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PHOTOMATE Scandinavia

Faisal Baryalai

Solutions Manager-Nordic Digital power

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HUAWEI FUSIONSOLAR PARTNER for CEE, Scandinavia, Baltics and Eurasia

MARKETING ROADSHOWS
PARTNER EVENTS

- OVER **15 EU** DESTINATIONS IN **2023**, REALIZED **150 EVENTS** WITH PARTICIPATION OF **OVER 3000 INSTALLERS**
- **4 ROADSHOW** TRUCKS, ALL DAY **PROGRAM** AND **TRAININGS**
- **PARTNER DAYS** IN MANY DESTINATIONS - SWE, LIT, HUN, ROM, BUL, EURASIA WITH PARTICIPATION OF **OVER 1700 PARTNERS**
- EU BIGGEST EXHIBITION **INTERSOLAR 2023,** 224 m2 STAND

GO SOLAR

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CONTENTS

- Huawei Digital Power-Product portfolio
- Intelligent Management System
- Ancilliary Services
- Installer certificates and registration

HUAWEI Digital Power Partner CSP

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HUAWEI provides all scenarios PV + BESS solution

Smart PV+storage generator

Smart String ESS

Green business power

Green home power

Smart microgrid

All-Scenario Smart PV + BESS Solution

Better LCOE and LCOS, grid forming, active safety

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HUAWEI Enterprise Partner Service

Huawei: A trusted long-term partner

Vision & mission

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

170+
countries and regions

207,000
employees

55.4%
of employees work in R&D

No. 4
in global R&D investment

120,000+
active patents held globally
(*Huawei has one of the world's largest patent portfolios.)

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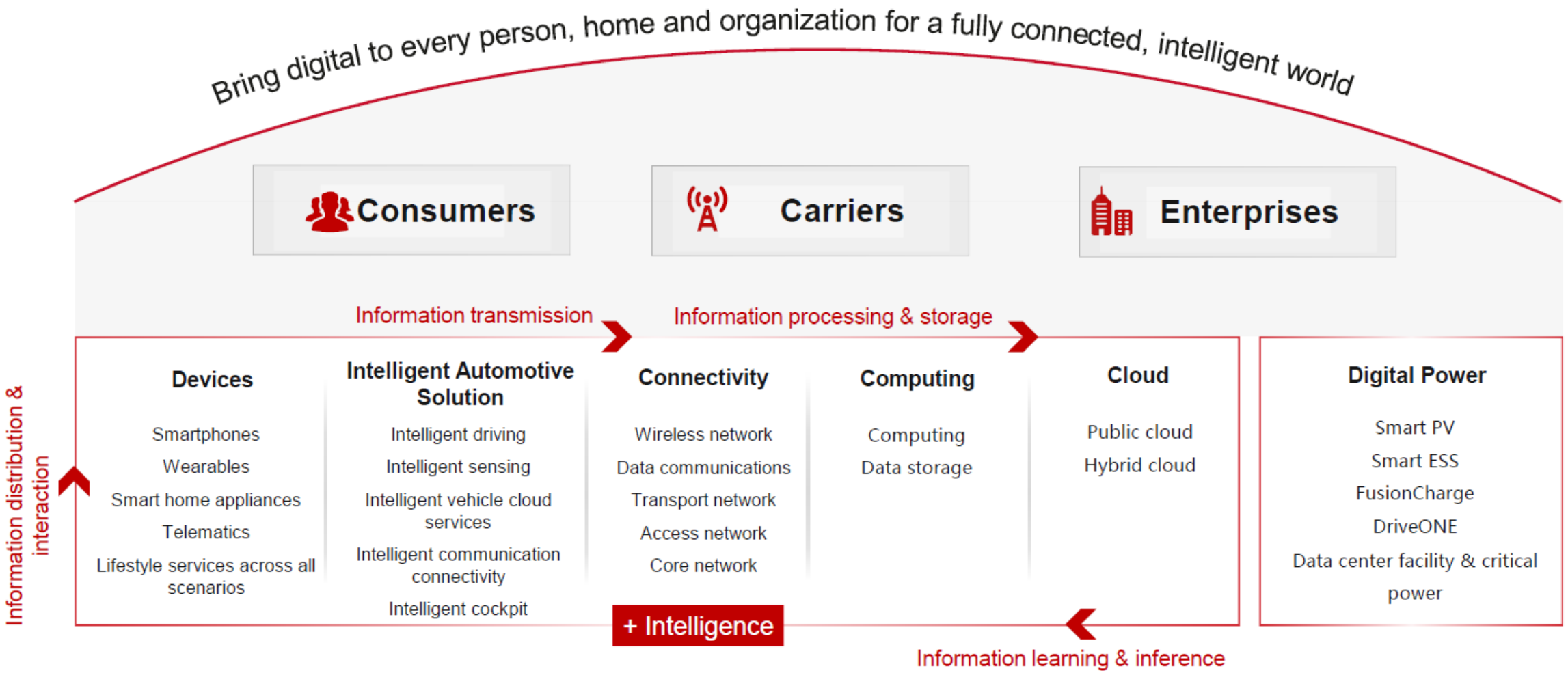
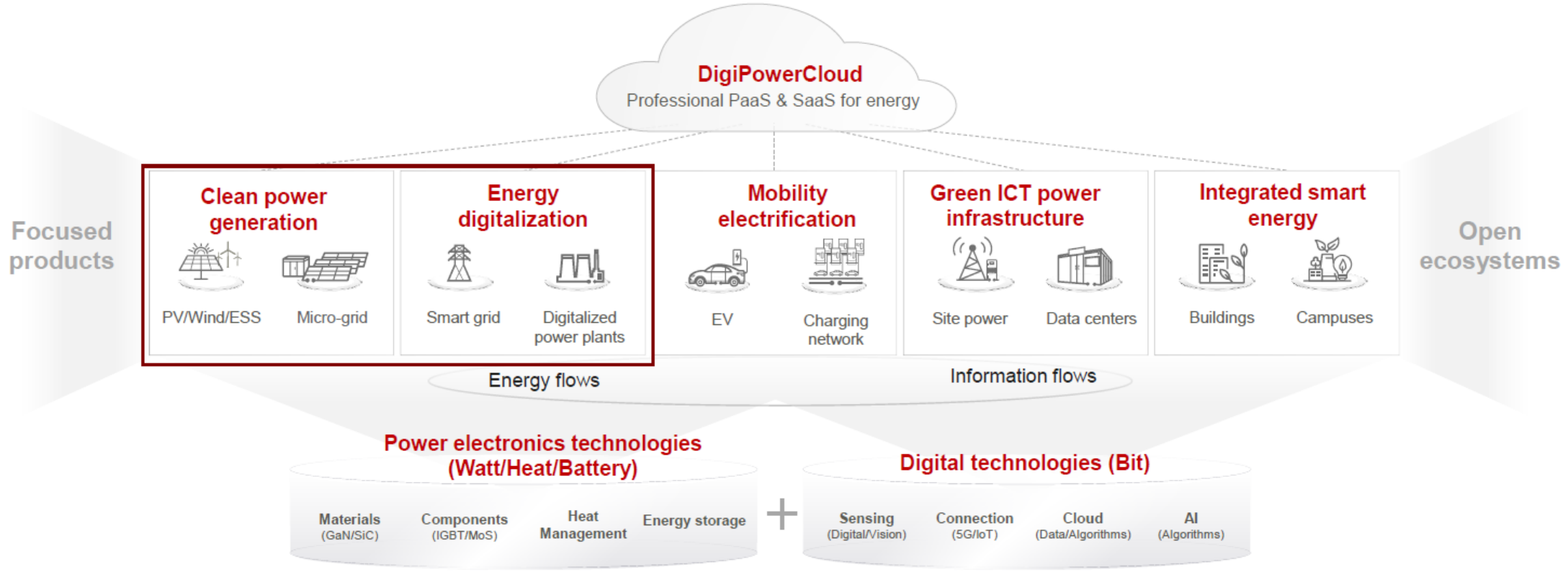
Focusing on ICT to provide products, solutions, and services to three customer groups



Huawei Digital Power: Integrating Digital and Power Electronics Technologies, Developing Clean Power, and Enabling Energy Digitalization to Drive Energy Transition for a Better, Greener Future

Evolving from high carbon to low carbon, and finally to net-zero carbon



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FusionSolar Continuously Building a Greener and Better Future Together with Our Global Customers

300+ GW
Inverter Shipment
Accumulated

90.7GW
Inverter Shipment
2022

30GW
STS Shipment
Accumulated

6.8GWh
ESS Shipment
2022

230 Million tons
Carbon Emissions Reduced

313 Million
Equivalent Trees Planted

Global R&D teams and technology platforms: Leveraging the domain specific advantages globally to keep leading

- 170 countries and regions
- 10000+ employees
  60% R&D
- 12 R&D centers
- 10%+ R&D investment
- 1700+ patents

Supply

Production and Supply: Huawei Strong Production Capability and Global Supply Chain Network

Strong Production Capability

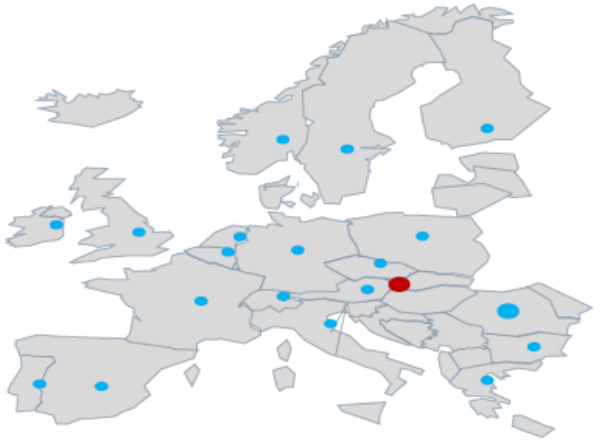
Inverter Production Capacity
180GW+
per year

Inverter Production Line
41

ESS Production Capacity
15GWh+
per year

ESS Production Line
27

Full coverage of 32 EU countries



24/7 Support

1 RSLC* and 32 CSLC*

110+ FSL*

European Supply Center In Hungary

2BD-S

32 *Country Spare parts Warehouse

Hungary EU spare parts center + **local spare part stock**

- Spare parts guarantee time: **Up to 20 Years**
- On site service **SLA < 48H**
- Spare part delivery time **2-5BD-S**

300+ GW
Inverter Shipment
Accumulated

90.7GW
Inverter Shipment
2022

30GW
STS Shipment
Accumulated

6.8GWh
ESS Shipment
2022

230 Million tons
Carbon Emissions Reduced

313 Million
Equivalent Trees Planted

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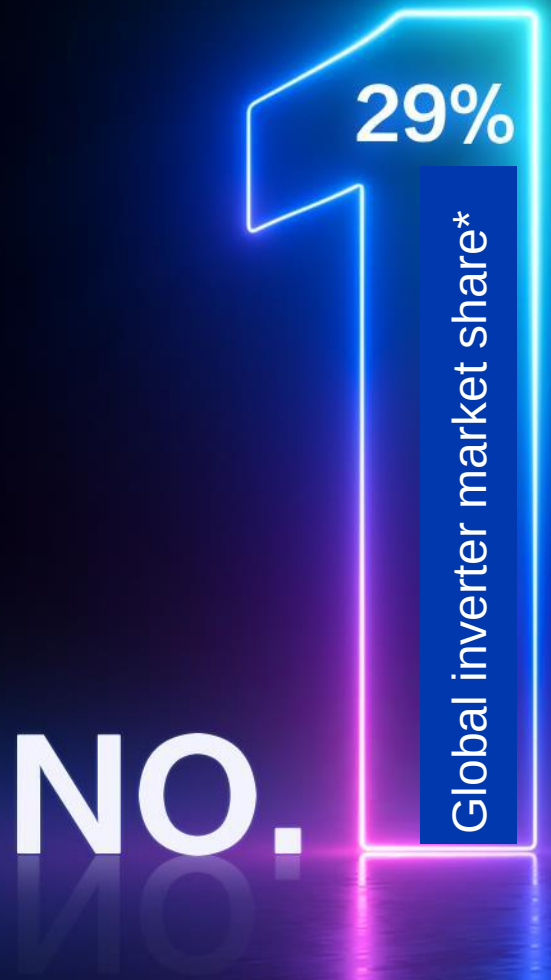
Huawei's Solar Inverter Business Has Ranked No.1 in Market Share for Eight Consecutive Years



C&I PV CAGR in 2022 **56%** **

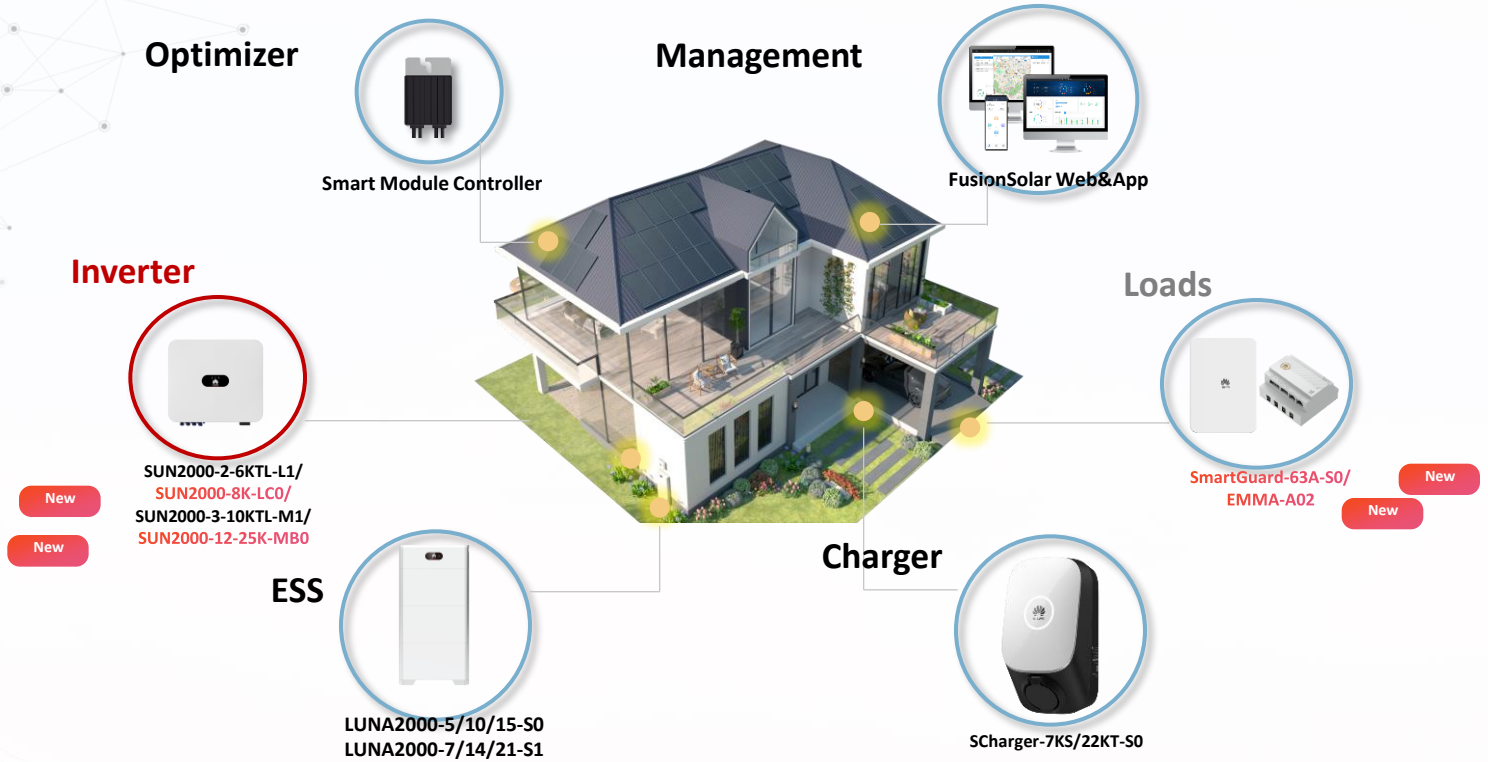
C&I PV Global enterprise customers in 2022 **100,000+**

C&I PV Carbon emissions reduction in 2022 **29 million tons**

* Data source: Wood Mackenzie **Data source: Estimated based on Huawei shipment data

Source: Wood Mackenzie

Residential On-grid PV+ESS Solution Overview



FusionSolar Residential Solution 4.0： 1+4+X

Shine on
Energy-using Prospect

Shine on
Full Journey Convenience

Shine on
Active Safety

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SUN2000-12/15/20/25K-MB0

HUAWEI Enterprise Partner Service

The Most Powerful & Future-ready Inverters in Residential

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Smart Energy Controller

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

Battery compatible (S0)

New

Three-phase

SUN2000-12/15/17/20/25K-MB0

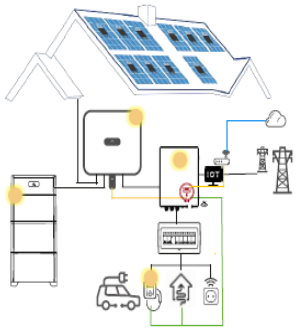
Battery compatible (S0, S1)

Three-phase

SUN2000-12/15/17/20/25K-M5

PV Only

Support Optimizer, ESS and smart appliances



Higher Power

6 kW → 10 kW

Single-phase

10 kW → 25 kW

Three-phase

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Triple reliability to ensure a 25-year service life with an annual failure rate <0.5%

Huawei Smart PV Solution Manufacture

4K views • 7 years ago

Huawei FusionSolar

Based on the principles of simplification, full digitalization and global automated operation and maintenance, Huawei, a global ...

https://www.youtube.com/watch?v=A0EPuO2XvHg&t=146s

Triple "Reliability"

Reliable design

Avoid product quality defects

Reliable production

Automation production line

Ensure the product supply

Reliable tests

Global Certification Center

Strict tests ensure user benefits

Reliability test

Unique rocket triggered lightning test

Explosion-proof test

TÜV SÜD

Huawei Inverter
Annual failure rate < 0.5%
Availability > 99.996%

"China Quality Award"
1st in Manufacturing

Phase II	Phase III	Phase IV
200 inverters, running for 963 days	4,939 inverters, running for 583 days	1790 inverters, running for 207 days
Yearly failure rate: 0.189%	Yearly failure rate: 0.252%	Yearly failure rate: 0.390%

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New Residential Battery Storage Solution LUNA2000-7/14/21-S1

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HUAWEI Enterprise Partner Service

Huawei Smart String ESS LUNA2000-7/14/21-S1

Module+ architecture, leading in all aspects

Higher
Longer
Wider
Safer

- **Higher** throughput
- **Longer** lifespan
- **Wider** operating temperature range
- **Rigorous** safety protection

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Simplistic and borderless design, easy to blend into surroundings

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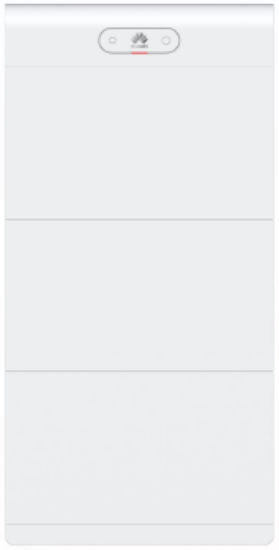
Define the Flagship Residential Energy Storage System

HUAWEI Enterprise Partner Service

LUNA2000-5/10/15-S0

New Available 2024 Q1

LUNA2000-7/14/21-S1



Above two generations of ESS will coexist in the market

Revolutionized Architecture

- **Industry's 1st** Module+ Architecture:
- **Industry's 1st** 280Ah Battery Cell in Residential ESS

