AI BOOST Optimal Electricity Cost & Active Safety

FusionSolar Residential Smart PV Solution

HUAWEI

01 **Company Introduction**

02 FusionSolar Residential Smart PV Solution

03 Summary

HUAWEI

Continuously Creating Values for Customers Achieving Sustainable Business Growth

Sustainable business growth with large operation scale & diversed business groups

170+
Countries and regions

44 in
Fortune Global 500

197,000
Employees

53.4%
R&D employees

14
Research institutes/ labs/centers

No.3 in
In R&D Investment

2020 Sales Revenue US$136.7 Billion

US$ billion

Year	Value
2013	39.3
2014	46.7
2015	63.1
2016	75.1
2017	92.5
2018	105.2
2019	120.9
2020	136.7

Huawei Digital Power: Leading Energy Digitalization for A Smart and Sustainable World

Digital Power

Site Power Facility

Provides power supply solution for communication network

No.1 and 29.3%
Market Share
Source: Frost & Sullivan

DC Facility

Provides power supply and distribution systems, cooling system and management system for data center

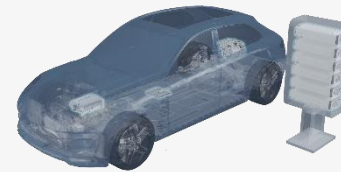No. 1 and 25.1%
Market Share in China
Source: Frost & Sullivan

Smart PV

Provides PV controller and management system for PV plants

2015-2020
No.1 Market Share
Source: IHS Markit

mPower

Provides Power system, Charging system and battery management system for electric vehicles

1st for the DC Charging
Module Conversion Efficiency
Source: State Grid Electric Power Research Institute.

Modular Power Supply

Provides Embedded power supply and adapter for ICT and terminal devices

Leading in Power Density, Efficiency & Reliability

Leader in ICT Digital Power Infrastructure

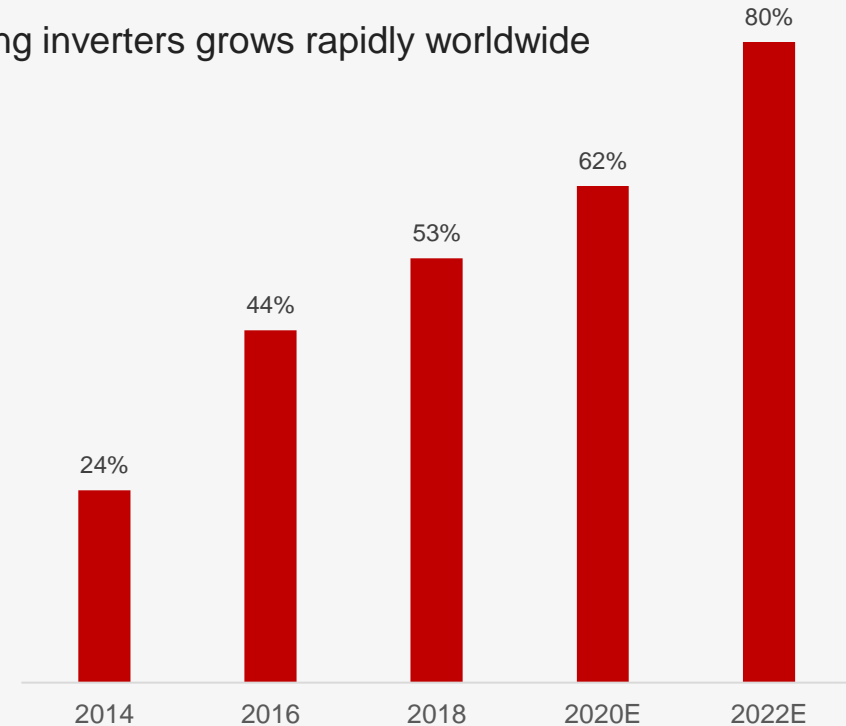**Leader in New Energy Digital Electronics**

Leader in Embedded Power Supply

Cumulative 160GW+ Global Sipments, Leading String Solution to become the Mainstream

The Leading Brand
Global Inverter Shipment

2015 – 2016 – 2017 – 2018 – 2019 -2020

IHS Markit

String inverters grows rapidly worldwide

Year	Percentage
2014	24%
2016	44%
2018	53%
2020E	62%
2022E	80%

Data Source: Third Parity Consultant Company

Leading Smart String Solution for All PV Scenarios

Commercial & Industrial

12~20kW 30~40kW

50/60kW 100kW

Residential

2~6kW 3~10kW

Utility-scale

215kW 100kW

Smart & String for All PV Scenarios

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Smart PV Solution

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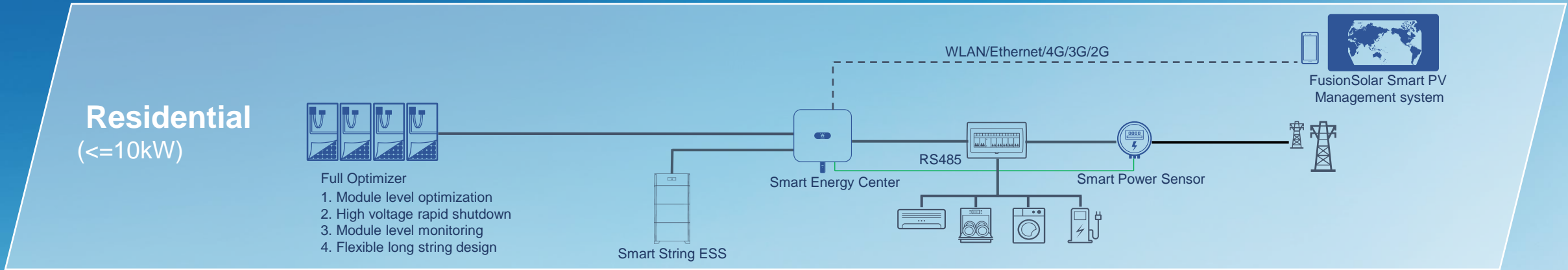# FusionSolar Residential Smart PV Solution

👍 Optimal Electricity Cost 🛡 Active Safety 👥 Better Experience

FusionSolar Residential Smart PV Solution

Residential
(<=10kW)

WLAN/Ethernet/4G/3G/2G

FusionSolar Smart PV
Management system

Full Optimizer
1. Module level optimization
2. High voltage rapid shutdown
3. Module level monitoring
4. Flexible long string design

