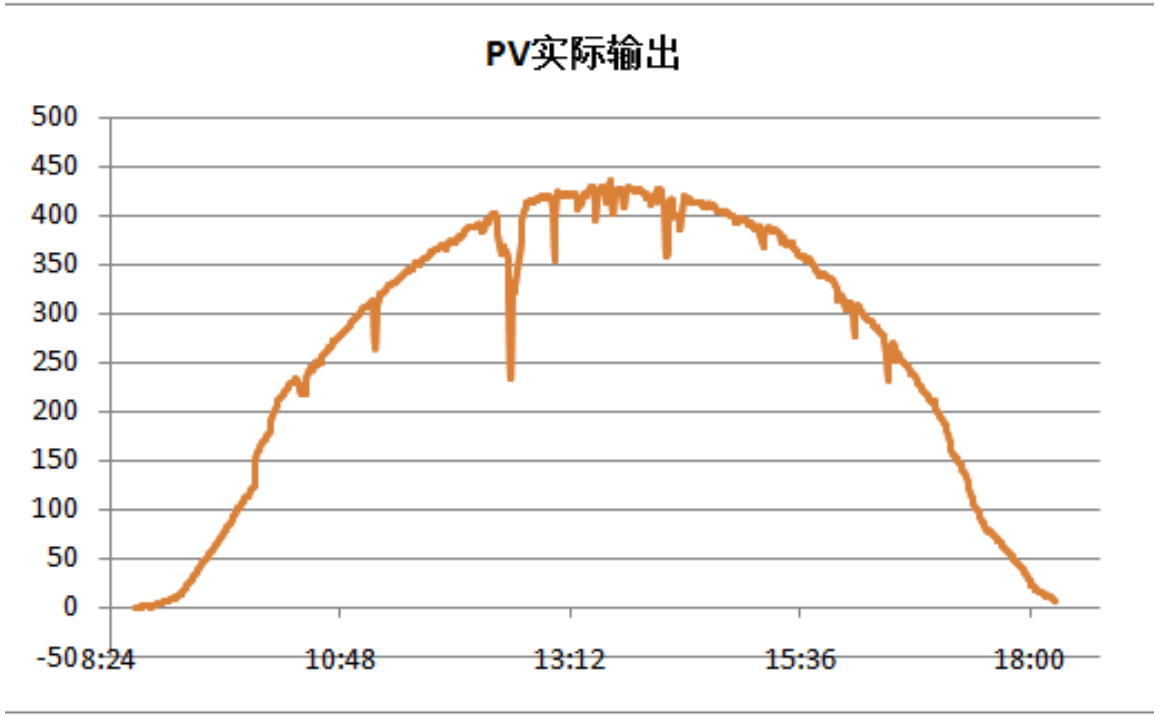
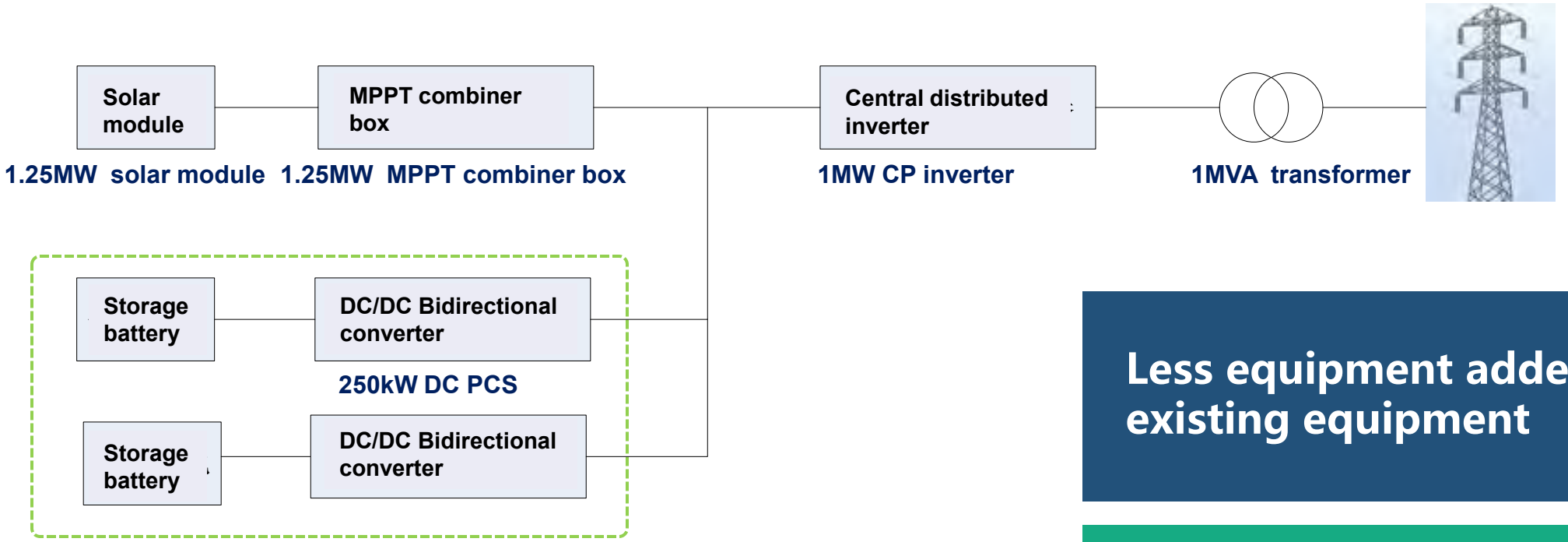