  Recycle times ≥ 12,000 (25℃, 60% EOL)

Ancillary services integration:

- 3rd party EMS needed
- Response time of dongle-inverter-battery output: (S0 and S1)
  - Trial version available end-of Sept
  - Official release end-of Dec

Higher capacity

5 kWh/30 kWh → **7 kWh/84 kWh**

Ultra-long service life

10 years → **15 years**

Huge rise in Charge/discharge power

3.5kW/7kW/10.5kW

Compared with Huawei's previous-generation residential ESS LUNA2000-5/10/15-S0 (data source: Huawei's internal lab)

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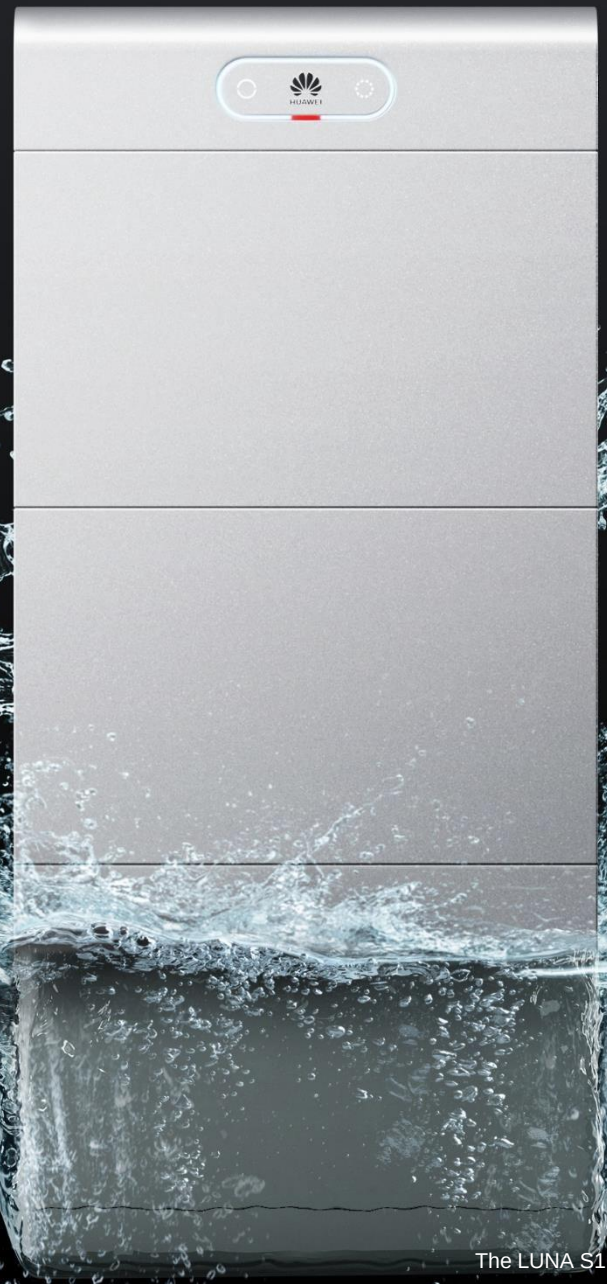
Industry's 1st IP66 residential ESS

	LUNA S1	Vendor B	Vendor P	Vendor S
Ingress Protection Rating	**IP66**	IP55	IP55	IP55

Easily cope with rain and water splashes.



Industry's only water immersion protection residential ESS

40cm

72h

Safe in case of waterlogging, ice, and snow coverage

The LUNA S1 is a non-professional waterproof device, pls. keep it away from water sources during daily use.

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5-layer enhanced safety, safeguarding every family, every day

Cell-level protection

- LFP cells from top suppliers
- Subjected to rigorous tests, such as cycle tests (up to 1/8 of cycle life) and puncture tests

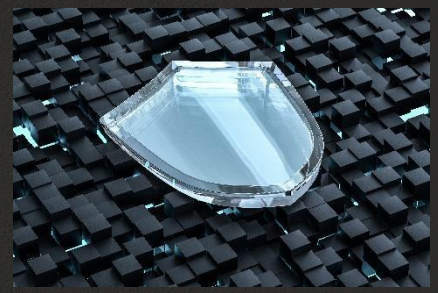
Electrical protection

- Multiple protection measures, such as overcharge, overvoltage, overcurrent, and over temperature
- External short circuit protection

Structural protection

- **Industry's 1st IP66** protection, **industry's 1st 40 cm** water immersion protection
- High-strength chassis, **5T** heavy pressure resistance, 20% hydrogen explosion test

Active protection



- Real-time cell-level temperature and voltage detection
- Intelligent ports detection
- SOH calibration for full-lifecycle health protection

Emergency protection

- **Industry-only** emergency fire suppression module
- **World-leading** active pressure release technology

Passed safety certification tests, such as VDE 2510-50, IEC 62169, ISO 13849, IEC 63056, IEC 62040-1, IEC 62477 and UN 38.3.

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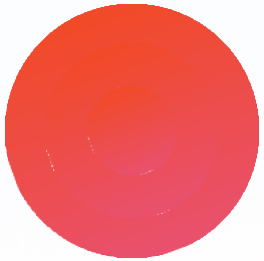

Innovative Architecture, More Usable Energy

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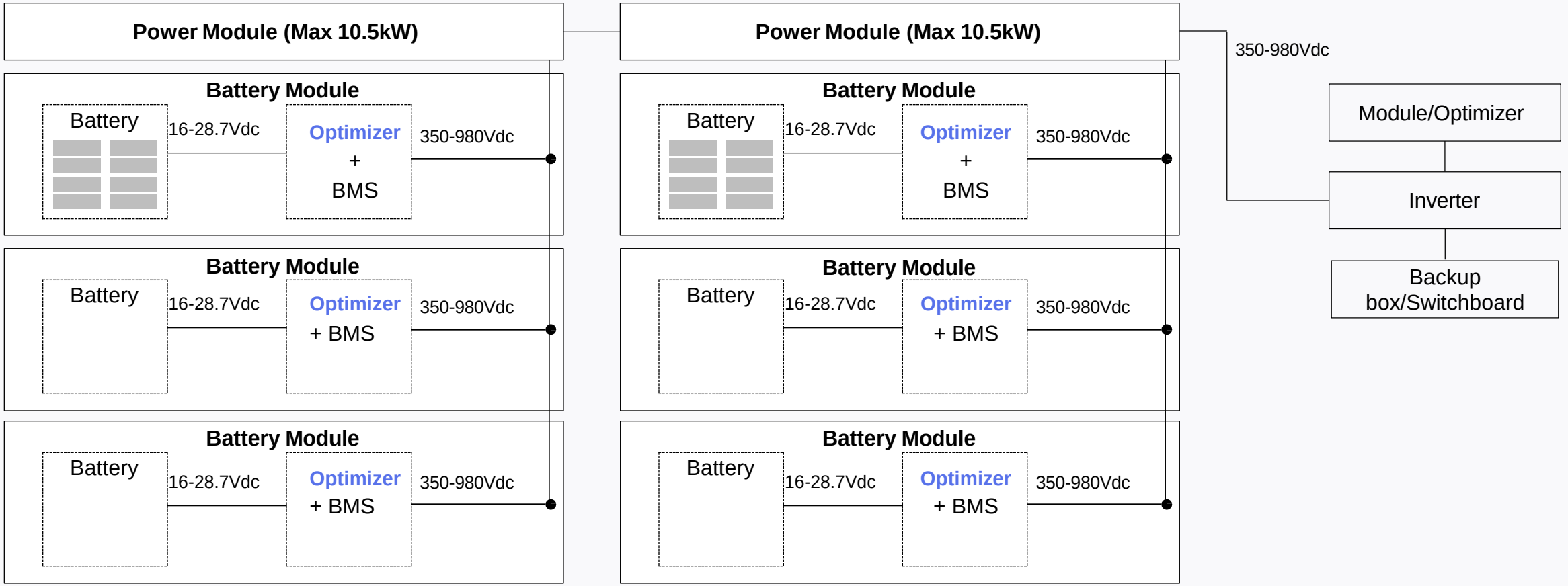
Module+ architecture, built-in energy optimizer, pack-level independent optimization

Module+

DC coupled and connected in parallel.
Each battery pack has a built-in optimizer

- Pack-level independent optimization and management
- Each battery pack only needs 8pcs of cells to independently achieve the system operating voltage 350V~980V



The PV & ESS solution is upgraded to cover more scenarios

Inverters Support ESS Capacity Expansion

A single inverter supports:
Max 30 kWh

LUNA2000-5/10/15-S0

L1, LC0, and M1 inverters:
Max 41.4 kWh
(20.7 kWh x 2)

LUNA2000-7/14/21-S1

MB0 inverter:
Max 82.8 kWh
(20.7 kWh x 4)

LUNA2000-7/14/21-S1

Plant-Level ESS Capacity Expansion (A Maximum of 3 Inverters Can Be Connected in Parallel)

Smart Dongle networking	EMMA networking
Max 90 kWh	Max 180 kWh

Smart Dongle networking	EMMA networking
Max 124.2 kWh (20.7 kWh x 6)	**Max 248.4 kWh (20.7 kWh x 12)**

The support for parallel connection of four S1 ESSs is to be determined.

Increased Charge and Discharge Power

Max 5 kW ⇨ Max 10.5 kW	Max 20 kW ⇨ Max 25 kW	Max 60 kW ⇨ Max 75 kW
Single-rack ESS	Single inverter	Entire system

Note: 1.The residential LUNA S0 and residential LUNA S1 cannot be installed in the same plant.
2. In the Dongle networking scenario, when MB0 services as the primary inverter and needs to be connected to both meter and ESS, the meter has requirements when more than two ESS are connected. For details, pls. check the MB0 user manual.

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Ultimate Experience for Installers &Users

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Cable-free connection, saving installation time by 50%+

Time-saving: No communications cable or power cable

Between power packs and battery packs

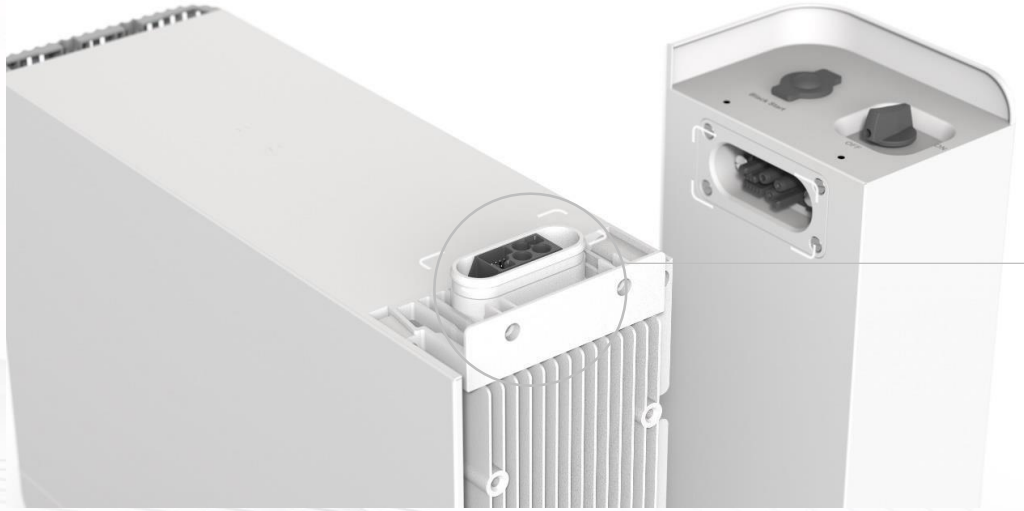
Between battery packs

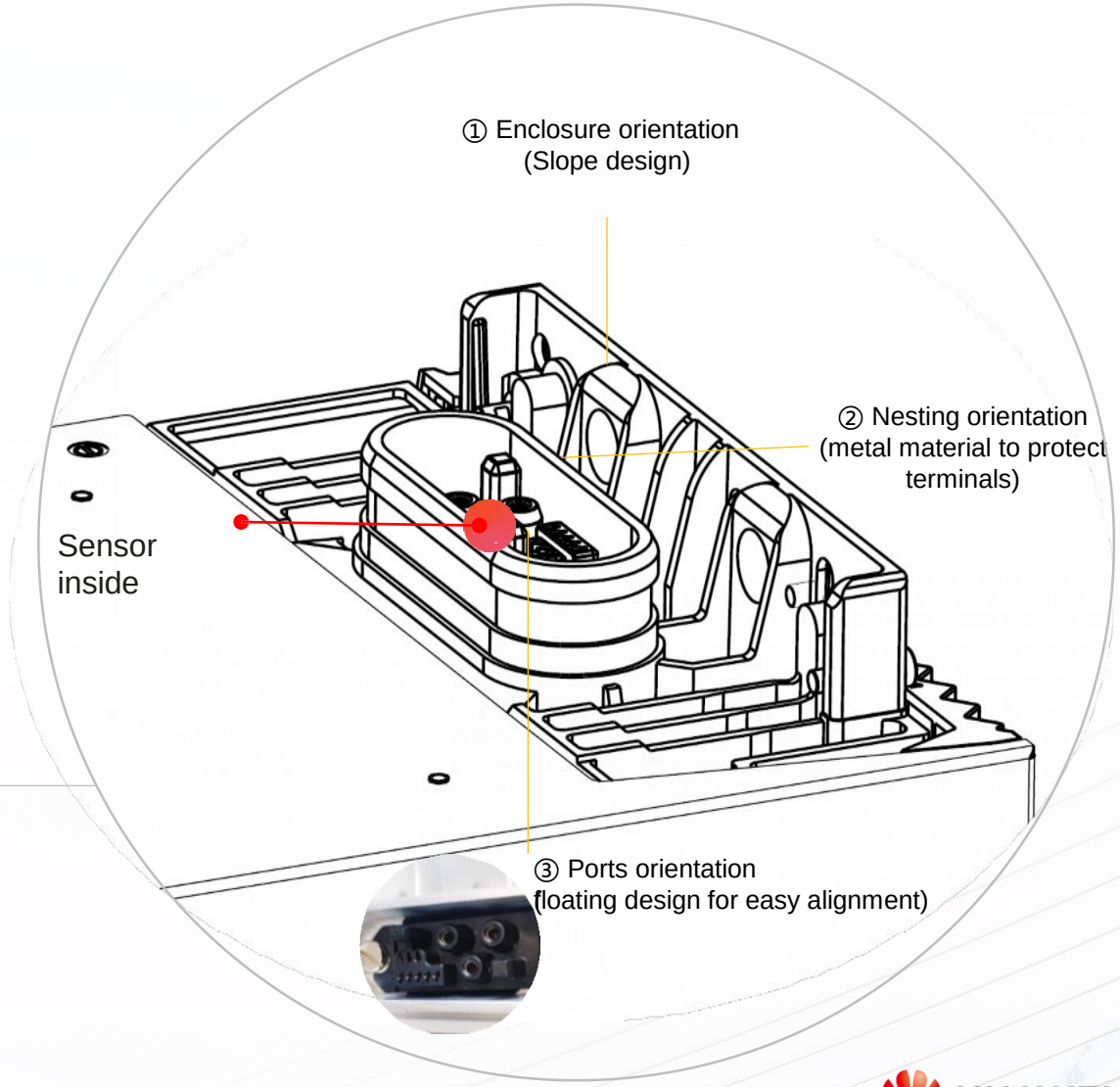
Labor-saving: Convenient docking

3-layer orientation design for easy docking

Free from worry: Intelligent ports detection

Sensor inside, identifies faults through temperature detection intelligently





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New Smart Management System Assistant EMMA A-02

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EMMA is a device that manages energy
in a home with a PV system.

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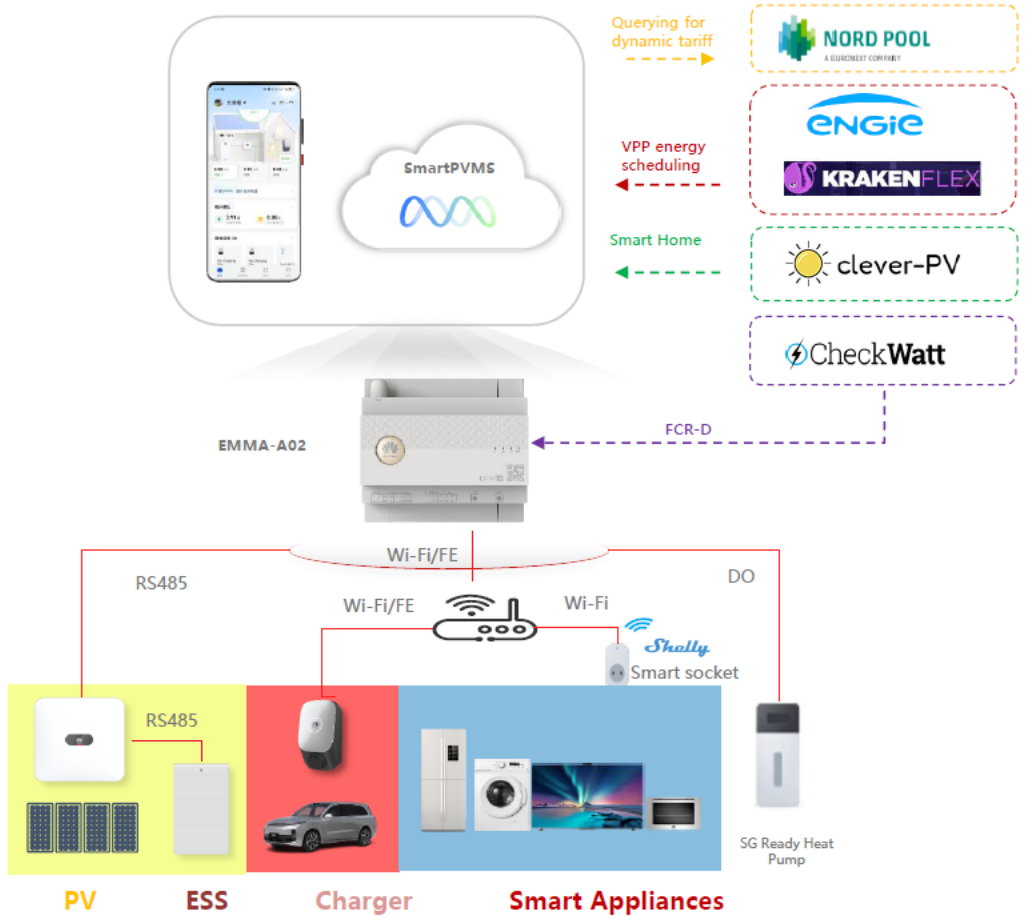
EMMA: A Smart, Open, New Generation Home Energy Management Assistant



Note:

1. *The EMMA solution comprises the EMMA-A02 controller and the FusionSolar SmartPVMS.*
2. *We highly recommend upgrading the EMMA-A02 controller to the V100R024C00SPC100 version.*

Smart Energy Management

- One-stop management of inverters, ESS, optimizers, chargers and appliances. Device status, power usage, consumption statistics, and real-time App monitoring.
- Home appliances can be flexibly controlled through Shelly sockets, supporting power usage priority sorting and scheduled power usage.
- Supports access to SG Ready standard heat pumps.
- Peak shaving, PV preference, and power limitation at the grid connection point (within 2 seconds).
- Automatic startup and shutdown of Diesel Generator (D.G.). *New*

Smart Scheduling

- Automatically connect to NordPool power market and obtain dynamic tariff in real time. *New*
- Using big data and machine learning, the system integrates electricity prices, weather, and load for optimized solar and ESS scheduling. This approach enhances price arbitrage, allows for zero-power grid connection during negative prices, and boosts average revenue by 5% to 10% in dynamic pricing scenarios *Capability enhancement*

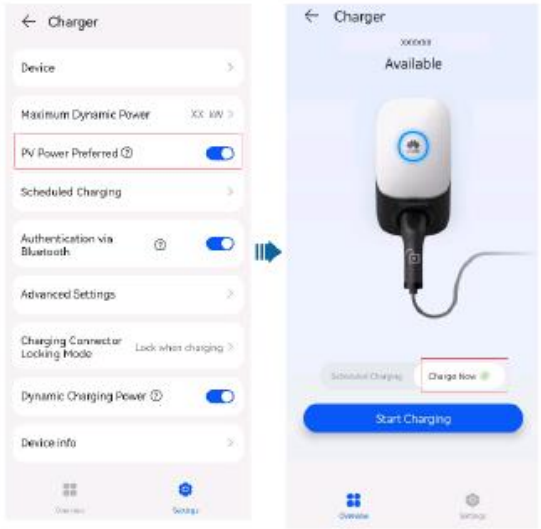
Open to 3rd parties

- The controller supports the Modbus-TCP standard protocol, integrates with 3rd VPPs, enables FCR-D frequency modulation, and responds to control instructions within 2.5 seconds. *New*
- SmartPVMS offers open REST APIs, enabling integration and management with 3rd party smart home systems and virtual power plants (VPPs).