Smart Energy Center

RS485

Smart Power Sensor

Smart String ESS

Smart Energy Center

SUN2000-2/3/3.68/4/4.6/5/6KTL-L1

Single Phase

Smart Energy Center

SUN2000-3/4/5/6/8/10KTL-M1

Three Phase

Smart String ESS

LUNA2000-5/10/15-S0

Support 2 ESS operating in parallel, up to 30kWh

Backup Box

Backup Box-B0/B1

Smart PV Optimizer

SUN2000-450W-P

Smart Dongle

Smart Dongle-WLAN-FE
Smart Dongle-4G

Smart Power Sensor

DDSU666-H (Single Phase)
DTSU666-H 100A(Three Phase)
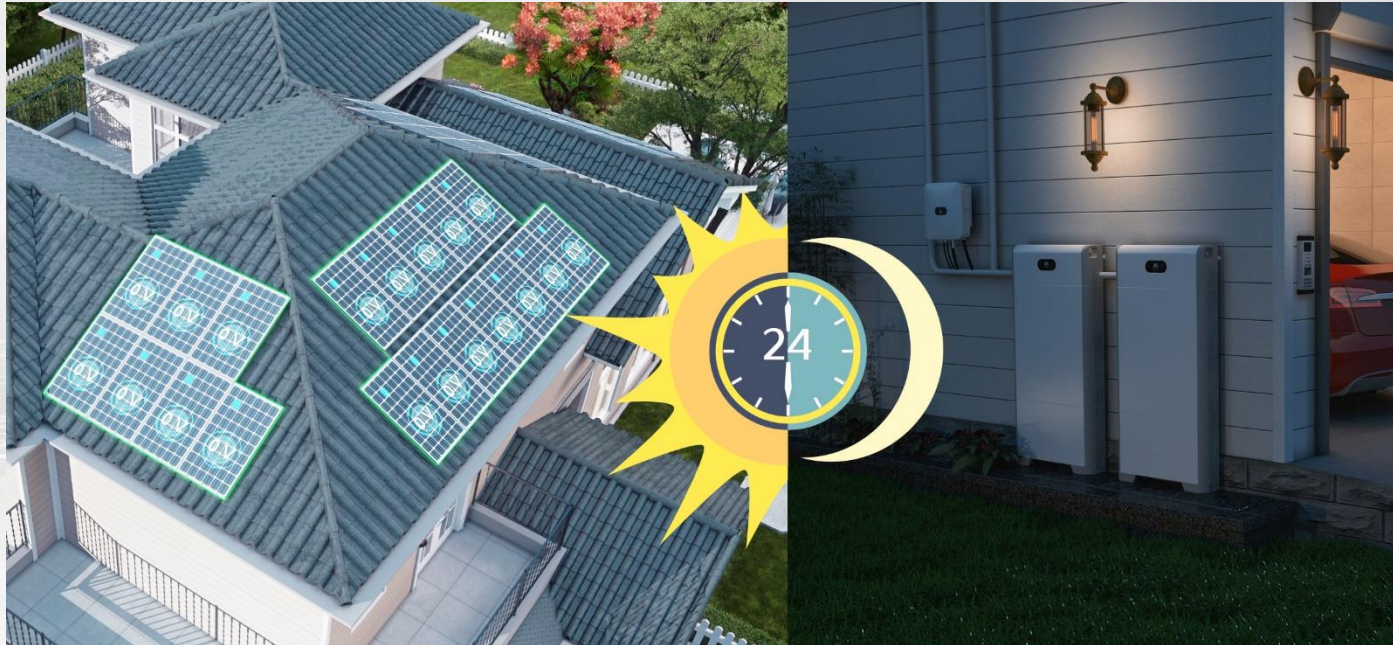DTSU666-H 250A (Three Phase)

Monitoring Portal

FusionSolar Cloud & APP

Optimal Electricity Cost   Active Safety   Better Experience

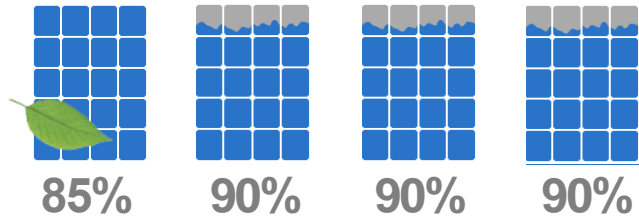**Generate** more PV energy for **daytime** consumption

Store more PV energy for **nighttime** consumption
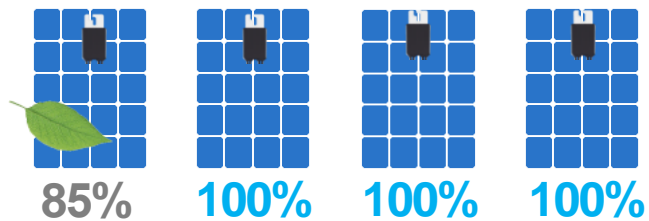
Maximized PV Power Self-Consumption

Up to 30%
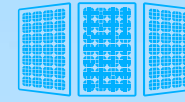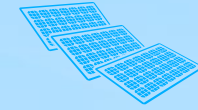## More Energy by Optimizing Each Module's Performance

Shading   Different Azimuth   Different Tilt

Without optimizer

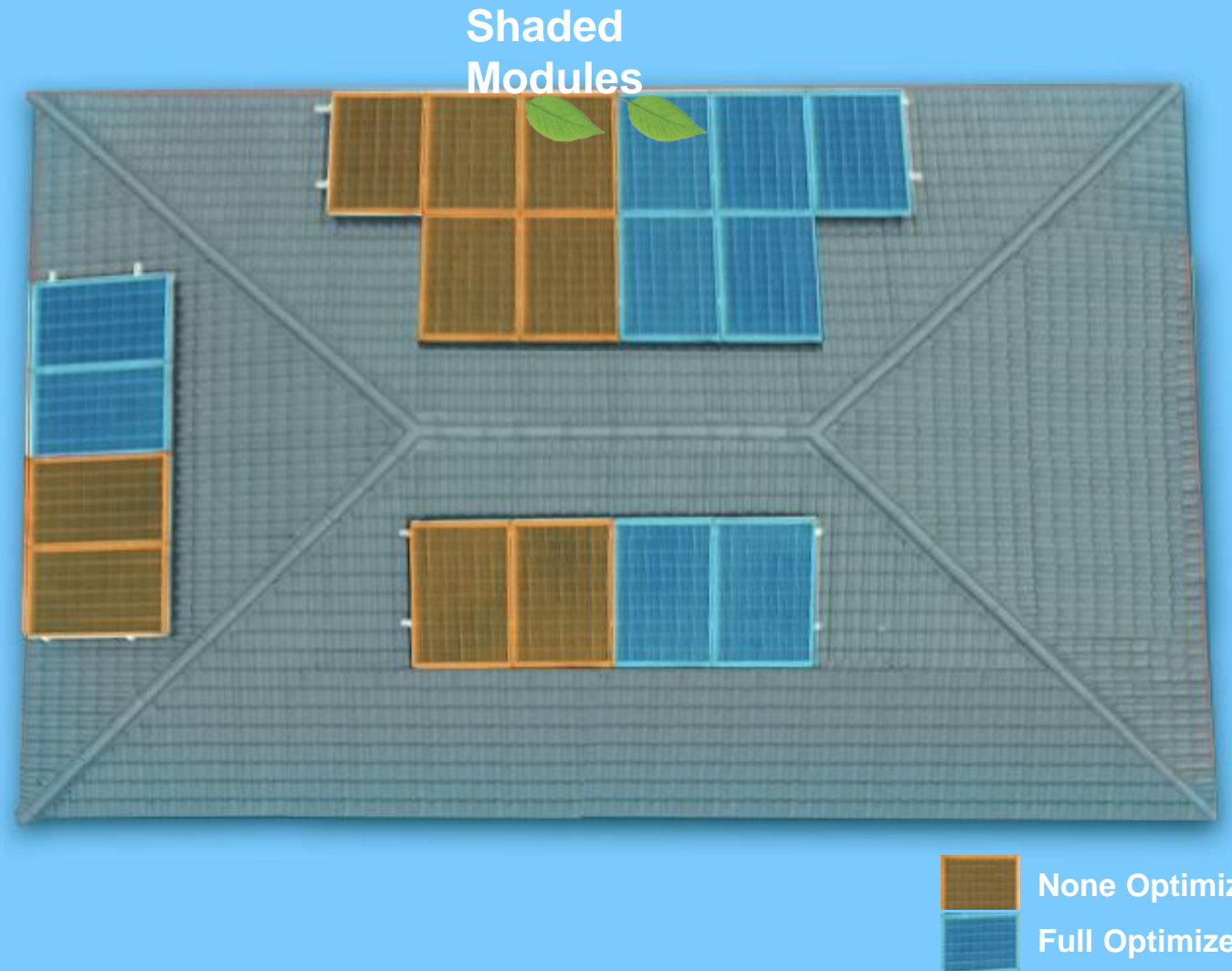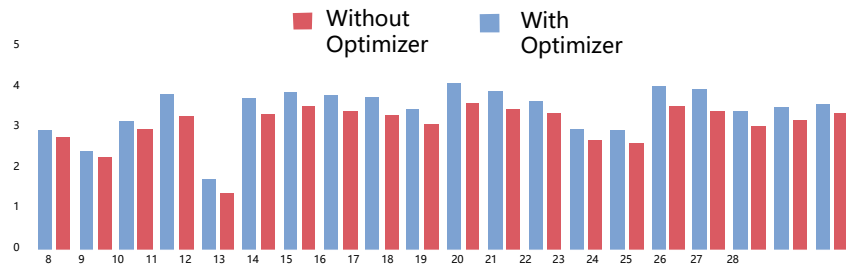85%   90%   90%   90%