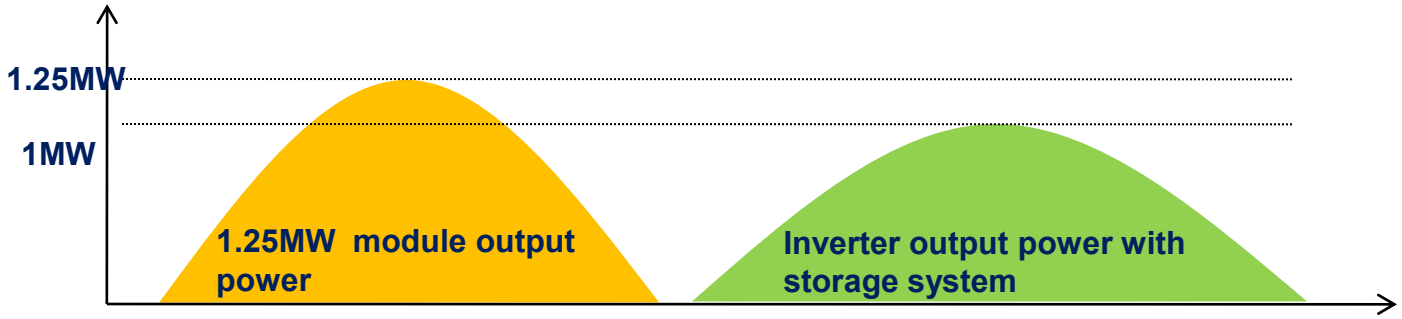