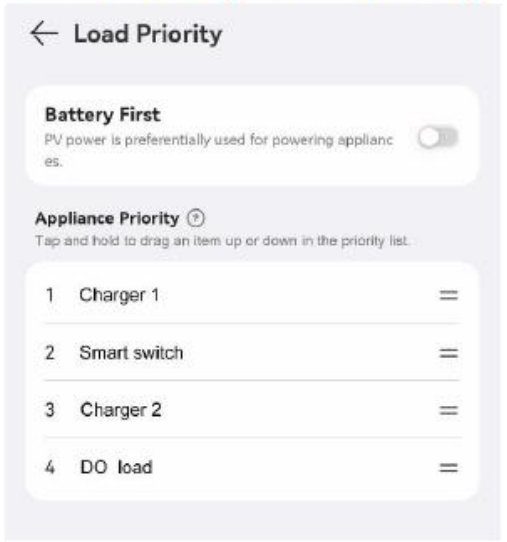
A Home that Always Shines

PV Preferred: Adaptive charging and the usage of PV power improves the self-consumption rate

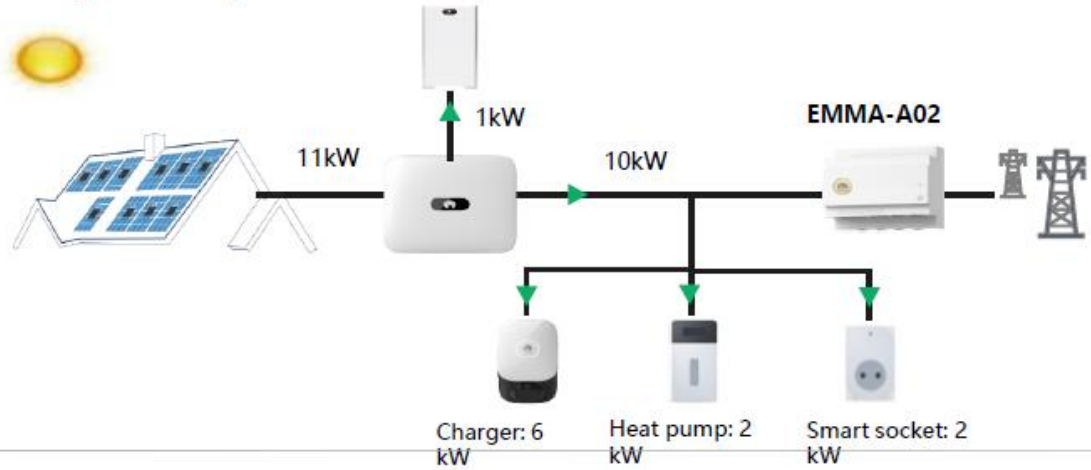
Charging pile



PV electricity usage priority



PV + ESS, sufficient light



PV surplus power > charger/smart appliance starting power

Provide power to charger or smart appliances by priority

Note: The PV preferred option is effective only when smart appliances are turned on or during scheduled power consumption periods. Smart appliances will not automatically turn on, even if there is surplus PV power, during off periods or outside scheduled power consumption periods.

Working Logic of Whole Home Backup Solution With D.G.

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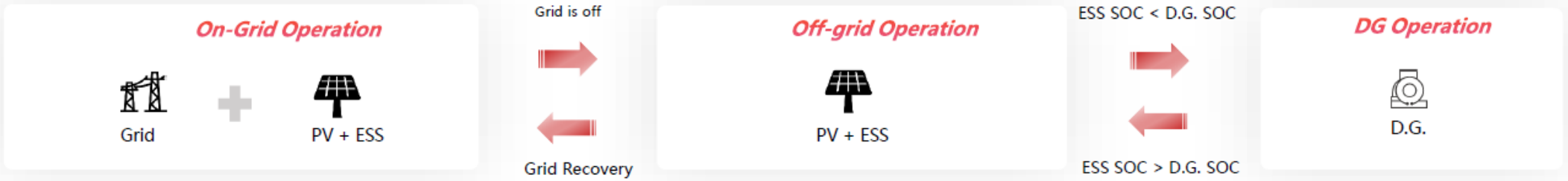
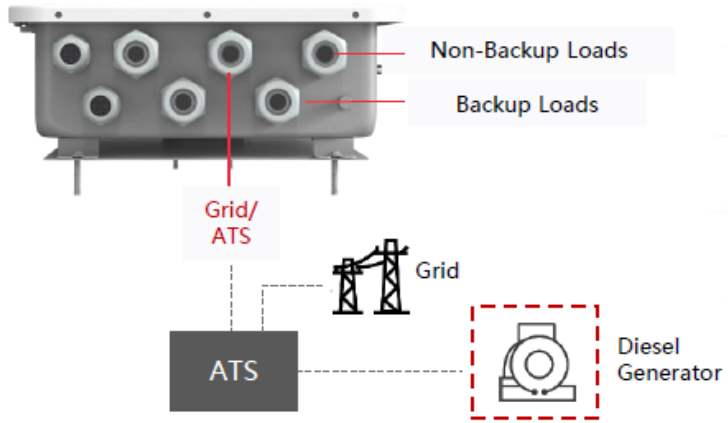
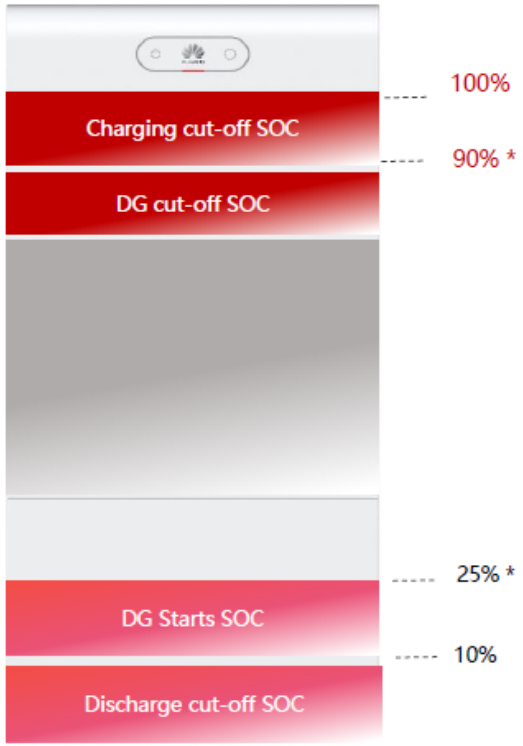
Working Logic:



Off-grid Power Priority: PV > ESS > D.G.



Note: 1-ATS is needed for backup with DG
2-Only MAP0 inverter supports DG



Off-grid backup + D.G. working logic:

① When grid is off, ESS discharges to loads.
② Until ESS SOC<25%, DG starts working.
③ When DG starts working, DG charges to ESS and loads at same moment.
④ Until ESS SOC>90%, DG stops working and ESS supplies power to loads.

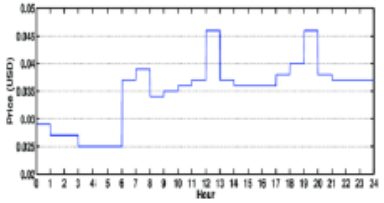
SmartGuard-63A-(T0, AUT0)User Manual

Smart Scheduling: Utilize the Big Data and Algorithm for Optimum Revenue of PV&ESS

Challenge: Fixed scheduling cannot maximize benefits.

Currently, the fixed ESS scheduling policies (Maximum self-consumption and TOU) cannot handle the real-time changes.

Floating electricity price

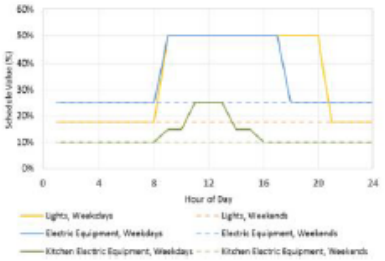


Electricity price varies greatly with external factors such as fuel price, season and market.

Changing weather

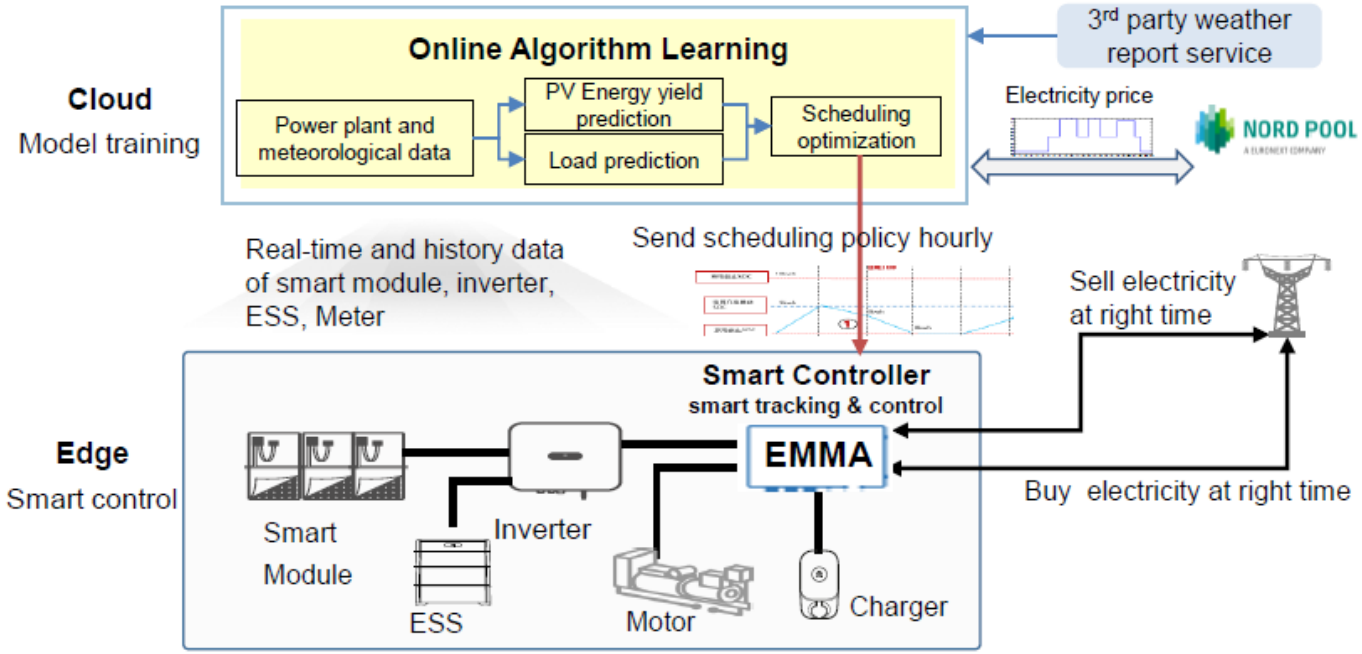
The PV energy yield is uncertain due to weather factors, and the fixed scheduling policy cannot change every day

Variable load



The load curve varies greatly between weekdays and weekends, and fixed scheduling is difficult to cope with

Smart EMS: Cloud-Edge collaboration, PV+ESS convergence, scheduling policy optimized hourly



Solution Advantage

- **Higher revenue**: The revenue in dynamic electricity price scenarios increases by 5%~10% on average.
- **Higher accuracy of optical power prediction**: the average prediction accuracy in the next 24H can reach 93% which is 1% higher than the industry.
- **Higher accuracy of load prediction**: the average prediction accuracy in the next 24H can reach 90% which is 2% higher than the industry.
- **Leading architecture**: Cloud-Edge collaboration continuously improves the scheduling algorithm precision.

The Relationship between EMMA's Smart Energy Management and Smart Scheduling

Smart Energy Management			Smart Scheduling
Features	Parameters	Description	
Power limit for grid feed-in	Max active power (kW)	Set an upper limit on the feed-in grid power.	The EMMA smart scheduling algorithm takes into account the power limits and ensures compliance. For example, in scenarios with a zero-power grid feed-in limit, the system can achieve zero power feed-in (anti-backflow) within 2 seconds.
Peak Shaving	Peak Shaving Power limit	Set an upper limit on the purchased power.	The EMMA smart scheduling algorithm adheres to Peak Shaving power purchase limits. The 24A TR6 version only supports fixed Peak Shaving and does not support time-based Peak Shaving. During time-based Peak Shaving, the scheduling algorithm follows the minimum power limits. The controller will regulate battery discharge to minimize power purchases as much as possible, but if the load demand is too high, it may still exceed the Peak Shaving threshold.
	Peak Shaving Backup SOC	Manage and monitor backup battery levels to ensure sufficient charge for peak demand periods and emergencies, achieving peak shaving.	The EMMA smart scheduling algorithm will adhere to the SOC limit.
Battery charge and discharge control	Battery charge and discharge cut-off SOC	State of Charge (SOC) cut-off for battery charging and discharging	The EMMA smart scheduling algorithm will adhere to the SOC limit.
Scheduled Electricity Usage	Scheduling electricity usage in terms of time and amount	Scheduling electricity usage at specified times for chargers and smart appliances connected via Shelly sockets.	The EMMA smart scheduling algorithm is compatible with scheduled electricity usage.
PV Preferred	PV preferred option	Chargers and smart appliances connected through Shelly sockets prioritize using power from PV or ESS.	The EMMA smart scheduling algorithm might alter the priority between the energy storage system (ESS) and smart appliances
Manage the diesel generator (D.G.)	D.G. start/cut-off SOC	Automatic start and stop	The EMMA smart scheduling does not affect the start-stop control of the diesel generator in off-grid scenarios.

The Relationship between EMMA's Smart Energy Management and Smart Scheduling

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Power limit for grid feed-in	Max active power (kW)	Set an upper limit on the feed-in grid power.	The EMMA smart scheduling algorithm takes into account the power limits and ensures compliance. For example, in scenarios with a zero-power grid feed-in limit, the system can achieve zero power feed-in (anti-backflow) within 2 seconds.
Peak Shaving	Peak Shaving Power limit	Set an upper limit on the purchased power.	The EMMA smart scheduling algorithm adheres to Peak Shaving power purchase limits. The 24A TR6 version only supports fixed Peak Shaving and does not support time-based Peak Shaving. During time-based Peak Shaving, the scheduling algorithm follows the minimum power limits. The controller will regulate battery discharge to minimize power purchases as much as possible, but if the load demand is too high, it may still exceed the Peak Shaving threshold.
	Peak Shaving Backup SOC	Manage and monitor backup battery levels to ensure sufficient charge for peak demand periods and emergencies, achieving peak shaving.	The EMMA smart scheduling algorithm will adhere to the SOC limit.
Battery charge and discharge control	Battery charge and discharge cut-off SOC	State of Charge (SOC) cut-off for battery charging and discharging	The EMMA smart scheduling algorithm will adhere to the SOC limit.
Scheduled Electricity Usage	Scheduling electricity usage in terms of time and amount	Scheduling electricity usage at specified times for chargers and smart appliances connected via Shelly sockets.	The EMMA smart scheduling algorithm is compatible with scheduled electricity usage.
PV Preferred	PV preferred option	Chargers and smart appliances connected through Shelly sockets prioritize using power from PV or ESS.	The EMMA smart scheduling algorithm might alter the priority between the energy storage system (ESS) and smart appliances
Manage the diesel generator (D.G.)	D.G. start/cut-off SOC	Automatic start and stop	The EMMA smart scheduling does not affect the start-stop control of the diesel generator in off-grid scenarios.

The Relationship between EMMA's Smart Energy Management and Smart Scheduling

Smart Energy Management			Smart Scheduling
Features	**Parameters**	**Description**	
Power limit for grid feed-in	Max active power (kW)	Set an upper limit on the feed-in grid power.	The EMMA smart scheduling algorithm takes into account the power limits and ensures compliance. For example, in scenarios with a zero-power grid feed-in limit, the system can achieve zero power feed-in (anti-backflow) within 2 seconds.
Peak Shaving	Peak Shaving Power limit	Set an upper limit on the purchased power.	The EMMA smart scheduling algorithm adheres to Peak Shaving power purchase limits. The 24A TR6 version only supports fixed Peak Shaving and does not support time-based Peak Shaving. During time-based Peak Shaving, the scheduling algorithm follows the minimum power limits. The controller will regulate battery discharge to minimize power purchases as much as possible, but if the load demand is too high, it may still exceed the Peak Shaving threshold.
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Manage the diesel generator (D.G.)	D.G. start/cut-off SOC	Automatic start and stop	The EMMA smart scheduling does not affect the start-stop control of the diesel generator in off-grid scenarios.

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What can EMMA be compared to?

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SmartDongle, Power Meter, EMS for load control

+

+

Third party EMS System

EMMA

All in one device

Integrates the Smart Dongle, electric meter, and home energy management system

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Intelligent Synergy, Revenue Increased by EMMA

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EMMA

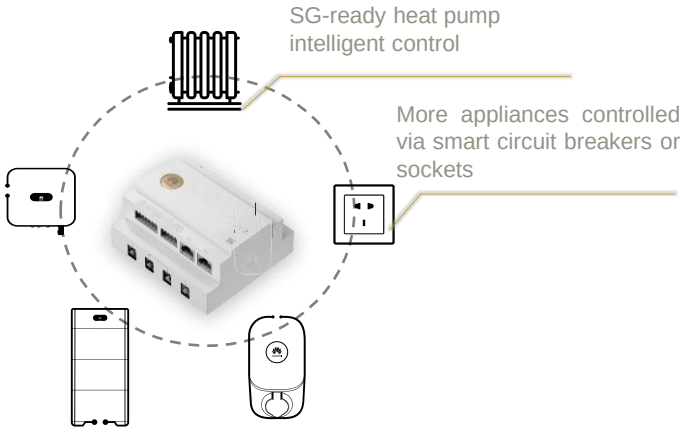
Energy Management Assistant

New

EMMA-A02

Integrates the Smart Dongle, electric meter, and home energy management.