With optimizer

85%   100%   100%   100%

Comparison Case
of Energy Yields

**Full optimizer system generates average 10%-13% more energy per day than no optimizer system**

Without Optimizer · With Optimizer

Shaded Modules

None Optimizer

Full Optimizer

	No Optimizer	Full Optimizer
PV Module	2,205 Wp	2,205 Wp
Optimizer	N/A	9x SUN2000-450W-P
Inverter	1x SUN2000-2KTL-L1	1x SUN2000-2KTL-L1

More Modules
with Long & Flexible String Design

Comparison Case

Other Solution

11　7　7

HUAWEI

25
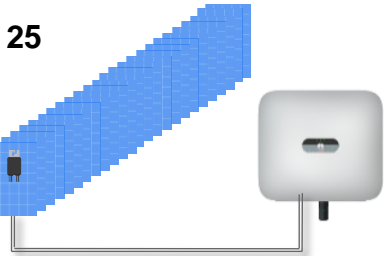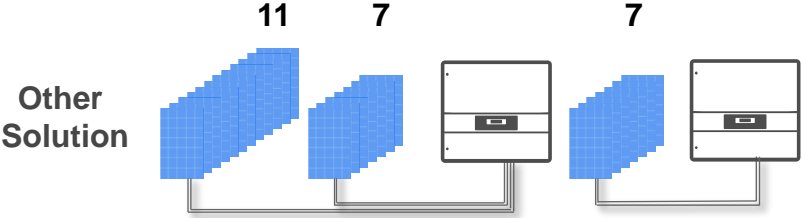
·Max. **200%** DC/AC oversizing for SUN2000- 5KTL-L1 & 10KTL-M1

	SUN2000-2-6KTL-L1	SUN2000-3-10KTL-M1
Maximum DC power per string	5,000 W	10,000 W

Smart String ESS
with Energy Optimizer

Power Module
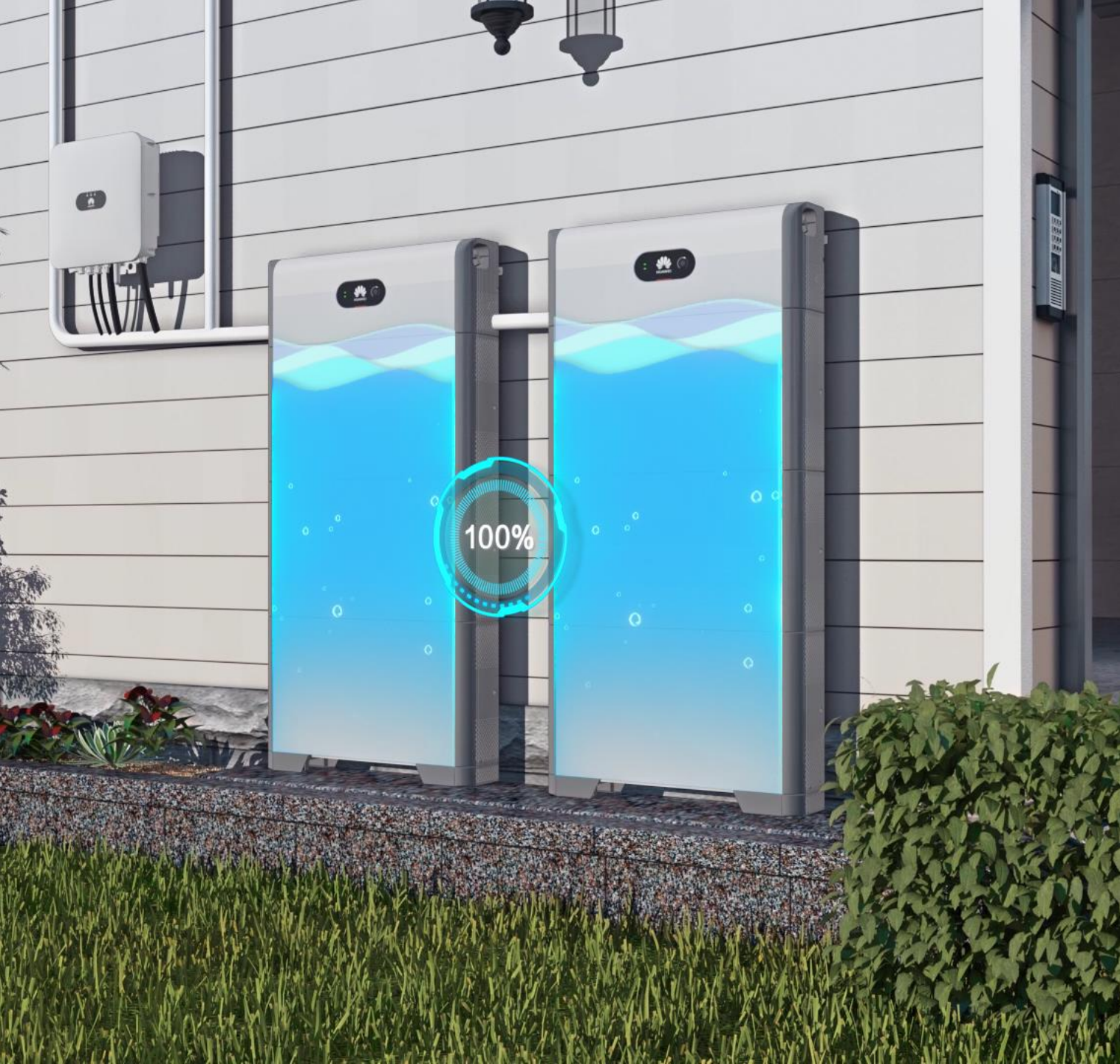
Battery Module
(Built in Energy Optimizer)

LUNA2000-5/10/15-S0

Smart String ESS Solution

A string of battery modules for flexible expansion

Energy optimizer to manage charge/discharge per module independently, supports new and old battery module mixed in one system without usable energy restriction

Other Modular Battery

HUAWEI

60%	60%
60%	100%
60%	100%
60%	

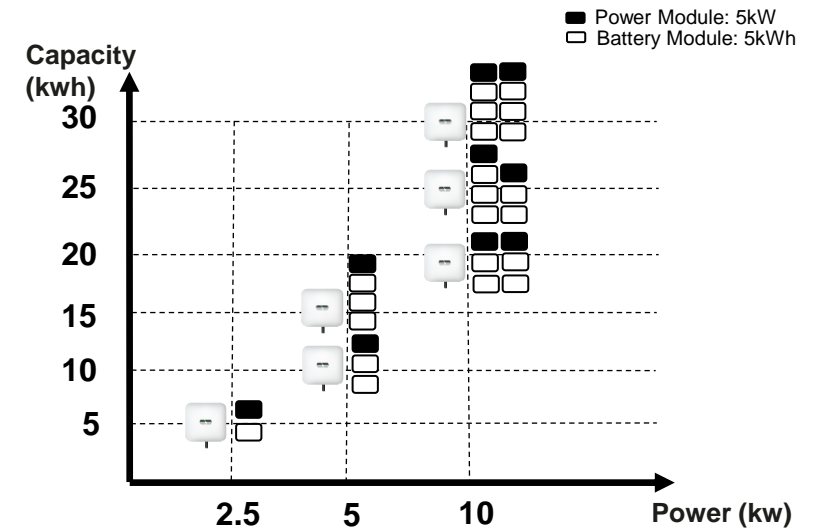SOH | SOC
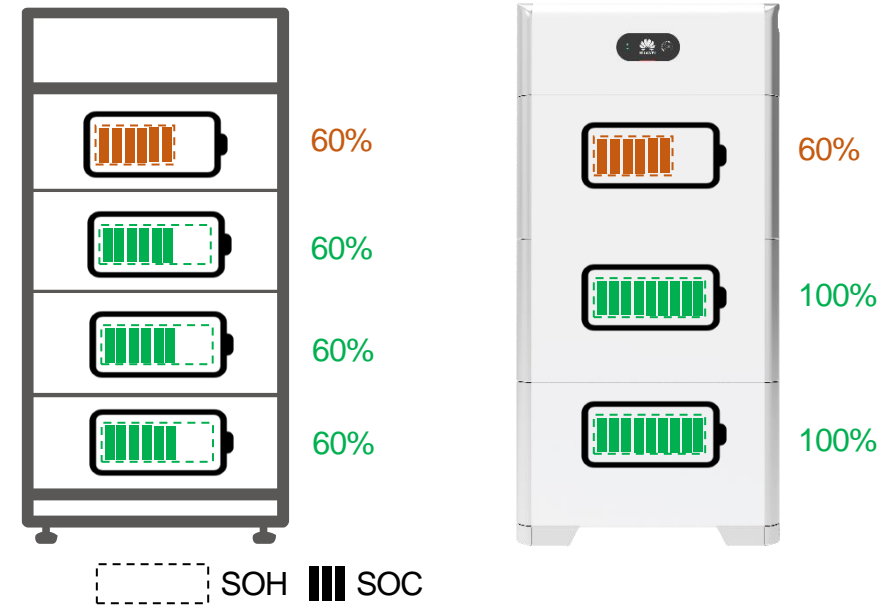
5-30kWh ESS