图 14 南都 PV 输出功率图

DC Coupled Distributed Storage Solution-Saving Initial Investment





Less equipment added, full use of existing equipment

Further increase the DC/AC ratio, reduce the power station electricity costs

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DC Coupled Distributed Storage Solution---Flexible battery applied

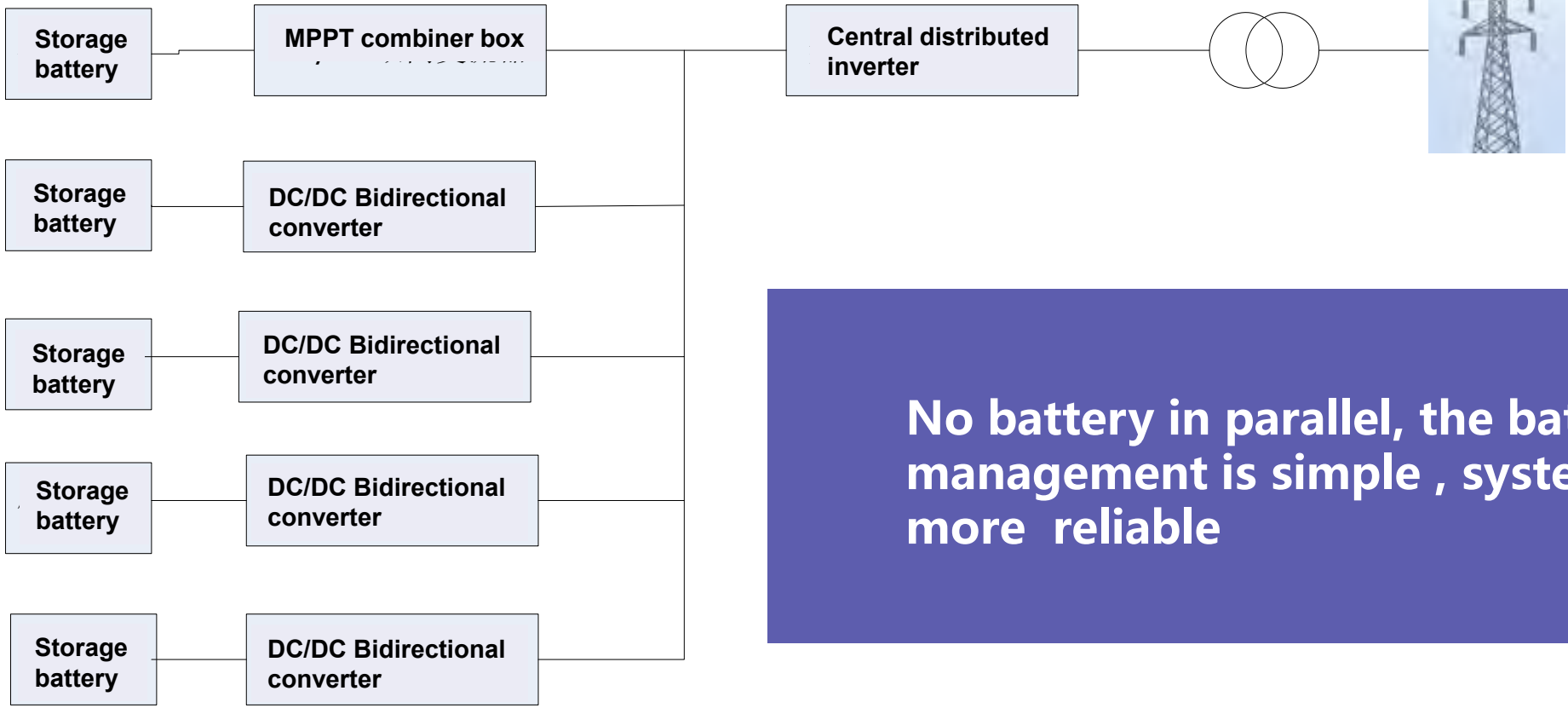
Year 2017
New solar plant

Year 2018
650V 450kWh
Lithium Battery

Year 2019
600V 500KWh
Lithium iron phosphate battery

Year 2022
400V 300kWh
Electric vehicle decommissioned battery

Year 2015
600V 200kWh
Lead carbon battery



No battery in parallel, the battery management is simple , system is more reliable

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DC coupled Distributed Storage Solution---distributed layout, lower risk

Distributed storage container

Block 1

Distributed storage container

Block 2

Distributed storage container

Block 3

Distributed storage container

Block 4

➢Distributed layout, physical isolated, no chain reaction risk, more safety.