Unified management for PV, ESS, charger, and appliances



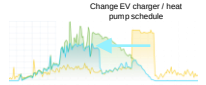
Intelligent PV + ESS Synergy

Accurate prediction of power generation and power consumption

Power limitation at the grid-connected point

Peak-valley price

Smart home mode



Heat Panel | Water Pump | Washing Machine | Charger | Water Heater | Air Conditioner

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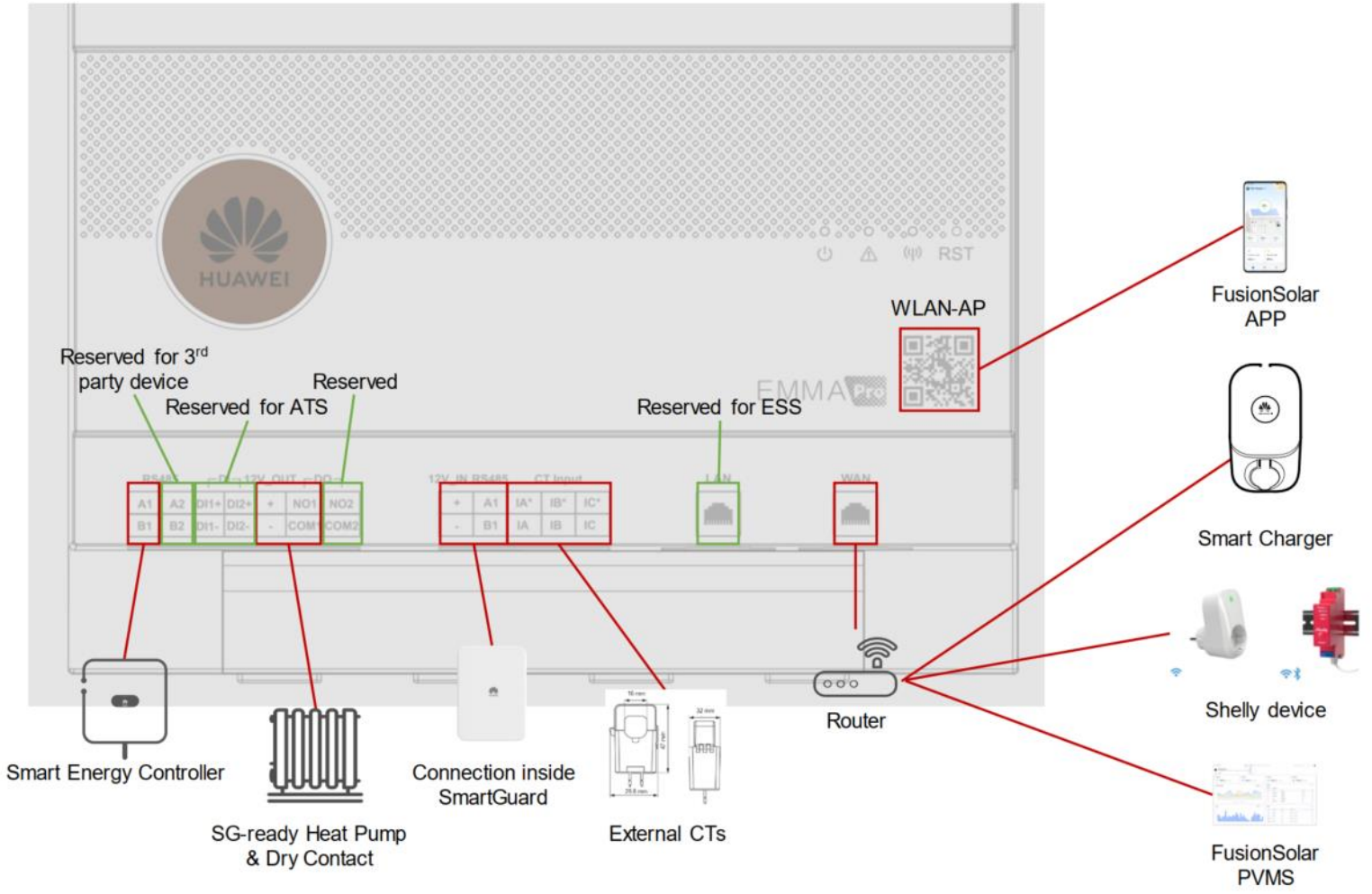
EMMA: Interface



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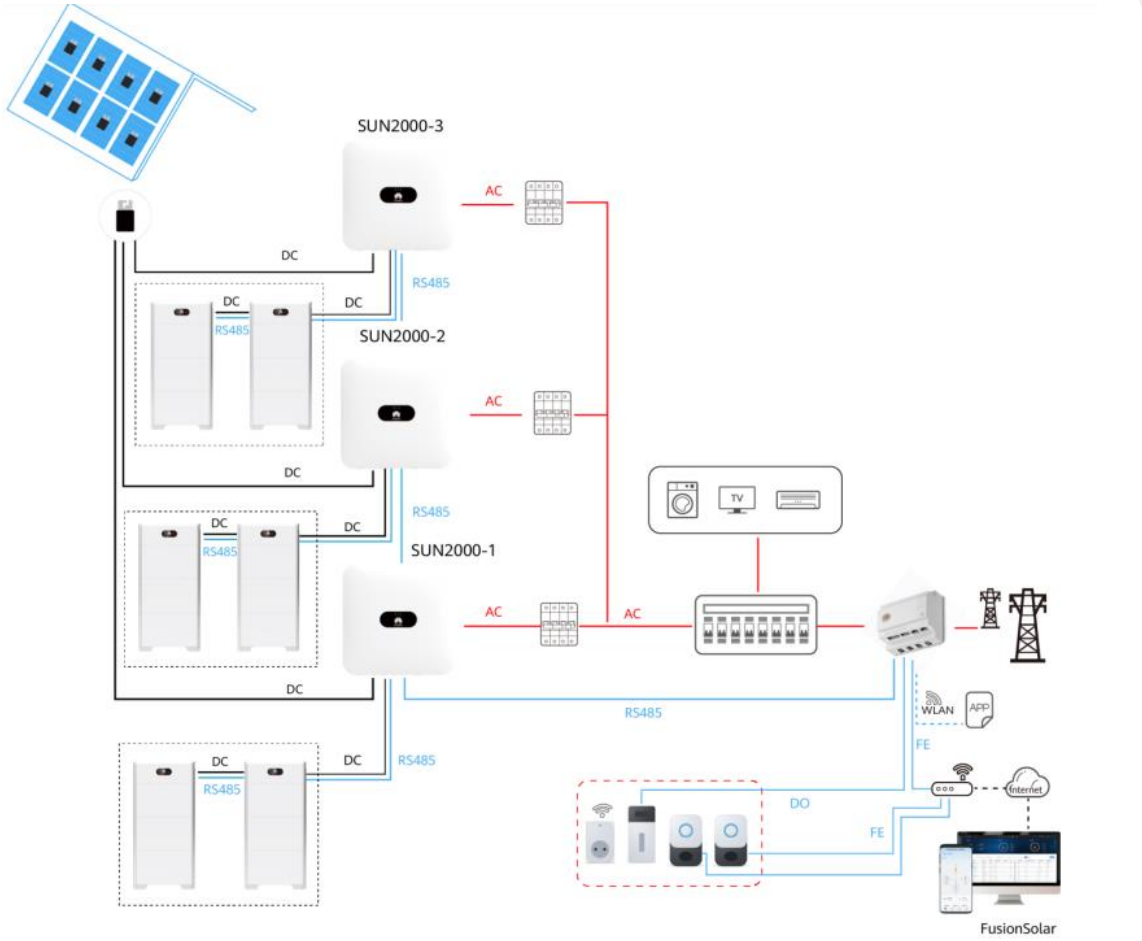
Single-Phase
PV+ESS Scenario + EMMA Networking



Product Overview

Components:

Inverter (supports up to three devices):

- SUN2000-8K-LC0
- SUN2000-10K-LC0
- SUN2000-(2KTL-6KTL)-L1

Energy storage system (ESS)

- LUNA2000-(5-30)-S0
- LUNA2000-7/14/21-S1 (in near future)

EMMA

- EMMA-A01:Only PV and ESS features are supported
- EMMA-A02: Features of PV, ESSs, smart chargers, and smart loads are supported.

Smart PV Optimizer

- SUN2000-450W-P
- SUN2000-450W-P2
- SUN2000-600W-P

Smart Charger

Smart Appliance Networking - More details on a separate slide

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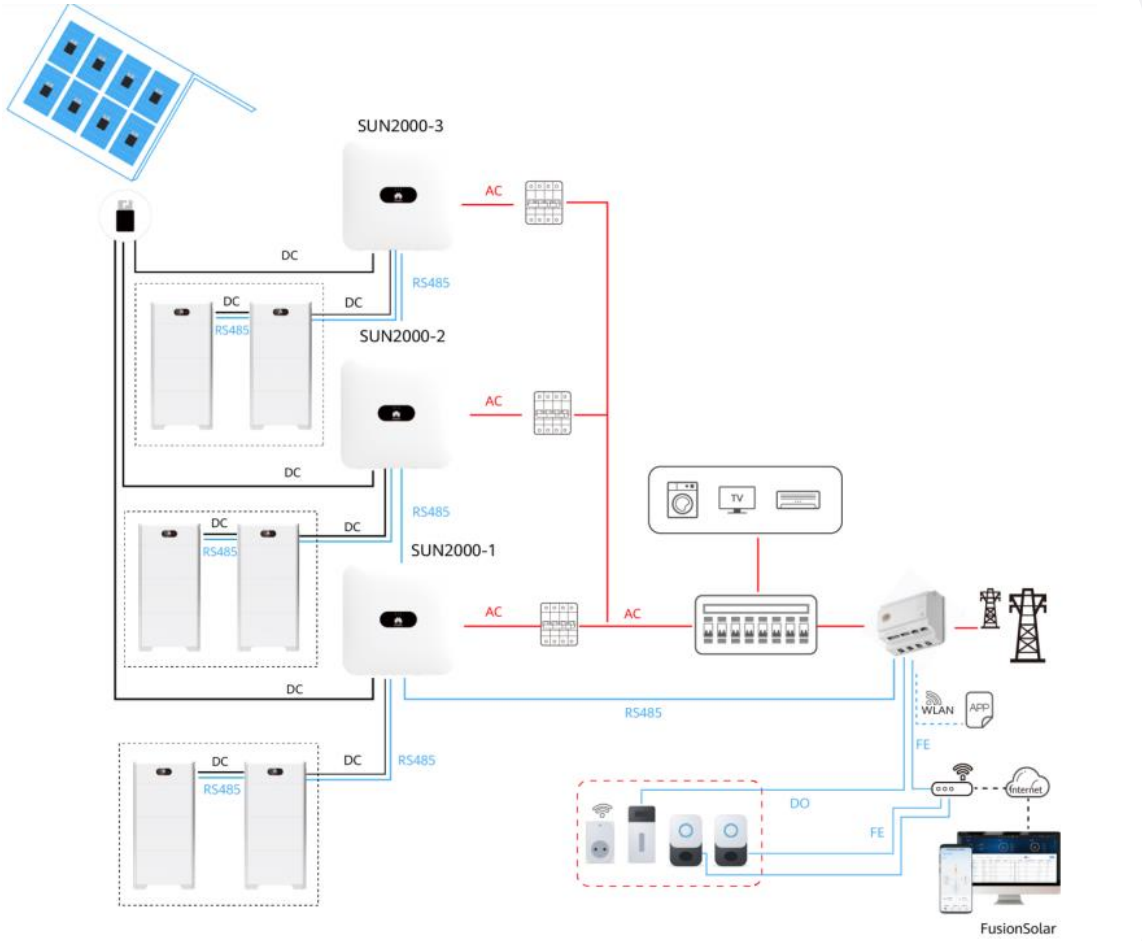
Three-Phase
PV+ESS Scenario + EMMA Networking



Product Overview

Components:

Inverter (supports up to three devices):

- SUN2000-(12KTL-25KTL)-MB0
- SUN2000-(3KTL-12KTL)-M1
- SUN2000-(8KTL-20KTL)-M2
- SUN2000-(12KL-25KL)-M5

Energy storage system (ESS)

- LUNA2000-(5-30)-S0
- LUNA2000-7/14/21-S1 (in near future)

EMMA

- EMMA-A01:Only PV and ESS features are supported
- EMMA-A02: Features of PV, ESSs, smart chargers, and smart loads are supported.

Smart PV Optimizer

- SUN2000-450W-P
- SUN2000-450W-P2
- SUN2000-600W-P

Smart Charger

Smart Appliance Networking - More details on a separate slide

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Smart Appliance Networking with EMMA-A02

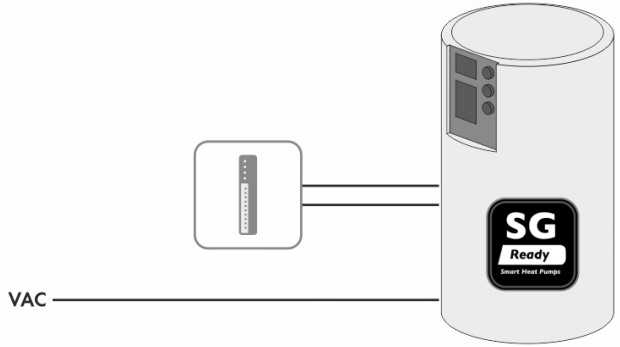
Smart Charger

SCharger-7KS-S0 (single-phase)
SCharger-22KT-S0 (three-phase)
up to two devices

Smart Switch

Smart socket - Shelly Plus Plug S
Smart relay - Shelly Plus 2PM
Smart circuit breaker - Shelly Pro 2PM
up to twenty devices

SG Ready heat pump



Only one smart grid ready device is supported

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Load control functions available with EMMA

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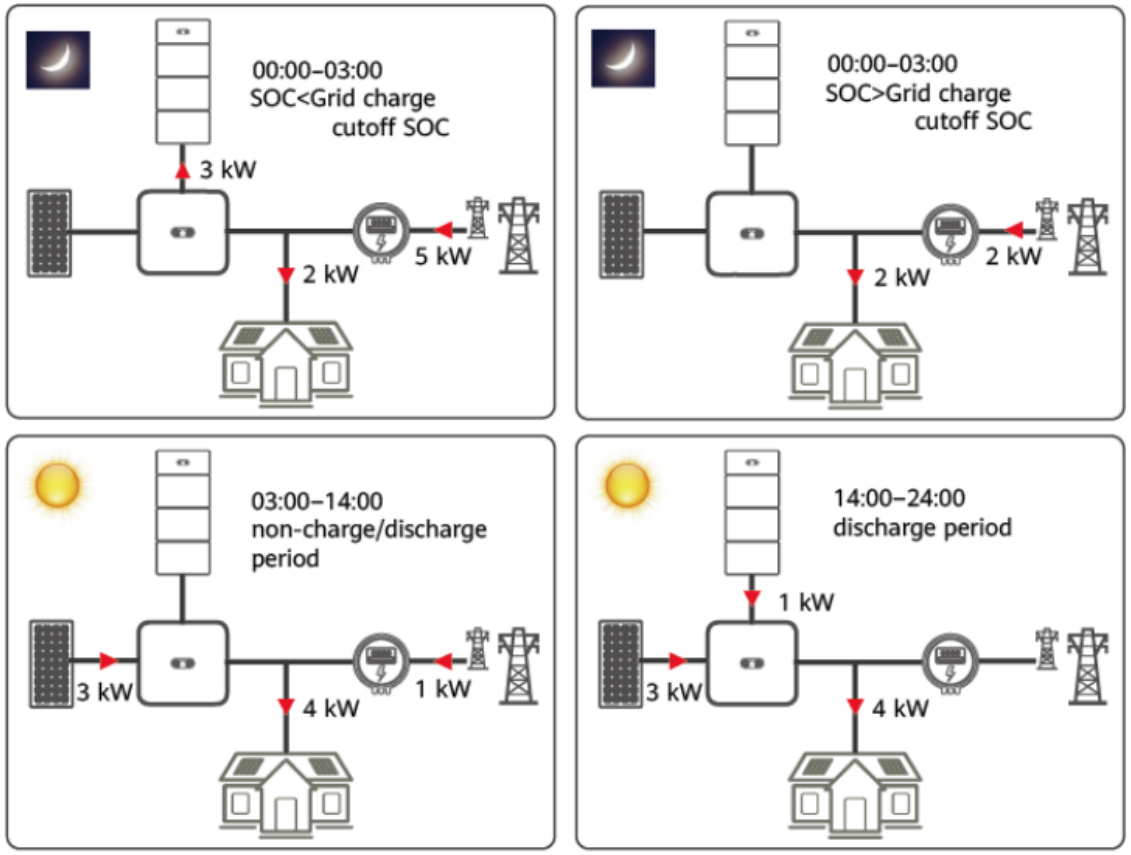
Available working mode for ESS Peak Shaving



The peak shaving function allows you to lower the peak power drawn from grid in Maximum self-consumption or TOU mode during peak hours, reducing electricity fees.
Reed more: Introduction Peak Shaving

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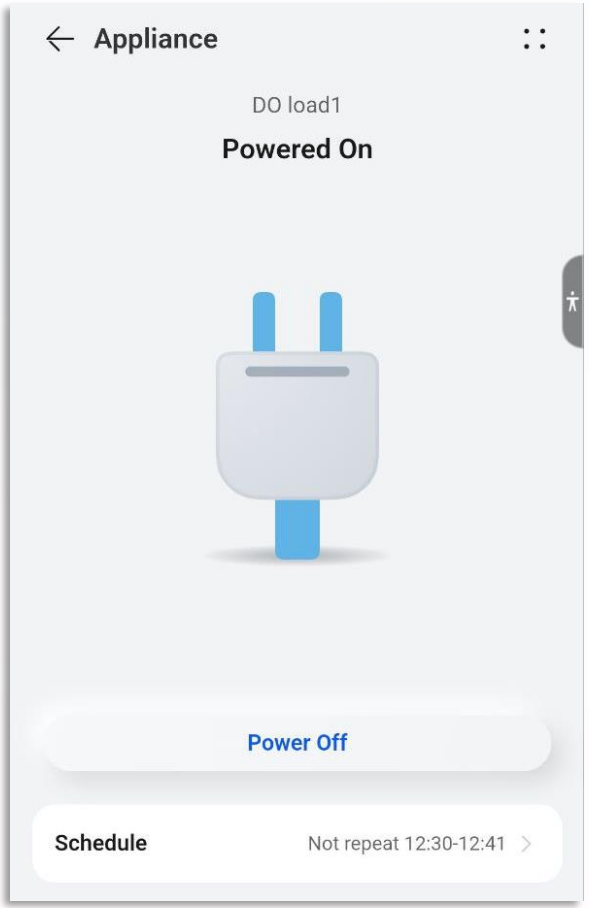
EMMA feature with smart home appliances

Remote control



Remote switching on and off of devices through the FusionSolarAPP application

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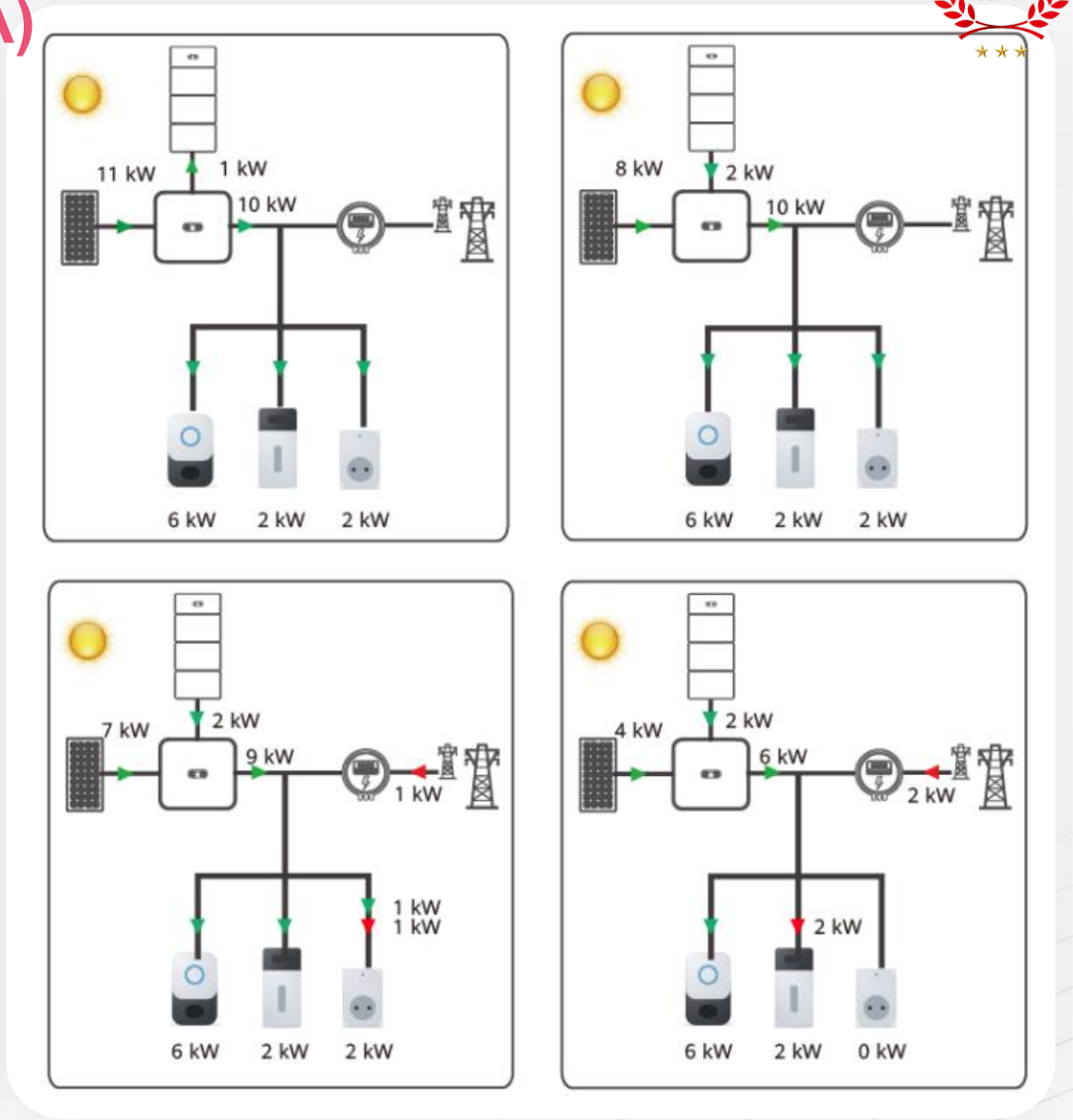
EMMA feature with smart home appliances

PV Power Preferred (EMMA)

Assume that your home has installed PV and ESS devices.