50kg Battery Module
Easy for two people installation without extra lift tools

100% DoD
100% depth of discharge, use as much energy as you pay for

Parallel Operating
Supports Max 2 Storage System Operating in Parallel, 5-30kWh

Power Module: 5kW
Battery Module: 5kWh

Capacity (kwh)
30
25
20
15
10
5

2.5   5   10   Power (kw)

2x POWER
Battery Ready
For More Energy

A 5KTL inverter allows **5KW** full power AC output plus **5KW** full power battery charge.

More Daytime Consumption

- Inverter output full power for daytime energy consumption

More Nighttime Consumption

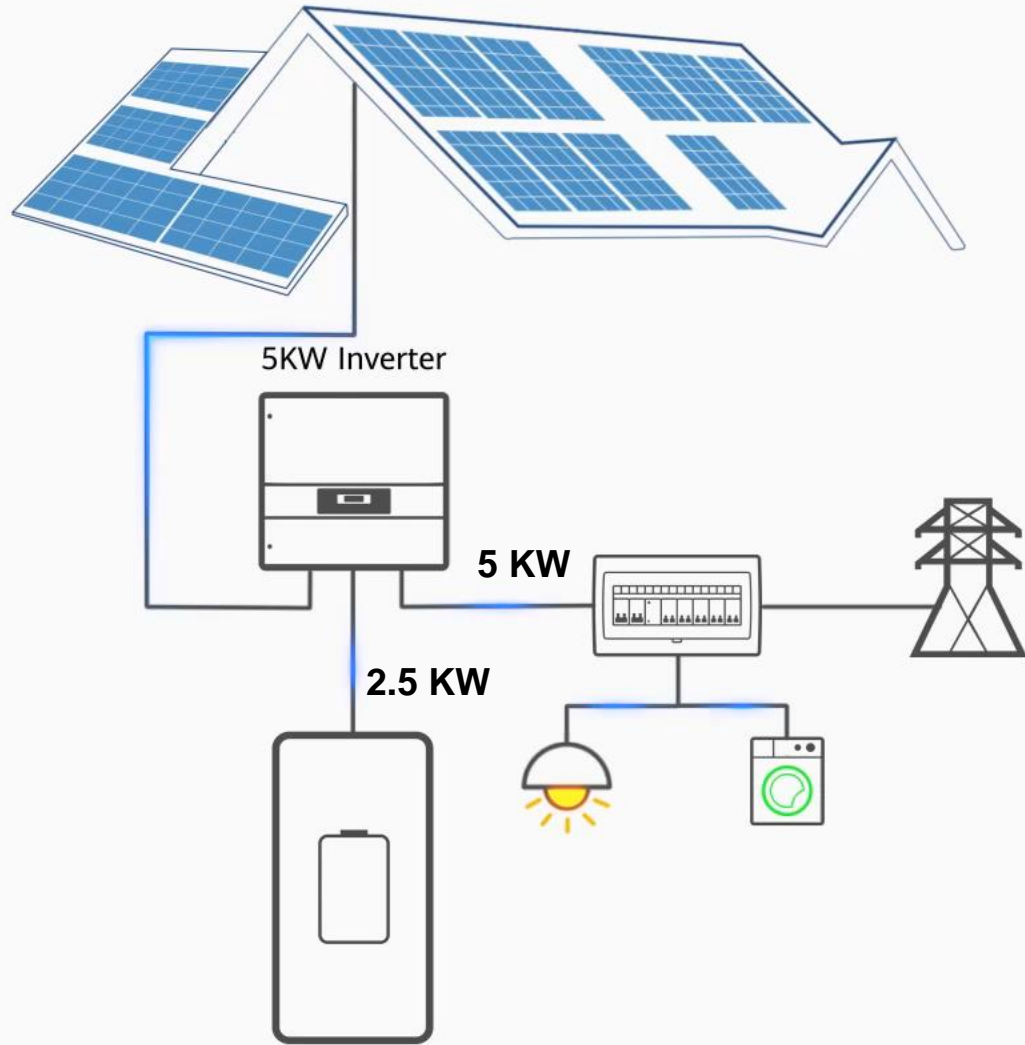- Inverter chargers ESS at full power for more nighttime energy consumption