➢step by step investment step by step construction

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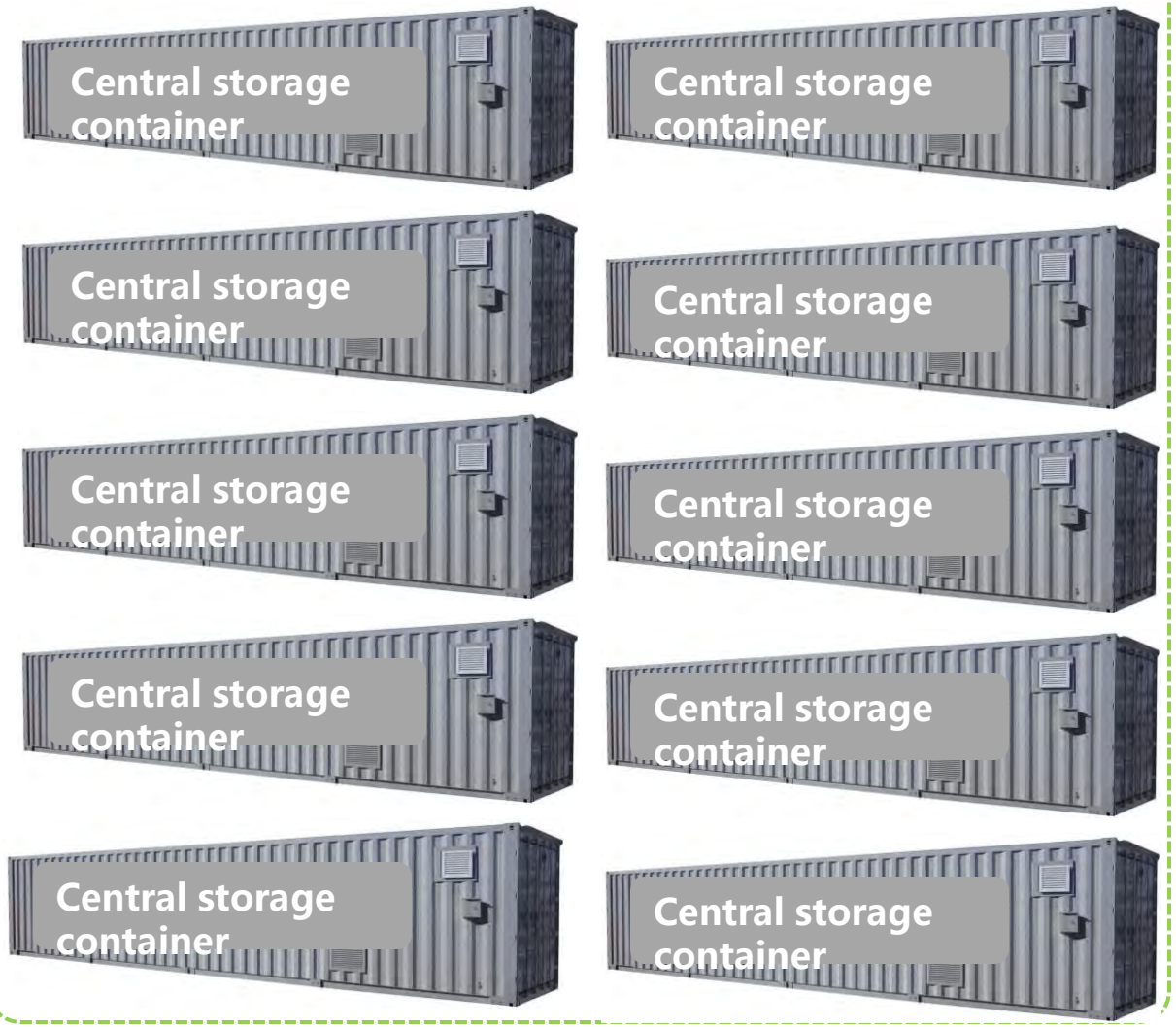
DC coupled Distributed Storage Solution---distributed layout, lower risk