In a season with sufficient sunlight, there is still surplus PV power in addition to power supplied to loads without smart switches.

Then, you connect the smart appliances including the charger, heat pump, and boiler, pool heater/filter, irrigation pump (controlled by smart sockets) to the SmartPVMS to consume surplus PV power and save home energy expenses.



EMMA PV Preferred Mode for Appliances

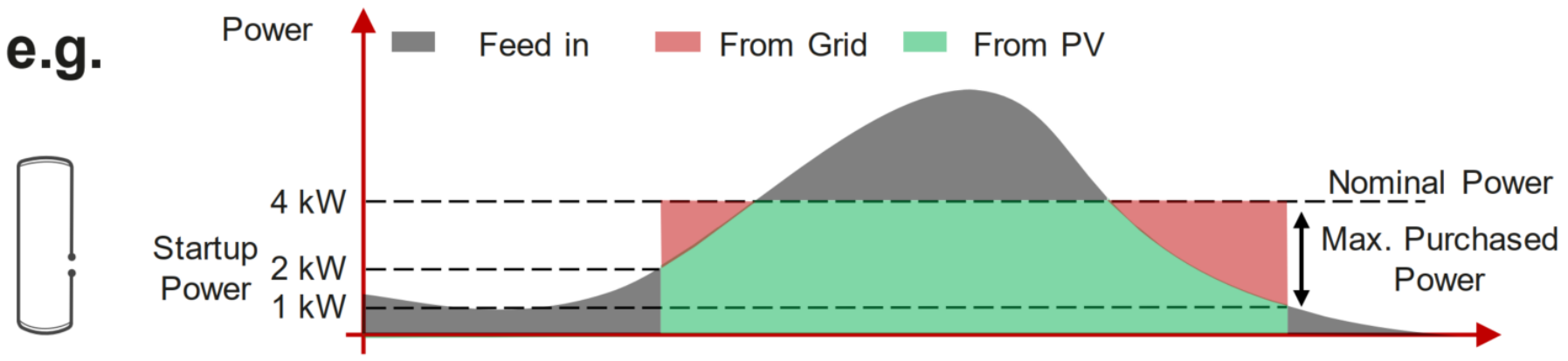
To achieve higher self-consumption ratio, controllable appliances can be set to start working only when there is enough excess PV power.

Parameters:

- Startup power (set separately for each device)
- Max. purchased power (≥ 0 kW; applied to all devices in the system)

Let’ s set the startup power to be 2kW for a heat pump and the max. purchased power to be 3kW for an example:

- It starts working when surplus PV power reaches 2kW;
- Due to usable PV power being lower than nominal power of heat pump (i.e. 4kW), it also uses power from grid.
- When power consumption from grid reaches 3kW, it stops working.



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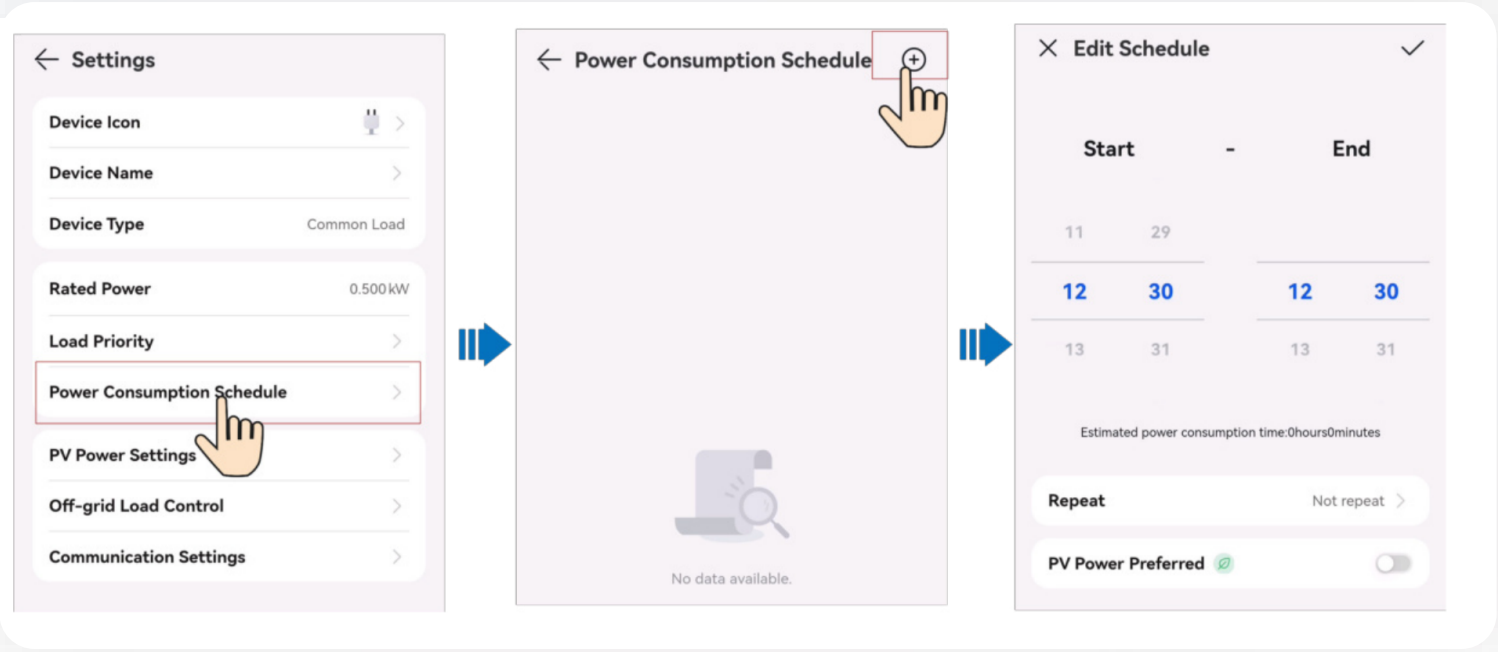
EMMA feature with smart home appliances

Setting the work schedule



We can schedule to start or shut down smart appliances at the specified time.

If the PV Power Preferred mode is enabled but the PV power is less than the surplus PV power threshold for power-on when the scheduled time arrives, the load is not started temporarily.

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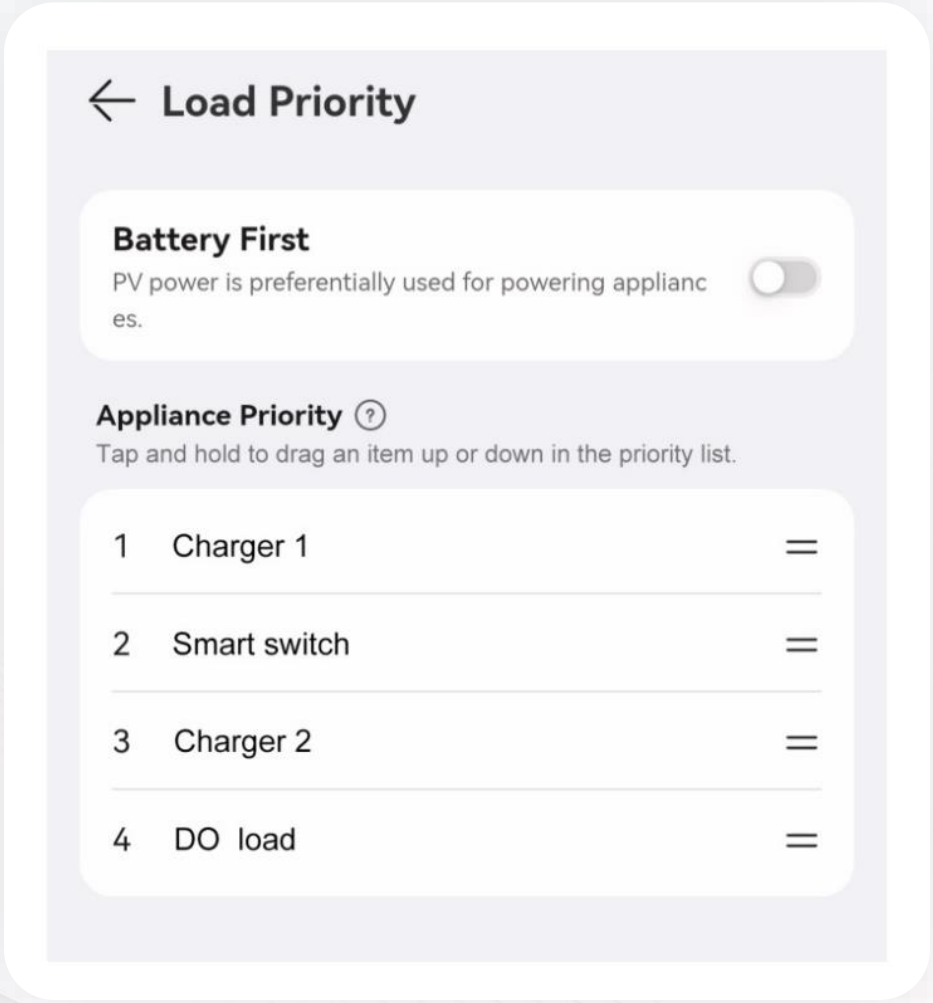
EMMA feature with smart home appliances

Load priority



Starting Loads by Priority

When the surplus PV power is greater than the surplus PV power threshold for power-on, the load at the highest priority is started first. Then, if the surplus PV power is sufficient for more loads, the loads are started by priority in descending order.

Shutting Down Loads by Priority

When the surplus PV power or grid power is insufficient to support all loads, the loads are shut down by priority in ascending order.

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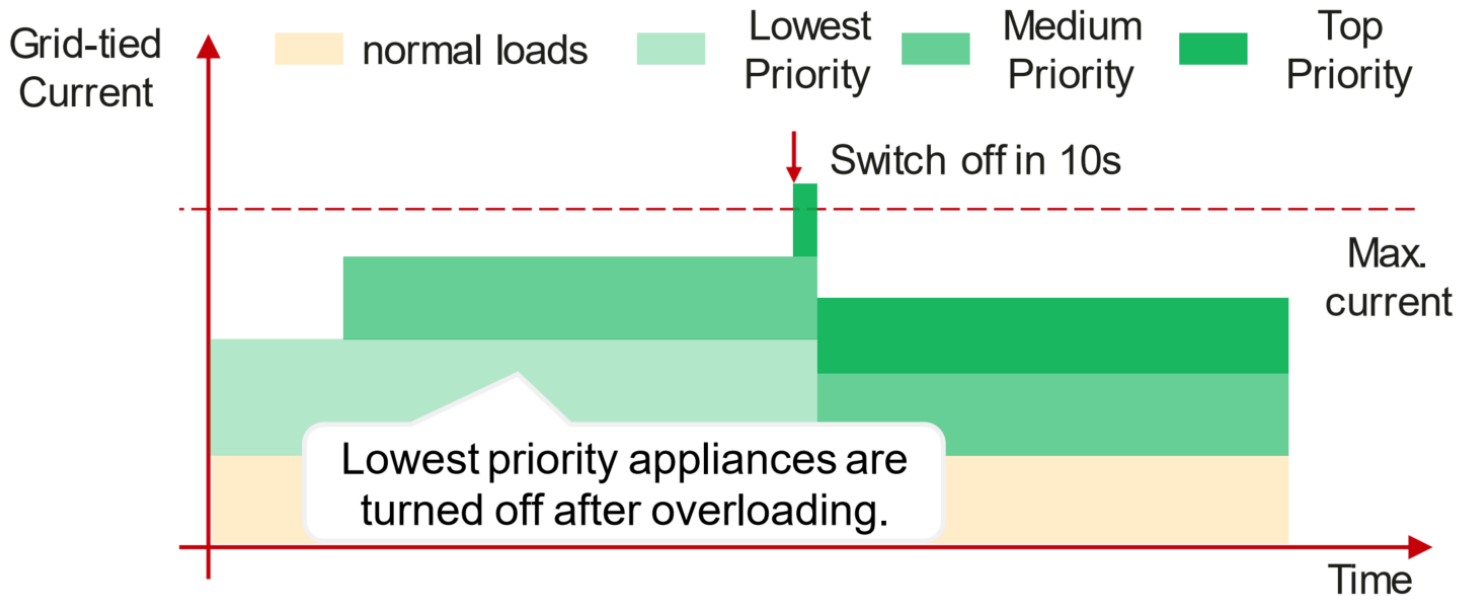
EMMA feature with smart home appliances

Load Balancing

EMMA continuously monitors the current at grid-tied point; so when the total current is over the max. current limit, the system will automatically turn some controllable appliance off, in the order of power consumption priority.



After a device is turned off, it can be restarted in the following conditions:

- It works in PV Preferred mode and the surplus power reaches the startup power;
- Restart it manually via App or web.

Huawei EMMA Solution Competitive Specifications

User Benefits	Solution Features	Dongle Solution (Continued commercial use)	EMMA Solution (Concurrent promotion)
Smart Appliances	Appliance access and control (via Shelly sockets)	×	√ (Shelly ≤ 20)
	Heat pump access and control	×	√ (SG Ready standard)
	Priority sorting for power usage	×	√
	Peak Shaving	√ (Single inverter)	√ (≤ 3 inverters)
	PV Preferred	√	√
	Three phase unbalance control	√ (Single inverter)	√ (≤ 3 inverters)
Smart charging	Number of chargers	1	1 or 2
	Charging permission sharing	×	√
	Next Trip Reservation Charging	×	√
	Scheduled Charging	√	√
	Inter-pile power control	×	√
	Single-phase and three-phase switching	√	√
	OTA upgrade	√ (Managing Chargers and PV devices with separate management systems results in low O&M efficiency.)	√
Manage the diesel generator (D.G.)	Manual start and stop	×	√ (via DO)
	D.G. output power limit	×	√ (via DO)
	D.G. fault detection (alarm reporting)	×	√ (via DO)
	Automatic start and stop	×	√ (via DO)
Smart scheduling	Smart scheduling	×	√
	Load Shedding (for South Africa)	×	√

One-stop management of Inverter, ESS, Optimizer, Charger, Appliances

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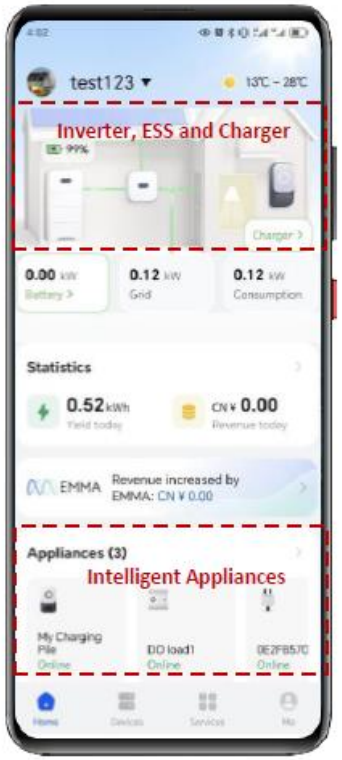
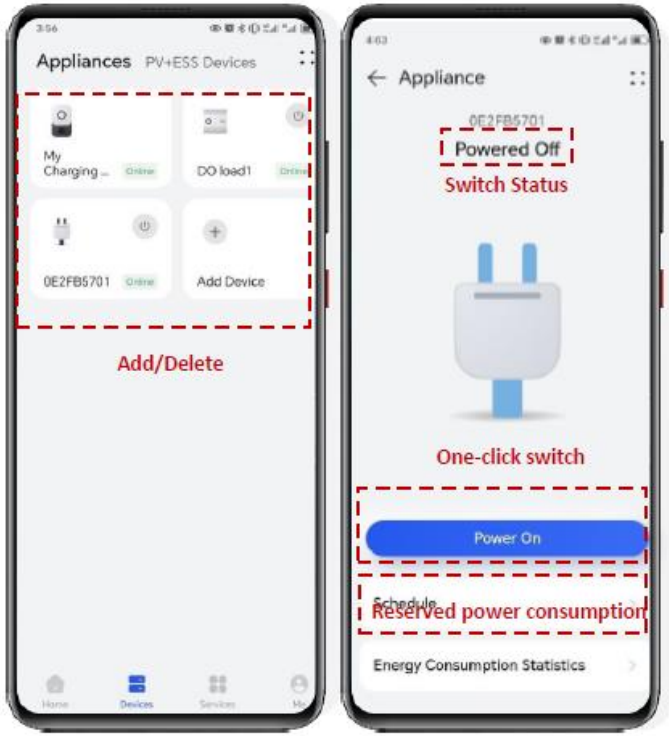
One-stop management



- PV, ESS, Charger and Appliances displayed on one screen
- Supports dual-stitch access management.

Intelligent switch/support reservation



- Smart switch, one-click switch
- Power consumption reservation is supported.

Power consumption statistics

- Real-time display of power consumption
- Daily, monthly, and annual power consumption data

Increased Benefits of EMMA Smart Scheduling in Various Scenarios

○ No revenue increase ● Revenue increased

Electricity price	User Scenario					Revenue increase rate
	PV Only	PV+ ESS	PV + ESS + Charger	PV+ ESS + Charger + Smart Appliances	PV+ ESS + Charger + Smart Appliances + Heat Pump	
Fixed price	○	○	○	○	○	N/A
Time-of-use price	○	●	●	●	●	Average increase of 6%
Dynamic price (including negative price)	●	●	●	●	●	Average increase of 5%~10%

Note: Smart scheduling is supported only with the EMMA controller or within a SmartGuard network. This function is not supported in Dongle networking scenarios.