Other PV + Storage Solution
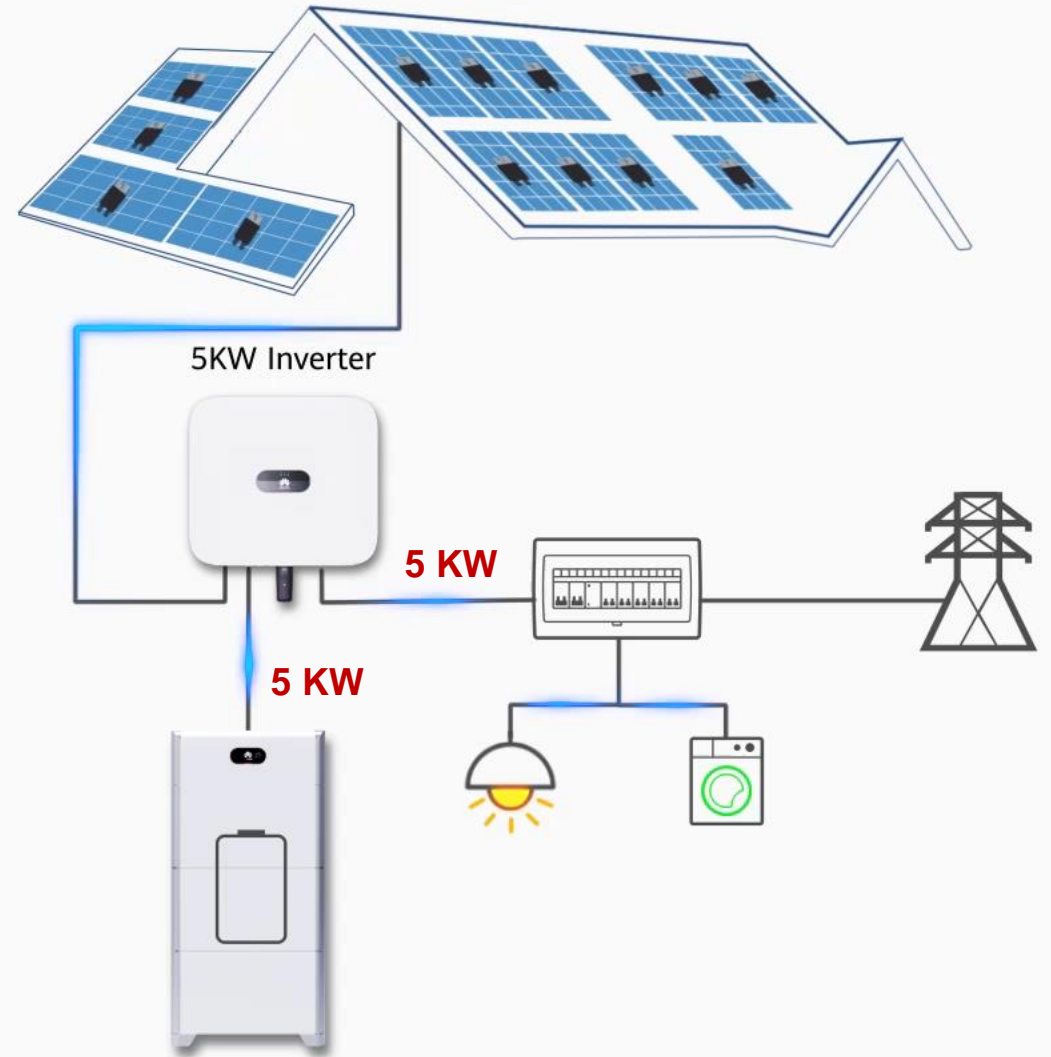
10 KWp PV

5KW Inverter

5 KW

2.5 KW

Battery Energy: 15 kWh

HUAWEI 2x POWER Battery Ready

10 KWp PV

5KW Inverter

5 KW

5 KW

Battery Energy: 15 kWh

Optimal Electricity Cost   **Active Safety**   Better Experience

Electric Arcing Is Threatening the Safety of PV System & Underlying Buildings

What is it?

- electrical breakdown of air that produces an prolonged electrical discharge

What causes Electric Arcing?

- Unreliable soldered joints within modules
- Broken PV cables
- Loosen PV connectors

What is the harm?

Can reach temperature of over 3000°C & easily start a fire

Arc Detection Challenges

Arc noise is generally weak and only accounts for 0.1% of the normal current signal, it is difficult to detect and often leads to missing detection

Inverter/Loads/Grid interference signals, as well as spectral overlay with normal current signal leads to faulty detection

AI Powered
Active Arcing Protection

What is AI Powered AFCI?

- HUAWEI inverter keeps self-learning new arc feature to accurately protect system from arc fault, even under complex noise

Self-learning new arc features with AI model

Accurate arc fault detection via local neural network algorithm

Speedy arc fault protection by inverter shutdown in 0.5s

Arc Feature Self-learning

Accurate Arc Fault Detection

Speedy Arc Fault interruption

Pinpoint Arc Fault Positioning

AI BOOST

Dc Arc Detection Of PV System (AFCI)
# TUV Technical Reports (IEC 63027 Draft)

SUN2000-2-6KTL-L1

Comparison	Adaptable Maximum Arc Current	Shutdown Time	Arc Energy	Arc Detection Accuracy	Pinpoint Arc Fault Positioning
IEC Standard	Imax (only 318V)	< 2.5 S	750 J	100%	Not Require
Huawei	*Imax (All Voltage Range)*	*< 0.5 S*	*500 J*	*100%*	*Support**

Huawei AFCI Performance Test Results

1) Meets the IEC 63027 Drafts (TUV Technical Reports).
2) Meets the UL 1699B-2018 Standard.
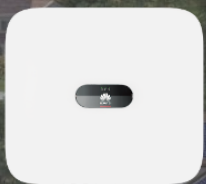
SUN2000-3-10KTL-M1

Projects	Results
Detectable Arc Type	Series Arc
Detectable Arc Fault Position	All Range
System Mode	With Or Without Optimizer
Pinpoint Arc Fault Positioning	Support*

Projects	Results
Adaptable Maximum Arc Current	Imax
Arc Detection Accuracy	100%
Arc Energy	< 500 J
Shutdown Time	0.5 S

* With Optimizer

AI BOOST

AFCI disabled, arcing continuously posing fire risks
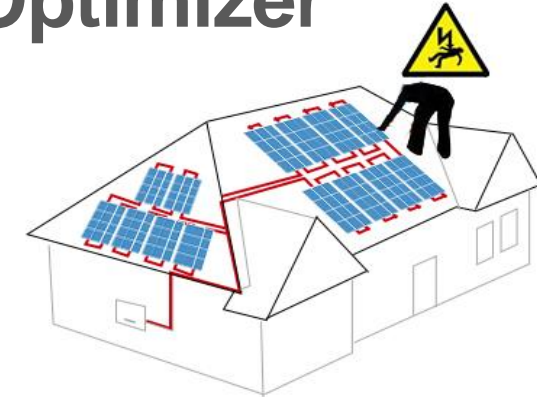
VS
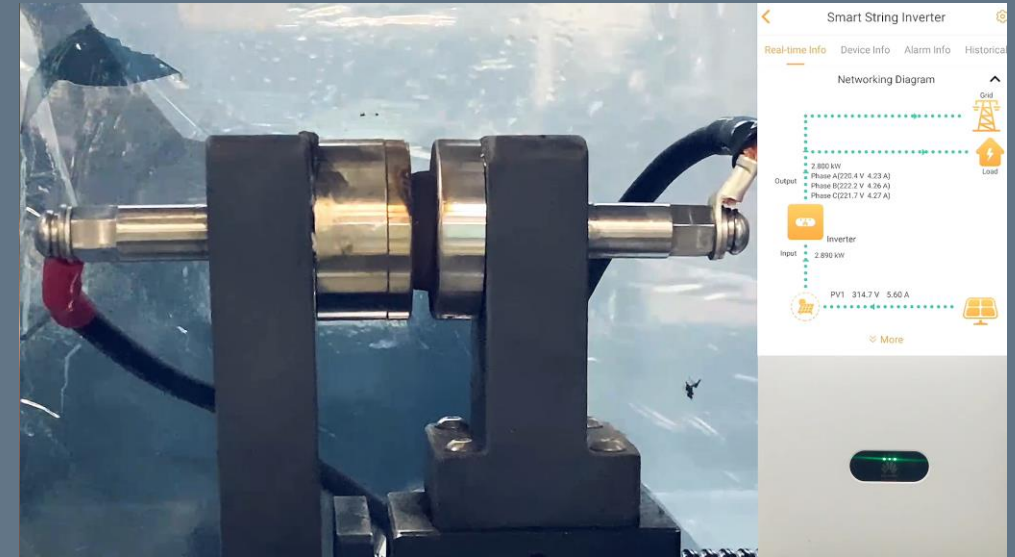
AFCI function enabled, arcing extinguished in < 0.5sec
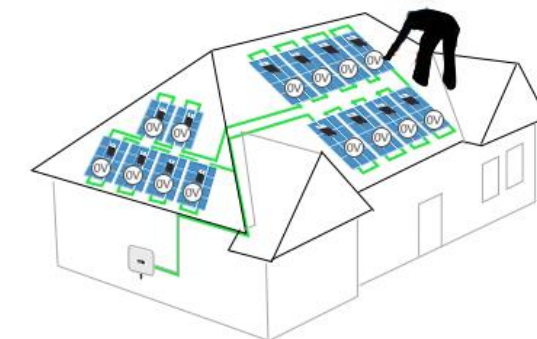
PV Arcing with/without AFCI Comparison

Safe House
with Smart PV Optimizer

Without optimizer: High DC voltage when system shuts down

With optimizer: Each optimizer outputting 0V when system shuts down

Pinpoint

Arc Fault Positioning for Easier Troubleshooting

Saving 80% onsite troubleshooting time and cost with accurate arc fault positioning

* Manually detection of DC arc fault in a 10KWp residential system usually costs 5hrs. Pinpoint arc fault position report lead to resolve the problem within 30 mins.