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Central storage solution

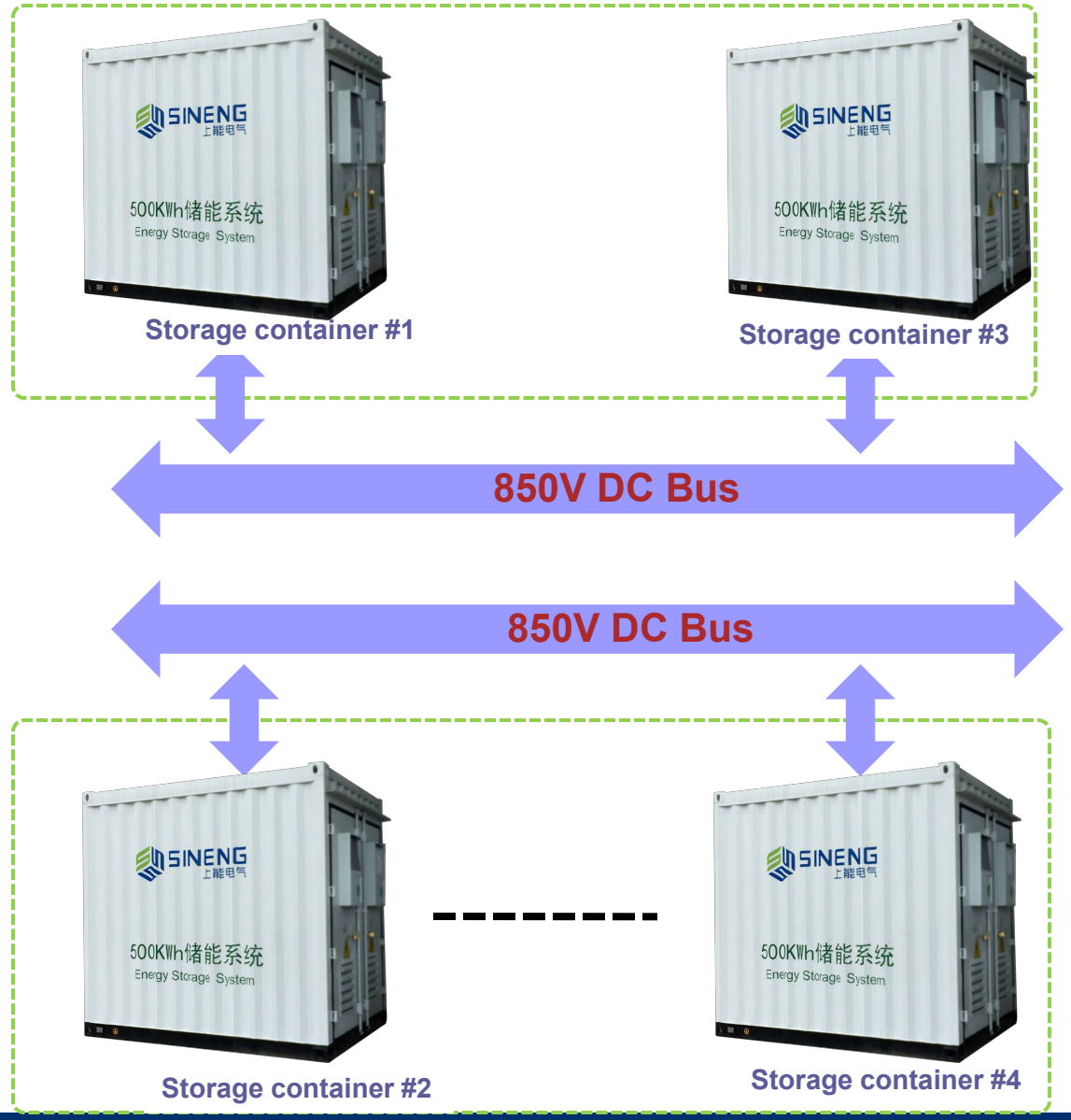
Large Scale Storage container

No physical Isolation

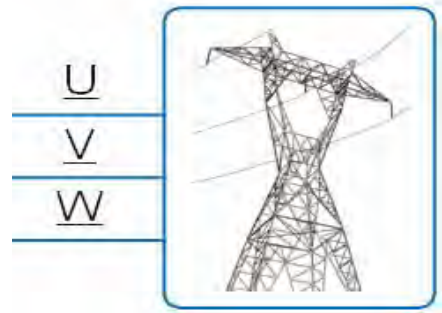
Any accident may cause huge losses

SINENG

Improved AC coupled storage solution----distributed storage for non-solar storage system



2MVA central-distributed integrated inverter solution



2MW 4000kWh AC distributed storage system

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Improved AC coupled storage solution----distributed storage for non-solar storage system

- Central-distributed inverter with bidirectional capability with more than 4GW reference
- Integrated with Step-Up transformer, saving the cost and period of installation
- Each DC PCS individually charge/discharge battery pack with highly control accurate and lower DC ripple current
- Constant DC 850V Bus voltage will increase the AC PCS efficiency
- 520V AC voltage will decrease the system lost

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Summary

Item	Stand-alone AC coupled	Tight AC Coupled	DC Coupled
System configuration	central	distributed	distributed
System investment	high	low	low
DC/AC ratio	limited	limited	up to 400%
System safety	low	middle	high
System efficiency	low	middle	high
Compatibility with orignal PV system	high	low	high
Energy management Complexity	complex	complex	easy
Charge and discharge Operation range	narrow	narrow	0-850VDC
Battery Compatibility	certain type	certain type	All tpye

Sineng DC coupled storage reference

- Huaneng, Demonstration 250KW/1MWh storage system
- PCS: Sineng bidirectional DC PCS
- Battery: ZTT Lithium iron phosphate battery

Sineng-ZTT Lithium iron phosphate battery storage solution

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Sineng PV coupled storage reference

Huaneng ,Geermu (Phase 4) ,250KW/1MWh DC storage system

Sineng-Narada Lead carbon battery DC storage solution

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Sineng PV coupled storage reference

- Sineng-Panasonic 100KW/125KWh Li(NiCoMn)O2 battery DC storage solution
- Sineng-EVE 100KW/125KWh Lithium iron phosphate battery DC storage system
- Integrated with Sineng Central-distributed inverter system

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