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New Whole Home Backup SMARTGUARD-63A-T0

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Reshape the Power Backup Experience

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Whole Home Backup 3 phase system

Partial
power backup

Whole home power backup 3 phase

Easy to install, without circuit modification

Very Soon

Smartguard-63A-T0

- Compatible with M1 and MB0: 1/3 rated power in off-grid
- Compatible with MAP0: 100% rated power in off-grid mode and support unbalanced load, max 3 inverters
- Support 63A current from the grid
- Support control of DG
- Support seamless switchover, heat pump, and shelly devices
- Integrate EMMA-A2 and circuit-breaker

Seamless

< 20 ms

Ultra-fast switchover to power backup mode

Reliable

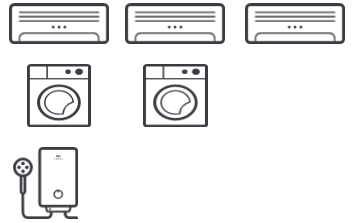
Bypass Mode

When a fault occurs
Manual bypass is supported

Powerful Backup Capacity

Higher power inverter and more energy ESS

Hierarchical shutdown for longer backup time



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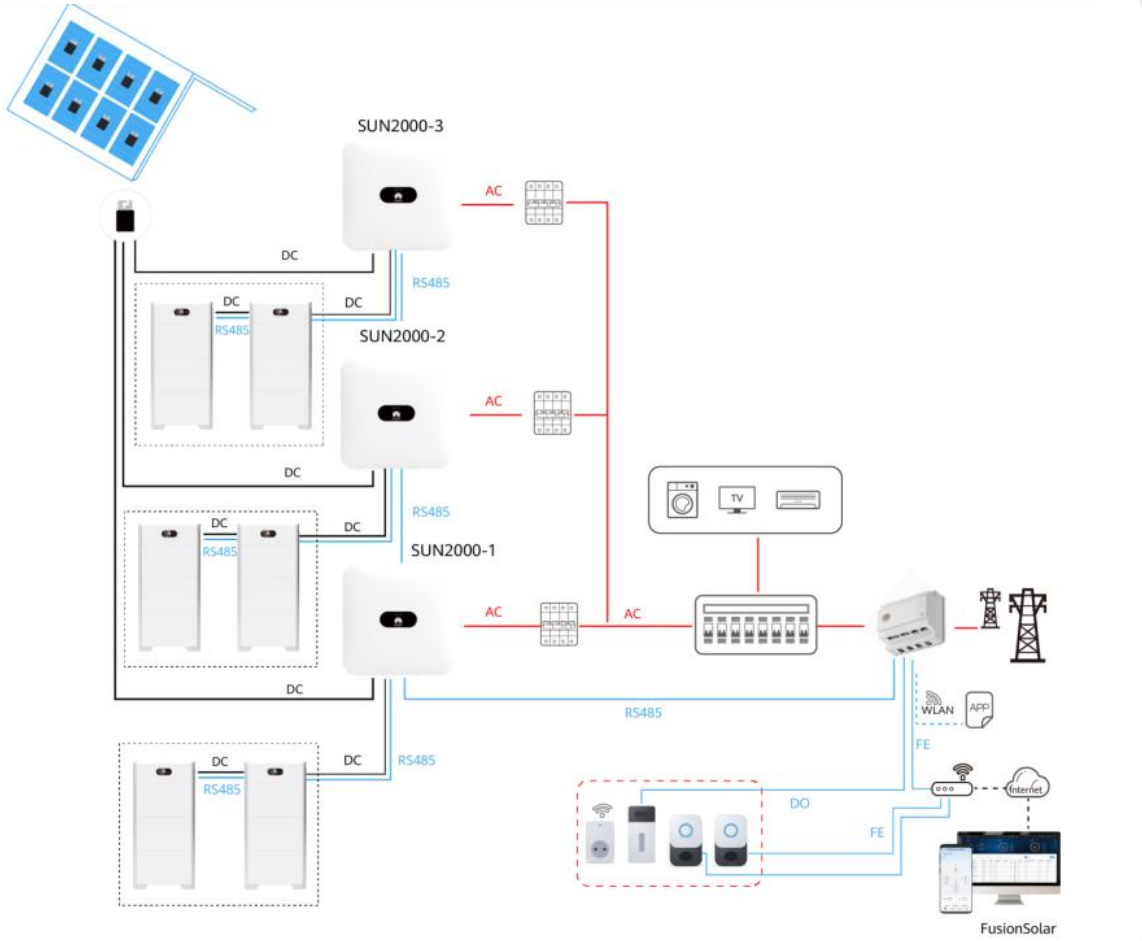
Three-Phase PV+ESS Scenario + EMMA Networking



Product Overview

Components:

Inverter (supports up to three devices):

- SUN2000-(12KTL-25KTL)-MB0
- SUN2000-(3KTL-12KTL)-M1
- SUN2000-(8KTL-20KTL)-M2
- SUN2000-(12KL-25KL)-M5

Energy storage system (ESS)

- LUNA2000-(5-30)-S0
- LUNA2000-7/14/21-S1 (in near future)

EMMA

- EMMA-A01:Only PV and ESS features are supported
- EMMA-A02: Features of PV, ESSs, smart chargers, and smart loads are supported.

Smart PV Optimizer

- SUN2000-450W-P
- SUN2000-450W-P2
- SUN2000-600W-P

Smart Charger

Smart Appliance Networking - More details on a separate slide

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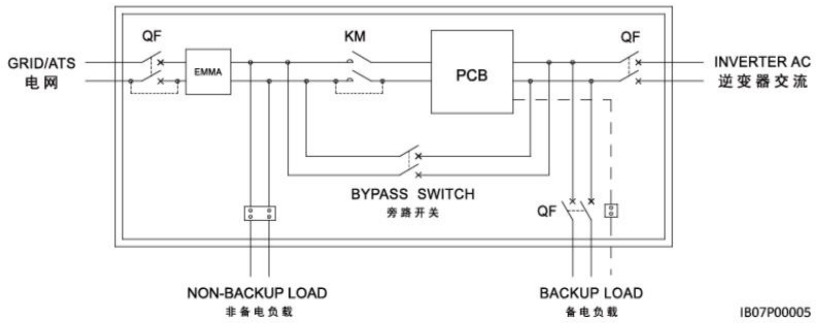
SmartGuard-63A-S0
What's inside?



SmartGuard is like a backup box, but better!

- EMMA
- Bypass switch
- Inverter AC input terminals 1&2 (AC switch)
- Backup and non backup load terminals
- Power control board

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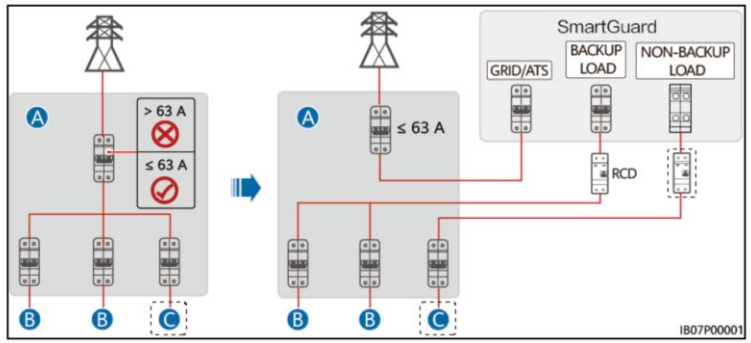
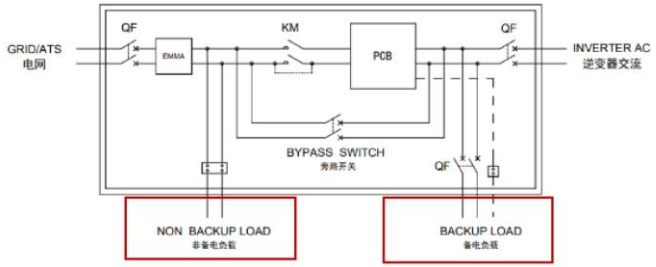
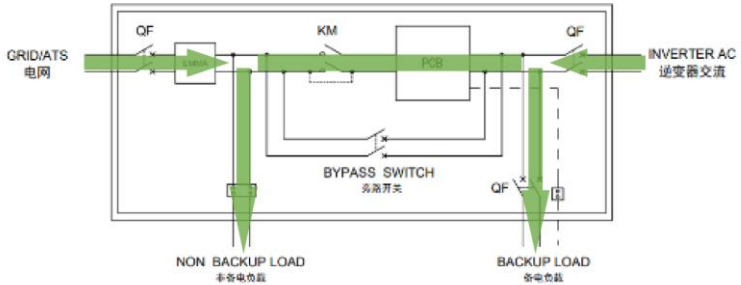
SmartGuard: Capacity and Working Modes

ONLY when the current capacity of the main circuit breaker is less than 63A, the SmartGuard can be used.

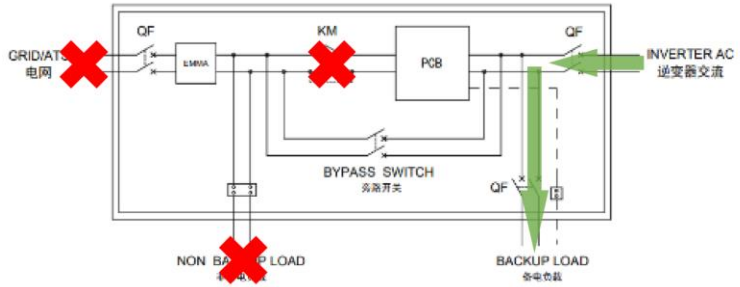


When we calculate the backup capacity, always consider the output current limit of the inverter. To avoid overloading and tripping during backup mode, it is ideal to divide the loads into backup loads and non-backup loads and to connect them to respective portal.





When the system is on-grid, KM will be closed, and the grid and PV system supply power to both backup loads and non-backup loads.



When it is off-grid, KM will be disconnected. For now, only the PV&ESS system supplies power to the backup loads and non-backup loads cannot work any more.

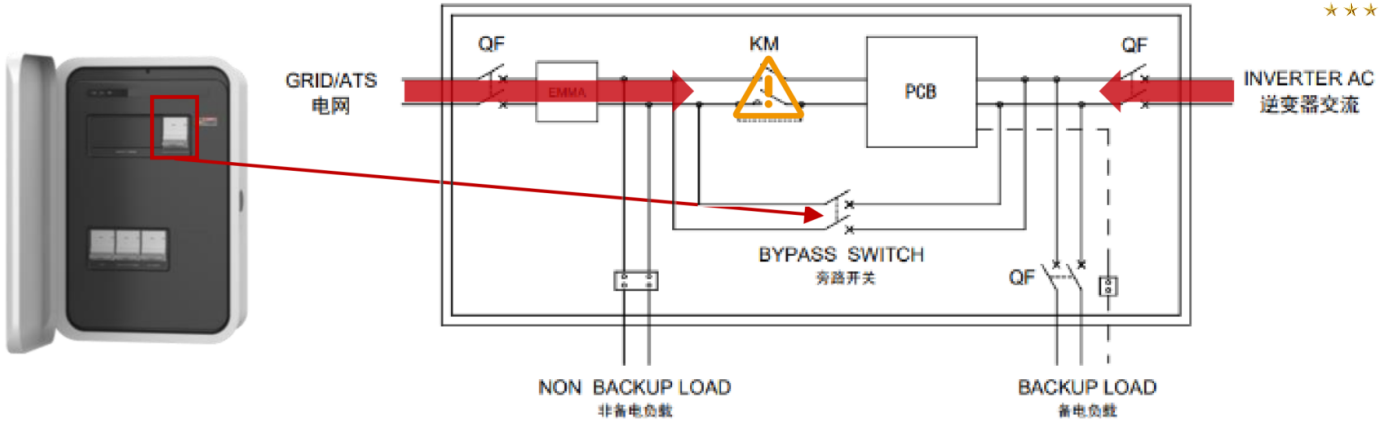
EMMA future with SmartGuard

Bypass Mode

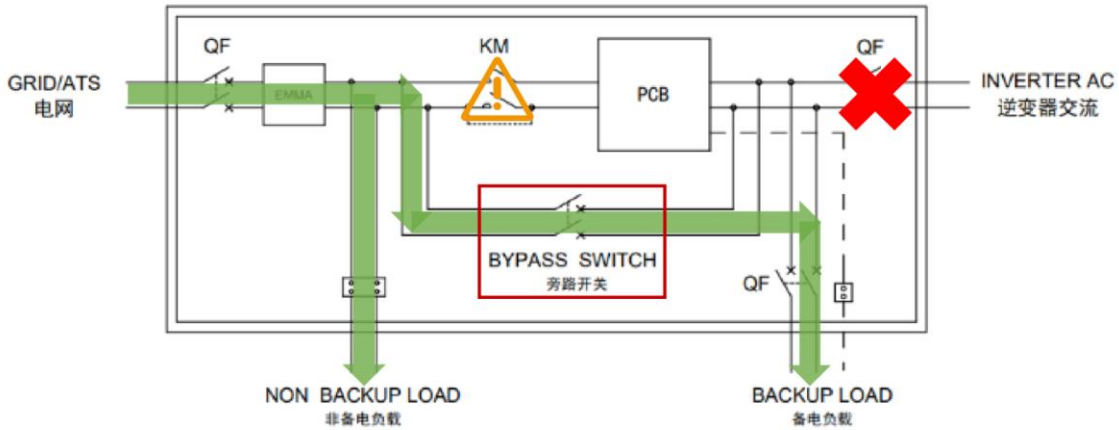
If a SmartGuard becomes faulty, even though the grid and PV & ESS system are still good, all home appliances will be out of power.

Under this circumstance, a bypass switch inside of SmartGuard can be used to enable the grid power to both backup and non-backup loads.

Firstly, disconnect the PV & ESS system side circuit breaker; and then turn on the bypass switch. During bypass mode, PV &ESS system cannot work and the PV &ESS system side circuit breaker must be open circuit.



Bypass Mode



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Load control functions available with SmartGuard

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EMMA future with SmartGuard

Off-grid load control

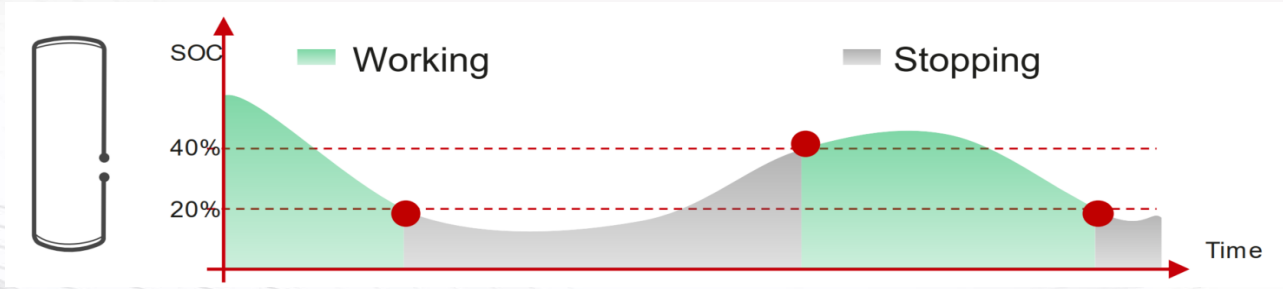
Smart home appliances can select any 1 out of 3 working modes during backup mode:

- Mode 1: Top priority load - Remain powered all the time
- Mode 2: Lowest priority load - Not working at all
- Mode 3: Automatically turn on/off according to SOC pre-settings

To extend the backup time of more critical loads, we can put some devices, which are less important, to Mode 2 or 3.

Example for Mode 3:
Let’ s set 20% SOC as shutdown trigger and 40% SOC as turn-on trigger for a heat pump working on Mode 3.

- With enough SOC, the heat pump worked on backup mode.
- When SOC goes down and reaches 20%, the heat pump went off.
- After a while, the ESS got charged to 40% SOC, and then the heat pump resumed working again.



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Commercial & Industry Product solutions & road map

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C&I Portfolio And New Products

Smart PVMS

Optimizer

MERC-1100/1300W-P

Available

Inverter

SUN2000-100/115KTL-M2
- Already registered in Rikta Rätt

Ready to order now

Smart string ESS

LUNA2000-200KWH-2H1

Available

LUNA2000-161/129KWH-2H1
LUNA2000-97KWH-1H1

Ready to order now

Power Unit

Liquid cooled Power Unit

Roadmap to be defined

Management System Tools

Smart Dongle + Smart PVMS

Available

Optimal Electricity Cost

Smart Energy Consumption

High Reliability

Smart O&M

Active Safety

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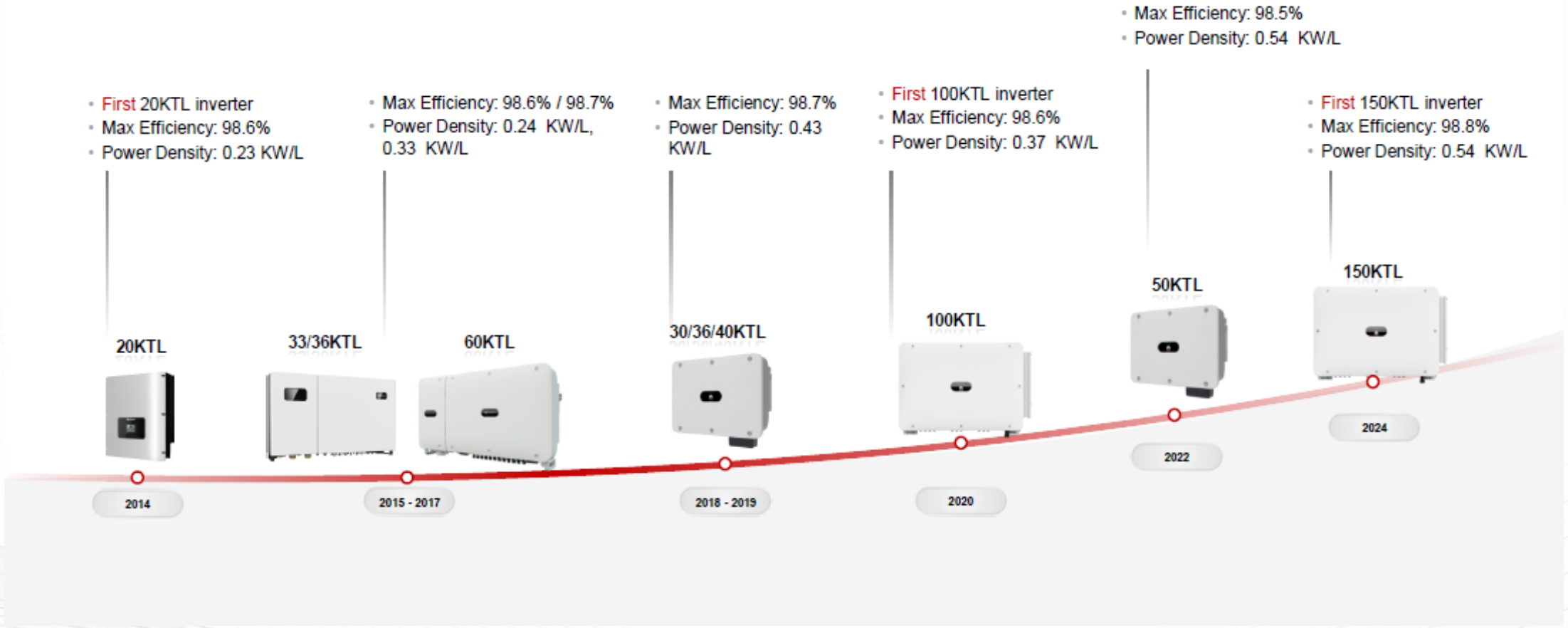
Leading the way in Power Electronics Innovation throughout the decades



HUAWEI

More Safe and Reliable PV Solution

C&I All-Rounder

Grid Friendly

Intelligent harmonic algorithm
Intelligent reactive power compensation

More Energy

Maximum efficiency: 98.8%
Built-in PID repair improves yield by 3%.