Less power loss because of shorter system tripping

3-Layer Protection

Battery Cell   Battery Module   Energy Storage System
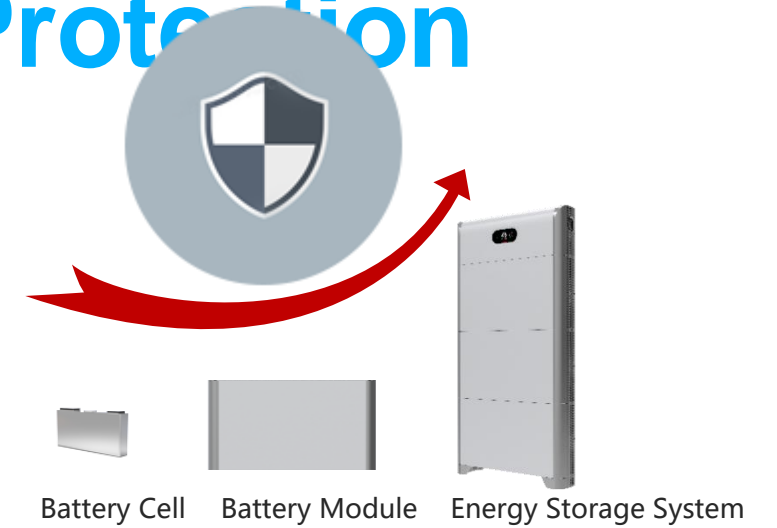
Cell Level Protection

- Lithium iron phosphate cell for safe and stable performance

Pack Level Protection

- 8 sensors per pack to supervise operating status

15kWh Battery	HUAWEI	A	B
Sensors per pack	3 x 8 = 24	3	4 x 4 = 16

System Level Protection

- Faulty pack auto isolation, touch safe
- Compliance to the most rigorous safety standard VDE2510
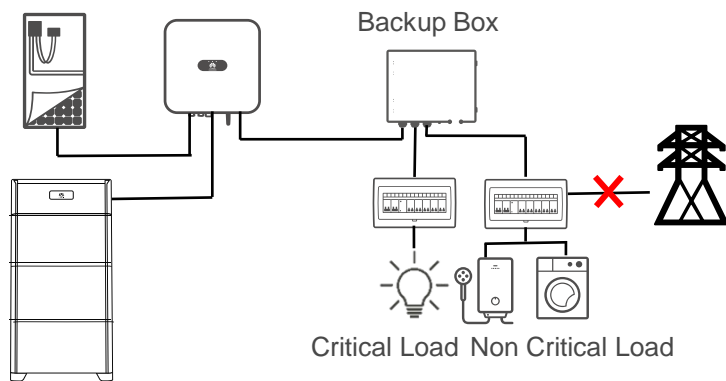
No Worry About Power Outage

With Backup Power

System switches to backup mode to supply emergent power to critical load automatically when power outage

Smart string ESS supports black start from blackout to restore system operating

Backup Box

Critical Load Non Critical Load

Optimal Electricity Cost   Active Safety   **Better Experience**
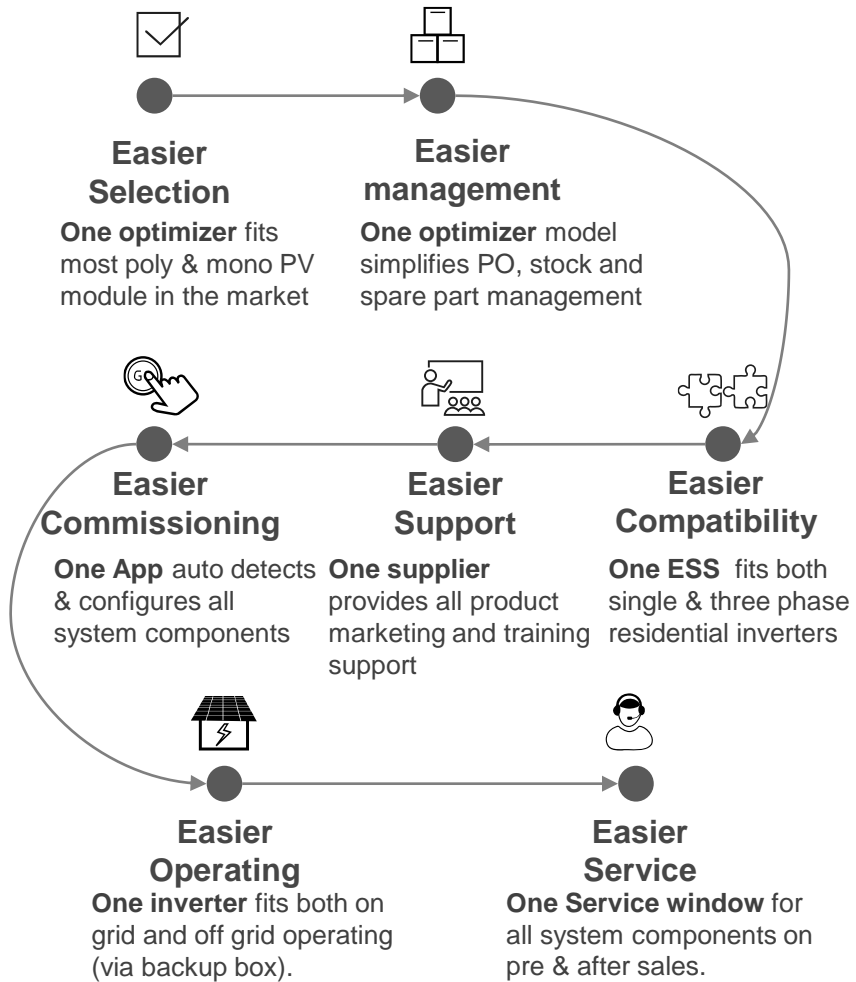
Sleek Design - Waterfall

Smart String ESS
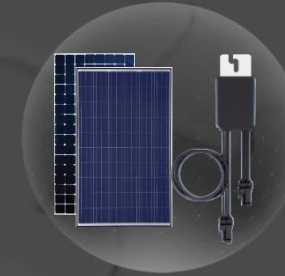LUNA2000-15-S0

Sleek Design -
Snowbergs surround the lake

Smart Energy Center
SUN2000-2-5-KTL-L1

One-Fits-All
Solution, Easier Business

Easier Selection

One optimizer fits most poly & mono PV module in the market

Easier management

One optimizer model simplifies PO, stock and spare part management

Easier Commissioning

One App auto detects & configures all system components

Easier Support

One supplier provides all product marketing and training support

Easier Compatibility

One ESS fits both single & three phase residential inverters

Easier Operating

One inverter fits both on grid and off grid operating (via backup box).

Easier Service

One Service window for all system components on pre & after sales.

1. One Optimizer

2. One Battery

3. One Inverter

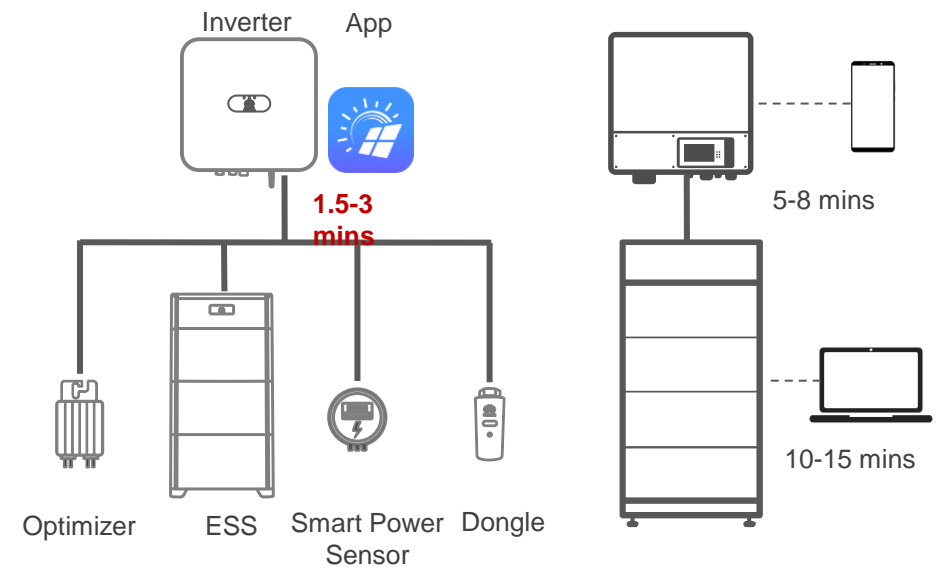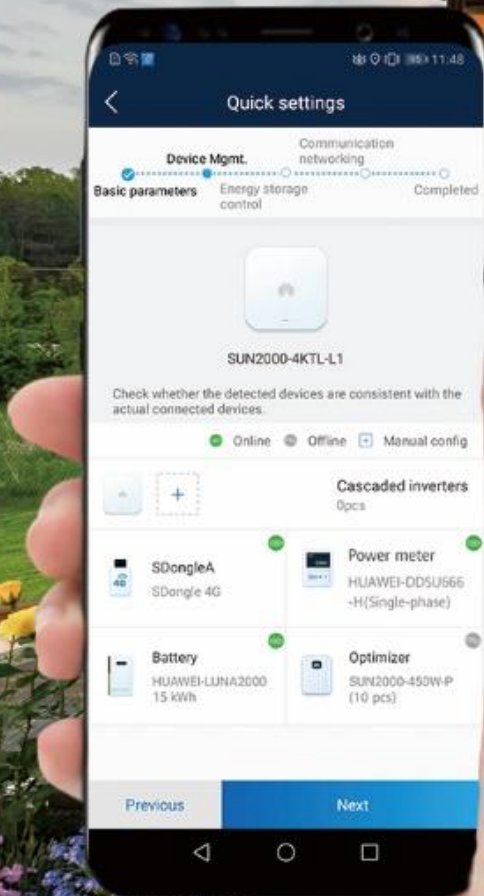**One-Fits-All**

4. One APP

5. One Service Window

HUAWEI

Auto Detection
of All System Devices

All inverter connected devices can be automatically detected in FusionSolar app

	HUAWEI Solution	Other Solution
System Setting up Duration	**1.5-3 mins** (Device Auto Detected in App)	15-20 mins (Separated Apps or web tools to add devices manually)

AI BOOST

<5sec
Module Auto-Mapping

Operating Steps	HUAWEI Solution	Other Solutions
2D barcode paste on template	Same	Same
Physical layout creation	<5sec (AI powered)	6.5min (manual)
Total configuration time	<1min	6.5min

@15KW system with 40 pcs of PV modules

Saving **86%** configuration time compared with other solutions

Flexible Communication & Power Control for All Scenarios

WLAN-FE Dongle
2 in 1 smart dongle, flexible communication option at Home

4G Dongle
Independent and stable operation , without location and communication constraints

Social Housing

Power Purchase Agreement

Apartment Roof

No Fuse or Other Quick-wear Parts, Inverter Touch Free

No Fuse

No LCD

No Button

Natural Cooling Verified by Telecom & Solar Application*

* For 3–10KTL inverter models

TUV verified: annual failure rate < 0.5%
Inverter availability up to 99.996%
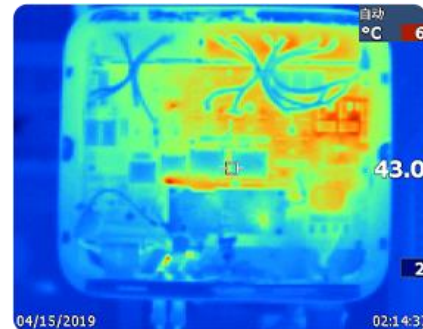
Station Phase II, 200 units, 963 running days	Station Phase III, 4939 units, 583 running days	Station Phase IV, 1790 units, 207 running days
Failure Rate:	**Failure Rate:**	**Failure Rate:**
0.189%	**0.252%**	**0.390%**

Technical Report

Technical Due Diligence Report on Huawei Inverters
Operation and Performance Technical Indces in 220MW PV
Plant

43.0

04/15/2019   02:14:37
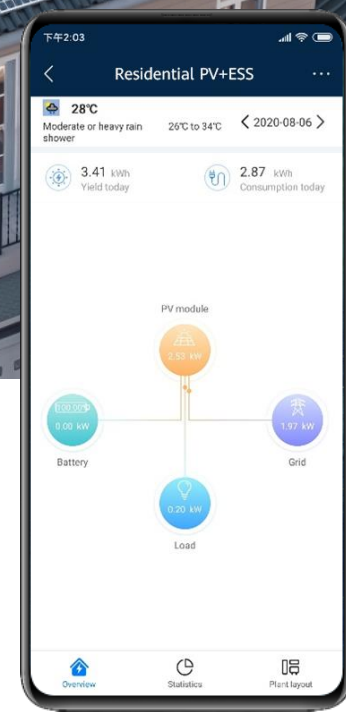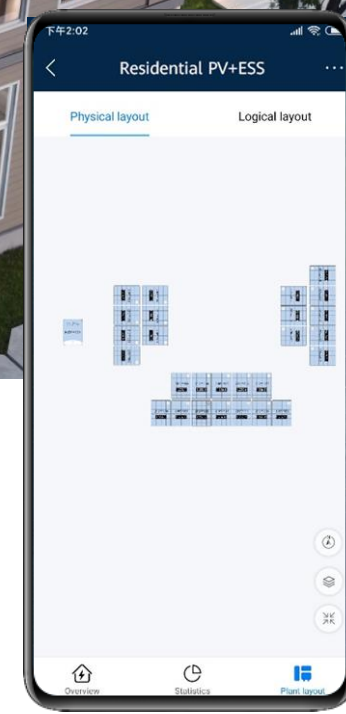
**High efficient thermal design
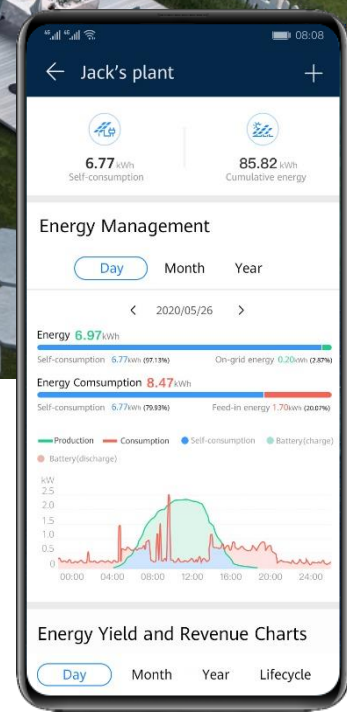to ensure low temperature
within enclosure**