Optimal BOS

PV design tool
Better BOS for 1 MW PV plants

Active Safety

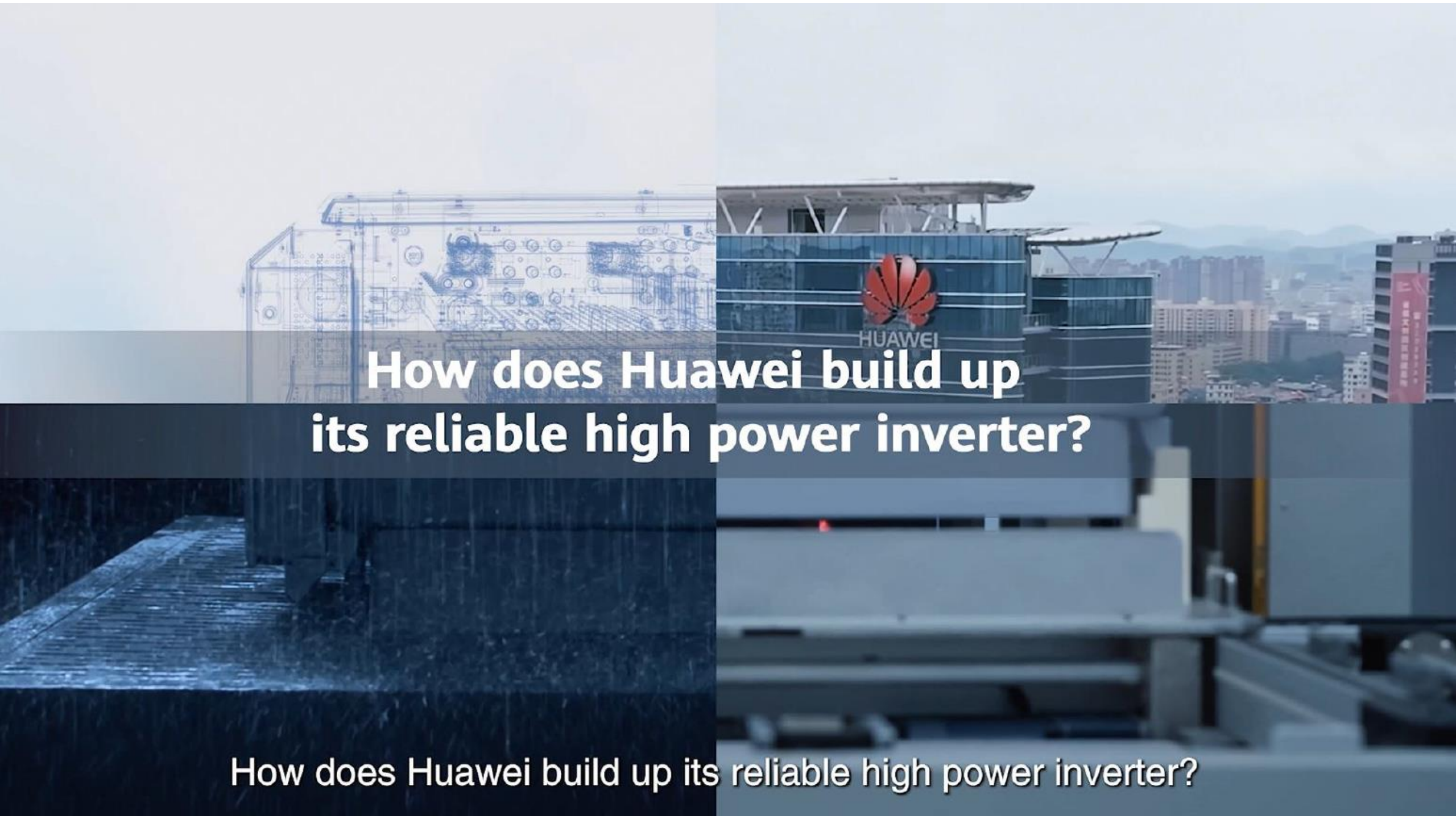
Device safety
Asset safety
Personal safety

Simplified O&M

Module-level insulation resistance detection

Long-Term Reliability

Product availability: 99.999%


HUAWEI
How does Huawei build up
its reliable high power inverter?
How does Huawei build up its reliable high power inverter?

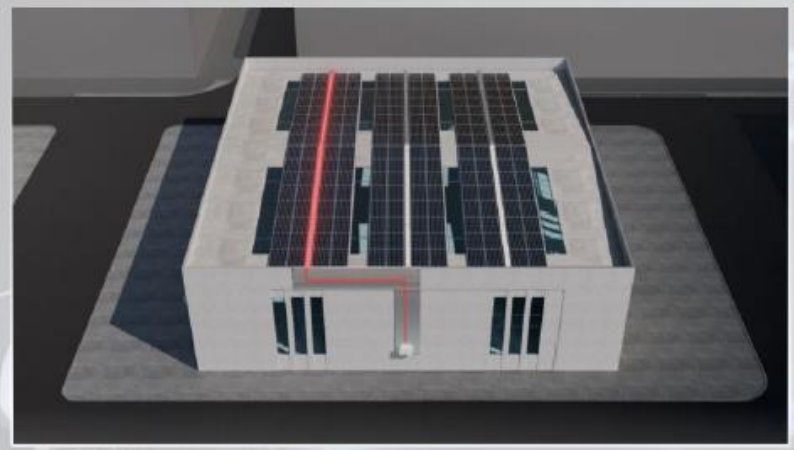
Leading AFCI Solution, Larger Detection Range, Ensuring Asset Safety

Industry Leading

TUV certification
IEC 63027 standard

200m Detection Range Only fit Small/Middle Scale Rooftop

Unable to Detect Longer range Arc fault



200m

450m Can Cover Larger Scale of C&I Application

Especially for MW rooftop

450m

Smart Connector Temperature Detection, Real-time Detection of Connector Temperature, Improving DC Connector Reliability

DC & AC Side

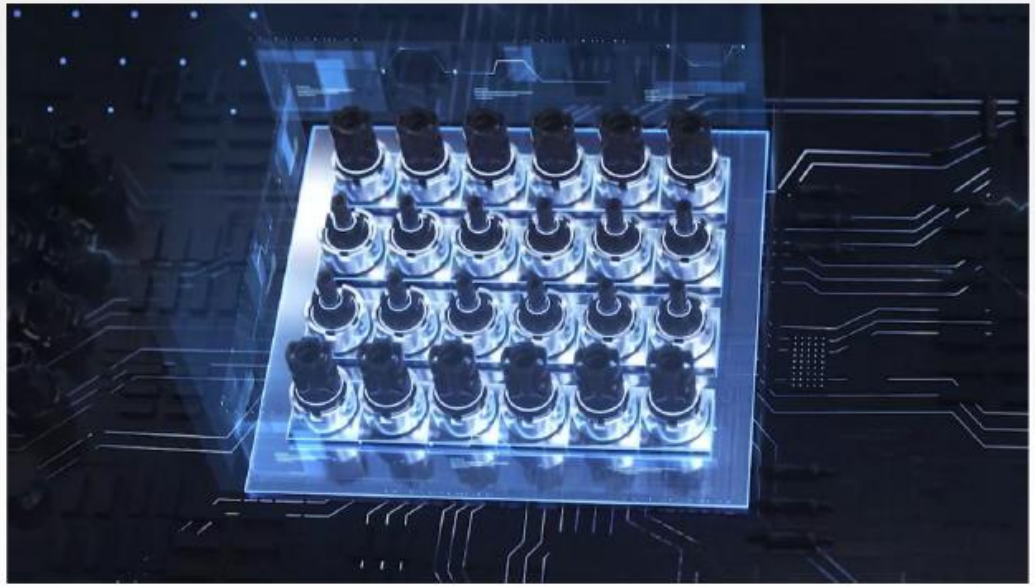
Over Temperature May Cause Fires

- Metal core improperly crimped
- Connectors loosen or not qualified installation
- Poor contact by external forces

Accurate Over Temperature Detection

Both DC connector and temperature sensor onboard

0.5s Shutdown when Over temperature Happens



Industry's first PV Ground-Fault Protection, cutting off ground faults within 15 ms during grid connection, ensuring inverter safety

Industry First

PV Ground-Fault Caused Highest Failures

- **Cable damaged**
- **Cables not firm connected**
- **Long-term stress cause by disordered cabling**

75%

PV Ground Fault @ PV Side Problem

Inverter damage	Fire risk

Rapid Shutdown and Protect Inverters Effectively

15ms Overcurrent Automatic Protection and shutdown

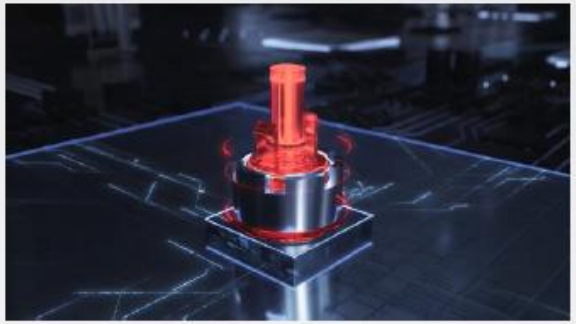
Value 2: System-Level Safety Solution, Ensuring Device and Asset Safety

Device Safety
PV Ground-Fault Protection

Industry's First

cutting off ground faults within 15 ms during grid connection, ensuring inverter safety

Device Safety
Smart Connector Temperature Detection



DC & AC Side

Real-time Detection of Connector Temperature

Asset Safety
Active arc extinguishing for fire prevention

Industry Highest L4 AFCI

Arc protection covering the entire roof

Active arc extinguishing for fire prevention

Device Safety
Active disconnection for device protection

Industry-unique Smart String-Level Disconnect

Intelligent and fast disconnection

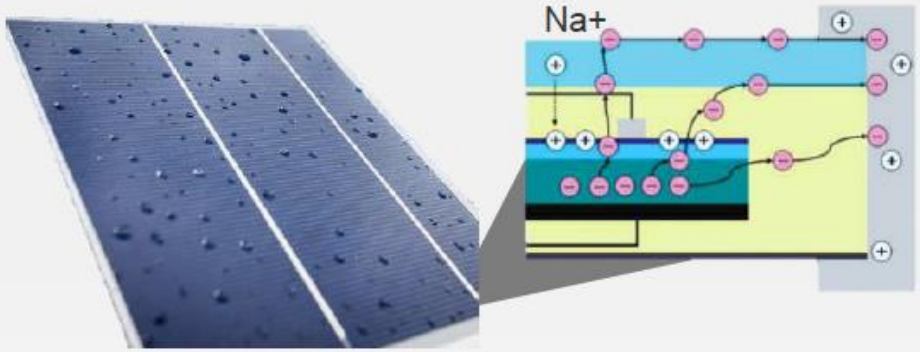
Ensure the safety of the DC side

Industry-leading PID repair improves the energy yield by 3%.

Industry Leading

Industry: PID is one of the most frequent problems in PV systems

PID reduces the energy yield by more than 5% throughout the lifecycle.



The modules work at a high voltage for a long time, and leakage current exists between the cover glass, packaging material, and frame.
The direct harm of PID is that a large number of electric charges accumulate on the surface of the cell, which downgrades the passivation effect on the surface, causing power attenuation.

PID is more severe in high-temperature and high-humidity areas.

PID is most likely to occur in high-temperature and high-humidity environments, or on modules with damaged packaging.
The severity is related to the humidity.

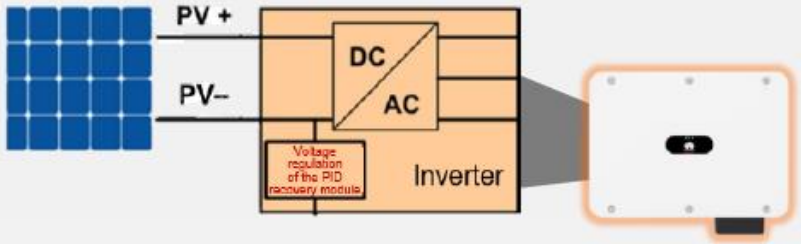
High temperature

High humidity

Damaged module

Huawei PID repair solution effectively avoids the PID effect and ensures energy yield.

Built-in PID repair function of Huawei inverters



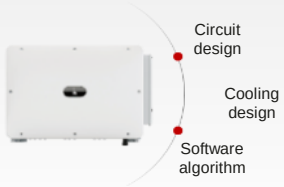
A rooftop project in Zhongshan City, Guangdong Province
TÜV's empirical tests prove that Huawei's PID repair function can improve energy yield by 3%.

98.8% Efficiency + Intelligent MPPT Tracking Algorithm, Improving Yield by 1.5%

More Energy
HUAWEI Enterprise Partner Service

98.8% efficiency

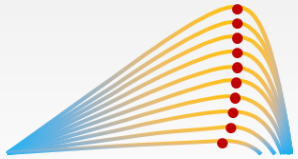
Focus on the three core elements of inverter efficiency
Improve inverter efficiency with three steps



- Three steps: Simulation in the early stage, test and verification, and long-term optimization
- 0.2% higher efficiency than industry average

High dynamic MPPT efficiency

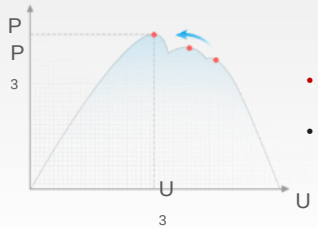
With Huawei's intelligent algorithm, the MPPT tracking efficiency reaches 99.839%.



- Dynamic MPPT efficiency: 99.839%
- Faster tracking of MPP when irradiance changes

MPPT multi-peak scanning

Conventional algorithms cannot accurately track the maximum power point. Huawei multi-peak MPPT scanning accurately locates the maximum power point.



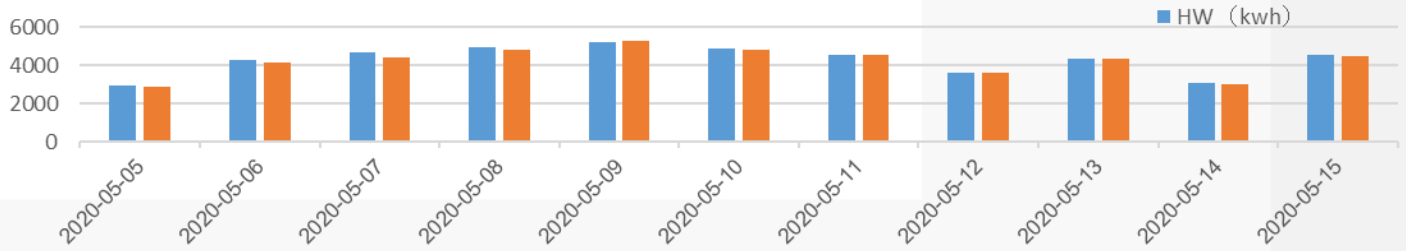
- Automatic identification of multiple peaks
- Full-range MPP scanning < 200ms

Rooftop PV Plant of a factory in Vietnam: Huawei's 100 kVA inverters outperform those of the competitor by 1.71%.

- Location: Vietnam
- Huawei: 9 x SUN2000-100KTL-M0
- Competitor: 9 x XX-100-CX
- Comparison test duration: 1 month

Huawei's intelligent MPPT tracking VS **Competitor's MPPT tracking**

In the 900 kW comparison test, the monthly energy yield of Huawei inverters is 1.71% higher than that of the competitor.



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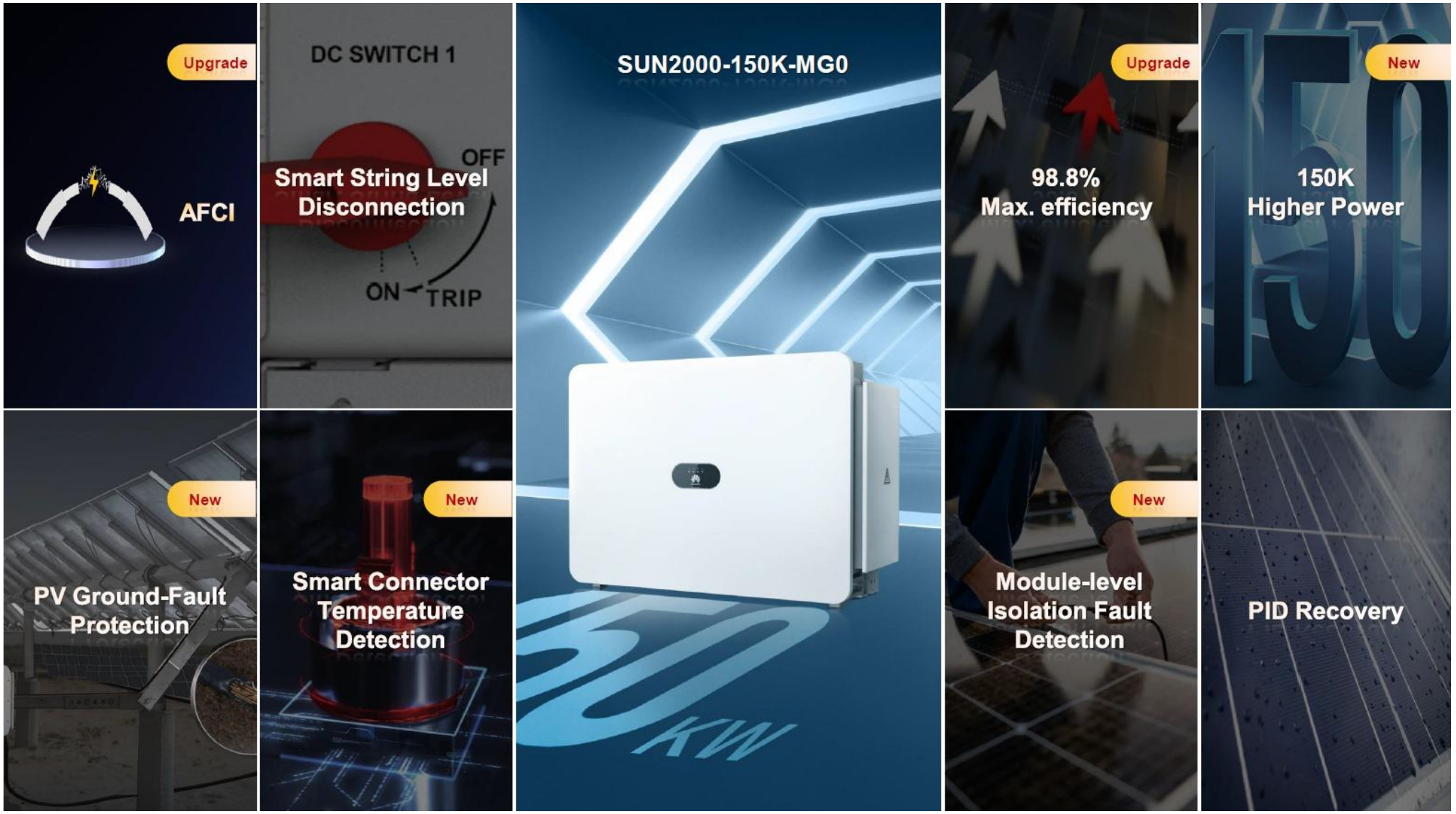
Upgrade
AFCI
DC SWITCH 1
OFF
Smart String Level Disconnection
ON
TRIP
SUN2000-150K-MG0
Upgrade
98.8%
Max. efficiency
New
150K
Higher Power
New
PV Ground-Fault Protection
New
Smart Connector Temperature Detection
KW
New
Module-level Isolation Fault Detection
PID Recovery

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INTEGRATING ALL YOU NEED

6 core values for higher ROI

- Higher Yield
- Active Safety
- Long-Term Reliability
- Simplified O&M
- Better BOS
- Grid-Friendly

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Commercial & Industry Energy Storage Systems - BESS

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Energy Market & Ancillary Services

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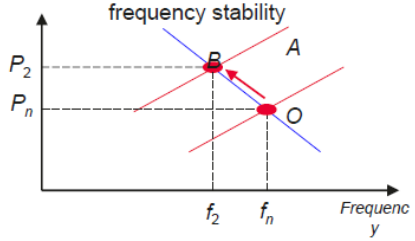
Ancillary Services: The Need for Frequency and Peak Regulation Increase, ESS Frequency Regulation ROI < 1 years @Sweden

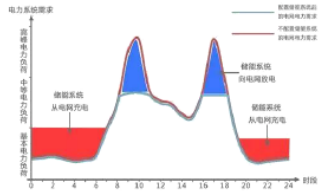
The Proportion of New Energy Continues to Grow, and the Demand for Frequency & Peak Regulation is Strong

What is Frequency & Peak Regulation?