- **Visible Power Flow**
- **Module-Level Monitoring**
- **Statistical Indicator**
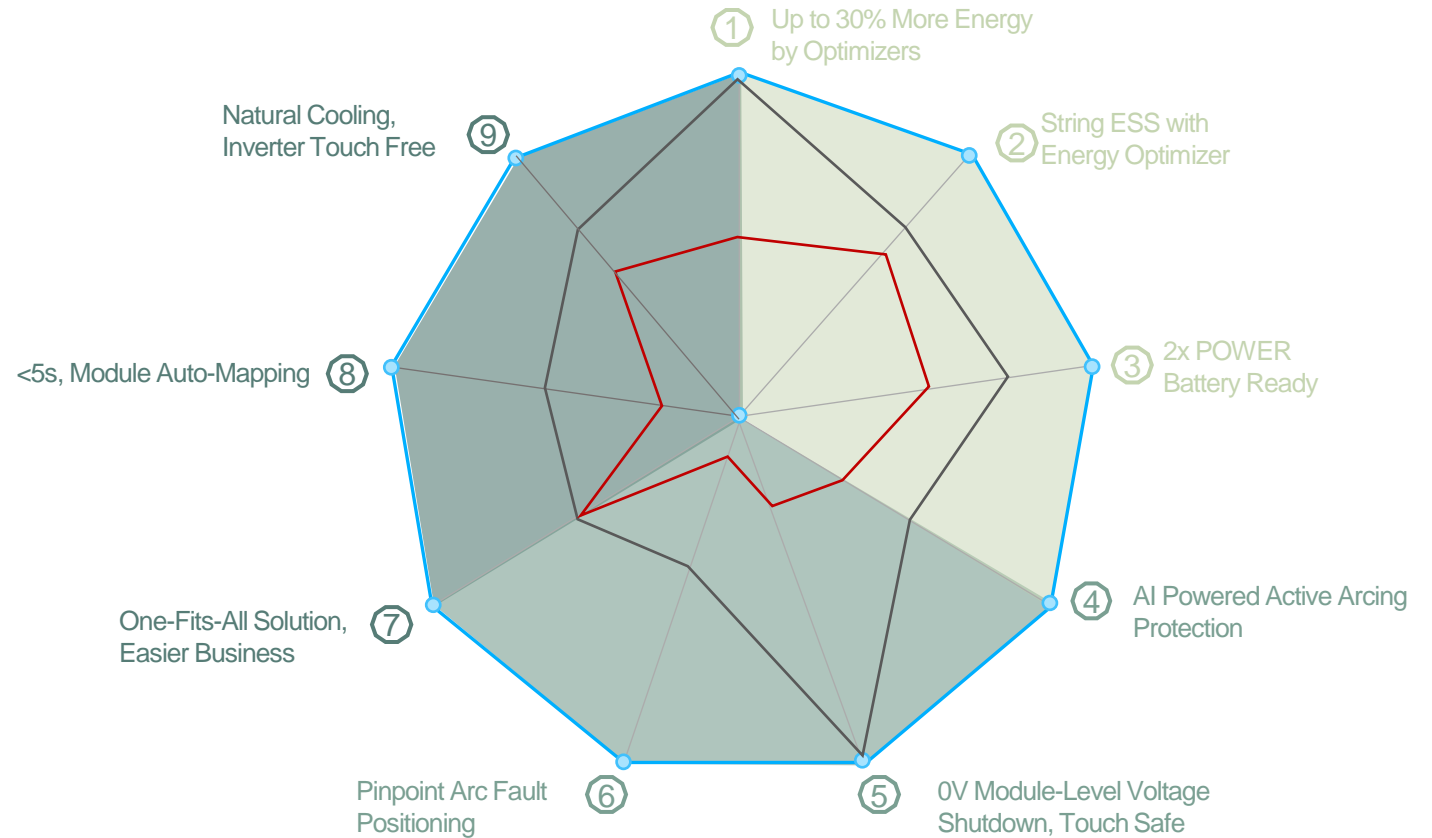
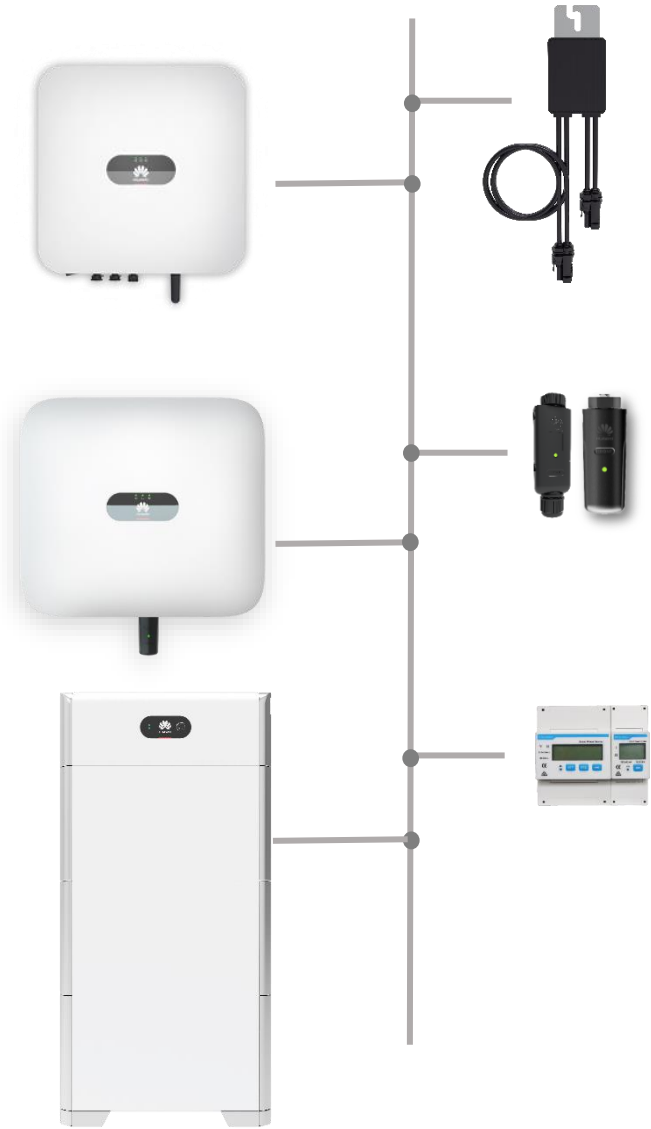Real-Time Power Flow

Module Level Monitoring

Self-Consumption &
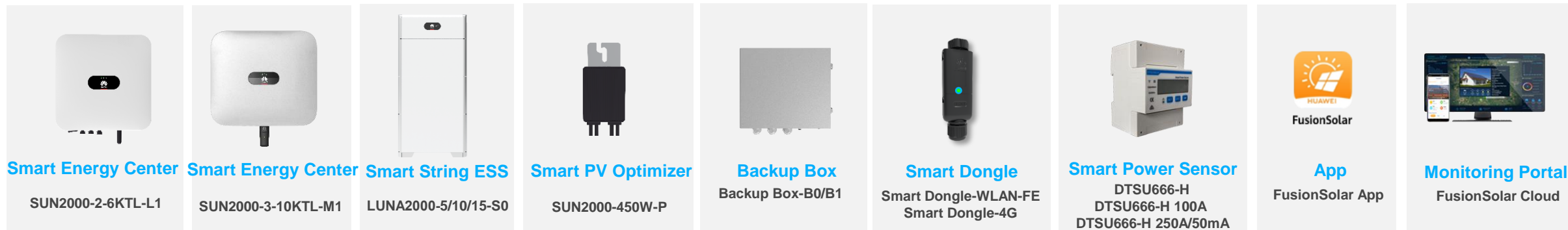Sufficiency Indicator

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HUAWEI

Nine Innovative Features of Solution

- ① Up to 30% More Energy by Optimizers
- ② String ESS with Energy Optimizer
- ③ 2x POWER Battery Ready
- ④ AI Powered Active Arcing Protection
- ⑤ 0V Module-Level Voltage Shutdown, Touch Safe
- ⑥ Pinpoint Arc Fault Positioning
- ⑦ One-Fits-All Solution, Easier Business
- ⑧ <5s, Module Auto-Mapping
- ⑨ Natural Cooling, Inverter Touch Free

— ● Huawei Solution

A   Other Optimizer Solutions

B   Other Inverter Solutions

Smart Energy Center	Smart Energy Center	Smart String ESS	Smart PV Optimizer	Backup Box	Smart Dongle	Smart Power Sensor	App	Monitoring Portal
SUN2000-2-6KTL-L1	SUN2000-3-10KTL-M1	LUNA2000-5/10/15-S0	SUN2000-450W-P	Backup Box-B0/B1	Smart Dongle-WLAN-FE Smart Dongle-4G	DTSU666-H DTSU666-H 100A DTSU666-H 250A/50mA	FusionSolar App	FusionSolar Cloud

Main Feature Difference	SUN2000-2-6KTL-L1	SUN2000-3-10KTL-M1
Available Time for Shipment	**Already Available**	**Already Available**
Compatible with HUAWEI new optimizer SUN2000-450W-P	√	√
LG Chem battery compatible	√	
HUAWEI LUNA2000 string battery compatible	√	√
WLAN-FE dongle compatible	√	√
4G dongle compatible	√	√
Active arc fault protection	√	√
Pinpoint arc fault positioning	√	√
Integrated PID recovery		√
Backup function availability	√	√

Thank you.

把数字世界带入每个人、每个家庭、每个组织，构建万物互联的智能世界。

Bring digital to every person, home, and organization for a fully connected, intelligent world.

HUAWEI