Frequency regulation: Process for maintaining supply grid frequency stability

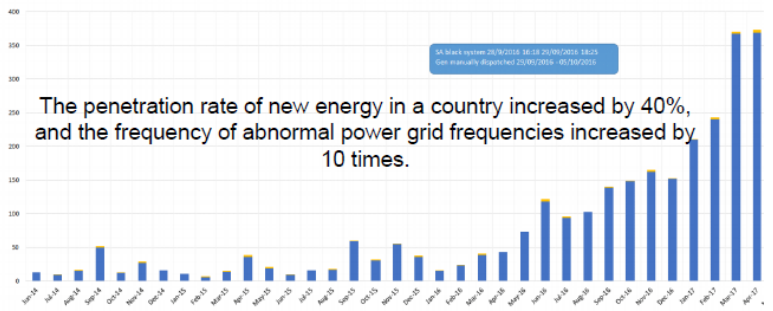


Peak regulation: Adjusting power supply during peak and valley periods



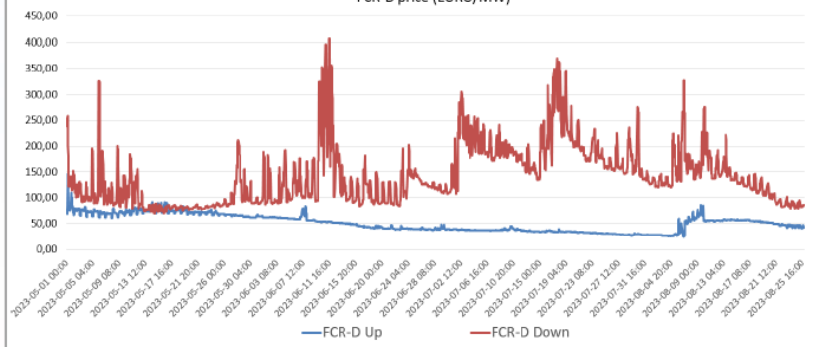
The Increase in the Penetration Rate of New Energy Affects the Stability of the Power Grid. Frequency & Peak Regulation Are

Mainland - Number of Frequency Band Exceedances
3 year historical trend



Peak & Frequency Regulation Cost is High. ESS Frequency Regulation ROI 4.4 Months @Sweden

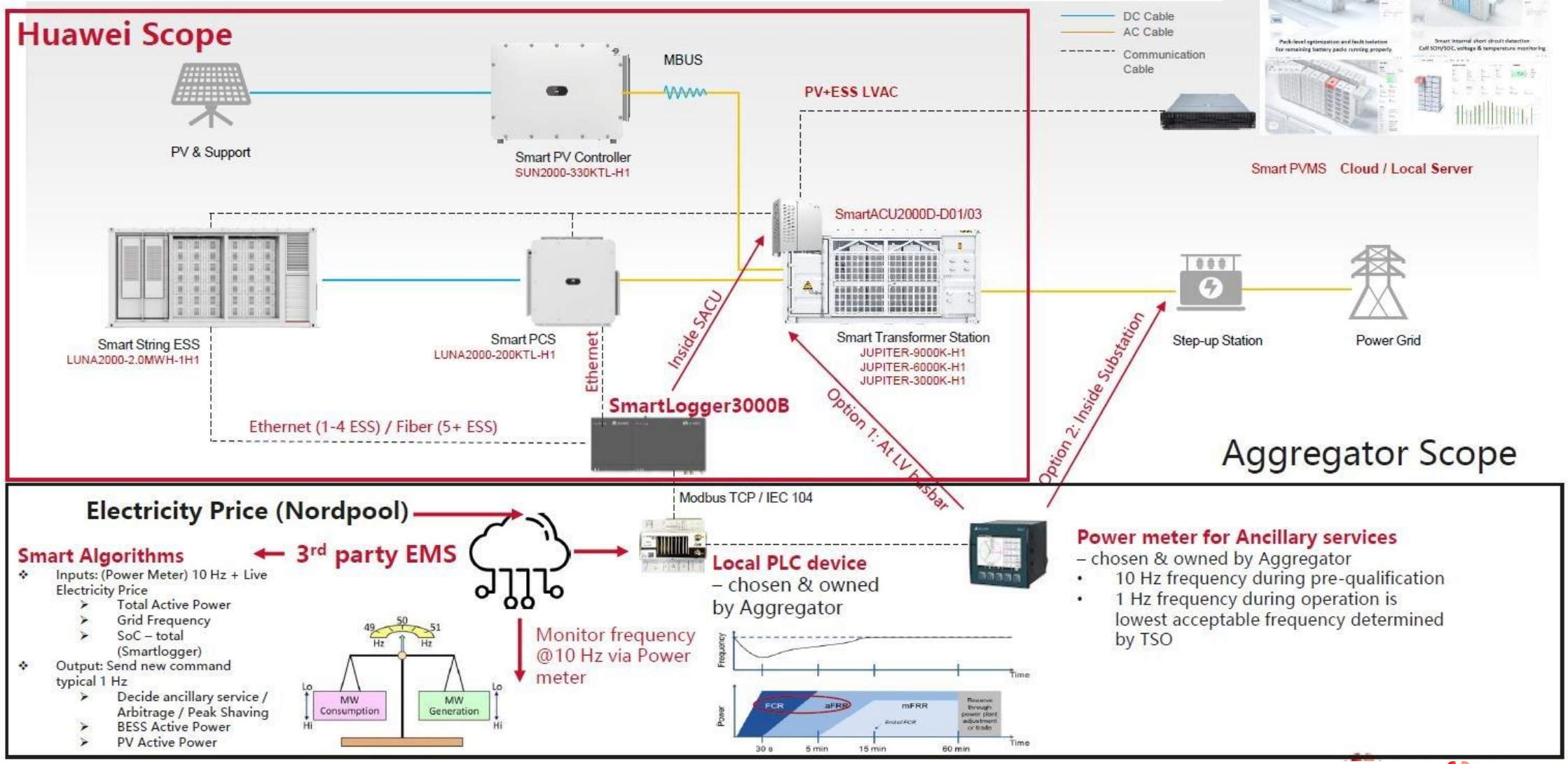
Swedish FCR-D prices for May-August 2023



ESS Frequency Regulation ROI 4.8 Months @Sweden with May-Aug prices

FCR-D Up: 49.9~49.5Hz Frequency Regulation Avg. price May-Aug 2023 (EURO/mW/h)	50,8
FCR-D Up: 50.1~50.5Hz Frequency Regulation Avg. price May-Aug 2023 (EURO/mW/h)	141,6
ESS kWh	100,0
Winning Hours h/Year	7008,0
Revenue EURO/Year	134862,0
ROI Months	4,4

Huawei Hybrid PV+BESS for Ancillary Services, Peak Shaving, Arbitrage



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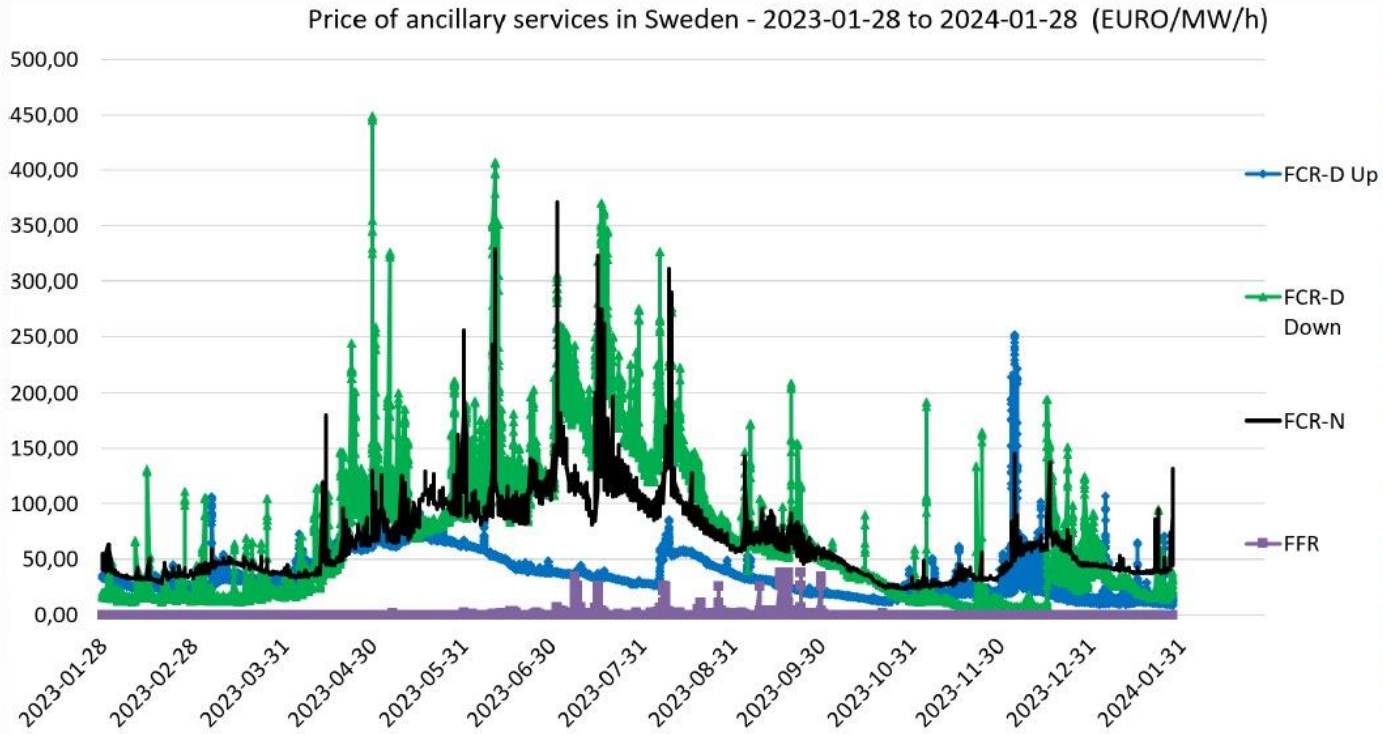
Ancillary Services: The Need for Frequency and Peak Regulation Increase, ESS Frequency Regulation ROI < 1 years @Sweden



Economical ROI's calculated for Huawei C&I ESS

FCR-N (€/MW/h)	65,39	Average price
FCR-D Up (€/mW/h)	36,33	Average price
FCR-D Down (€/MW/h)	69,26	Average price
ESS kW (97 kWh)	92,00	The total qualified power for this 97 kWh ESS - limited by batterypack total discharge power
Winning Hours h/Year (80%)	7008,00	Assume win 80% of all hours for this year
Revenue EURO/Year - 1x ESS 97 kWh, 100 kW - FCR-D UP (100% Power)+ FCR-D Down (100% Power) + FCR-N (60% Power)	93373,42	Revenue including FCR-N
Revenue EURO/Year - 1x ESS 97 kWh, 100 kW - FCR-D UP (100% Power)+ FCR-D Down (100% Power) + FCR-N (60% Power)	68079,08	Revenue without FCR-N
Fee to aggregator	40,0%	Aggregator needs to also pay Balance Responsible Party (BRP) and Grid Company (Vattenfal, EON, Ellevio, Tekniska Verken, Göteborgs Energi, SK,
ROI (Years) - 1x ESS 97 kWh, 100 kW - FCR-D UP (100% Power) + FCR-D Down (100% power) + FCR-N (60% Power)	0,98	Very capable aggregator: can also include FCR-N
ROI (Years) - 1x ESS 97 kWh, 100 kW - FCR-D UP + FCR-D Down	1,35	Average aggregator: only manages FCR-D Up + FCR-D Down
Number of hours per year with FFR during	759,00	During 2023: FFR only needed 8.7% of all the hours of the year!
FFR during 2023 (SEK/MW/h)	56,83	Average price
Average price FFR during 2023 (EURO/MW/h), 1 year average EUR/SEK = 0,087	4,94	
Revenue EURO/Year - 1x ESS 97 kWh, 100 kW - FFR	3752,93	
ROI (Years) - 1x ESS 97 kWh, 100 kW - FCR-D UP (100% Power) + FCR-D Down (100% power) + FCR-N (60% Power) + FFR (100% Power)	0,92	FFR is not so profitable in 2023, maybe in 2024 it will be better? Seems SvK was just testing it in 2023. Only active during summer and not at the max volume so often.

FCR-D Up + FCR-D Down: **1.35 years ROI**

FCR-N (60% of max Power) + FCR-D Up + FCR-D Down: **0.98 years ROI**

FFR + FCR-N (60% of max Power) + FCR-D Up + FCR-D Down: **0.92 years ROI**

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HUAWEI SMART BATTERY STORAGE:

OPTIMAL LCOS, ACTIVE SAFETY

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2 MWh ESS + PCS	
Rated output power	200 kW
Max. Efficiency	99 %
Max. input voltage	1500 Vdc
Rated output voltage	800 Vac
Rated capacity	2064 MWh
Cell Type	LFP Cells
Container	20 feet
Protection level	IP55

200 kWh ESS + PCS	
Rated output power	100 kW
Max. Efficiency	98,5 %
Max. input voltage	1100 Vdc
Rated output voltage	400 Vac
Rated capacity	200 kWh
Cell Type	LFP Cells
Container	2,5 x 2 x 1 m
Protection level	IP55

BATTERY ARCHITECTURE

OPTIMAL CONFIGURATION

LCOS battery reduction **over 15%** compared to the standard solution

EXTENDED SERVICE LIFE

Temperature rise <5 ° @ 1C Enhances **battery life**

EASY MAINTENANCE

OPEX annual savings **~ € 725 / MWh**

SECURITY & RELIABILITY

Reliability **- 99.9%** Fire hazard prediction

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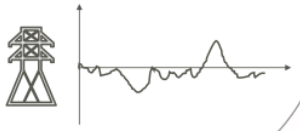
Five Business Models of ESS to Support Value Implementation in Business

Maximum Self-Consumption

Elec. Cost > $0.3/kwh, ROI < 5 years

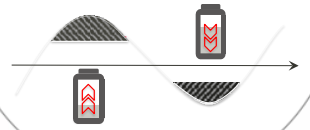
Ancillary Services (FFR, FCR-D…)

Frequency regulation cost > $18/MW/h, ROI < 1 years



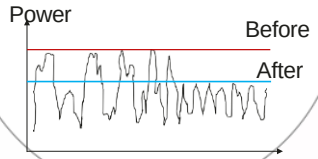
TOU

Elec. Cost Diff. > $0.2/kwh, ROI < 5 years



Demand Management

Demand cost > $130/kw/year, ROI < 8 years



E.g. Nodes for EV charging

Avoid grid reconstruction

The grid capacity is insufficient. Grid reconstruction - Cost €74k/ Duration 6 months

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Luna2000-97-200kWh-1H/2H

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ESS model	ESS capacity (1 cabinet)	Quantity of battery pack	Max. charge/discharge rate	Parallel use
LUNA2000-97KWH-1H1	96.8kWh	6	1C	• Different capacity models can be used together （Max. 20） • Capacity range: 96.8~3870 KWh
LUNA2000-129KWH-2H1	129.0kWh	8	0.8C	
LUNA2000-161KWH-2H1	161.3kWh	10	0.64C	
LUNA2000-200KWH-2H1	193.5kWh	12	0.5C	

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Challenges and complexity

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Challenges in Battery Energy Storage System Industry

Low Available Capacity

- Series & Parallel mismatch due to inconsistency between battery cells, which leads to lower available capacity according to Cannikin Law

Pack & Rack Optimizer

Complex O&M

- On-site battery installation wiring & commissioning
- Regular SOC calibration by professional staff

No need for periodic balancing
No need for experts to visit sites

Short Lifespan

- Unbalanced temperature control design, resulting in a temperature difference of >10℃ inside the container and a 25% reduction in battery lifespan

Distributed Temperature Control

Fire Risks

- Battery cell over-charge, over-discharge ,or other faults
- Key components(circuit boards, contactors, etc.) failure cause sparking and arcing

Cell to system safety protection
Avoid thermal runaway

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Key Value1: Active Safety

In the face of endless safety problems
3-protection measures to ensure system safety

- **Device safety**
- **Property safety**
- **Personal safety**

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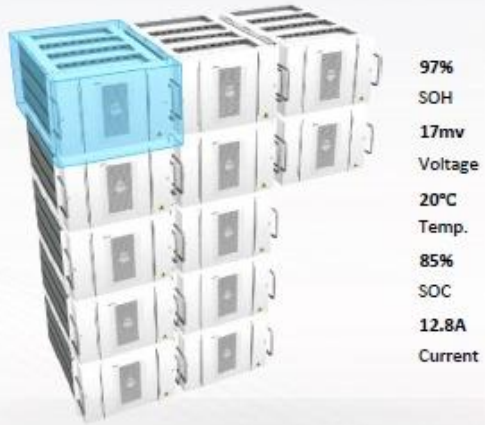
3-Dimensional Active Safety Design for Device, Asset & Personal

Device Safety Design

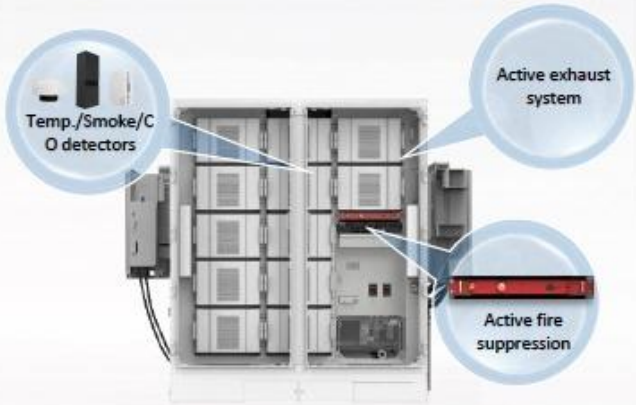
Potential risk mitigation



- 100+ Cell access test
- Cell-level running status + Pack-level isolation & shutdown

Asset Safety Design

Active fire suppression



- Multi-detectors + Exhaust system + Fire suppression

Personal Safety Design

'Safety airbag' design

- Top explosion venting - Instead of front blast release, avoiding personal injury

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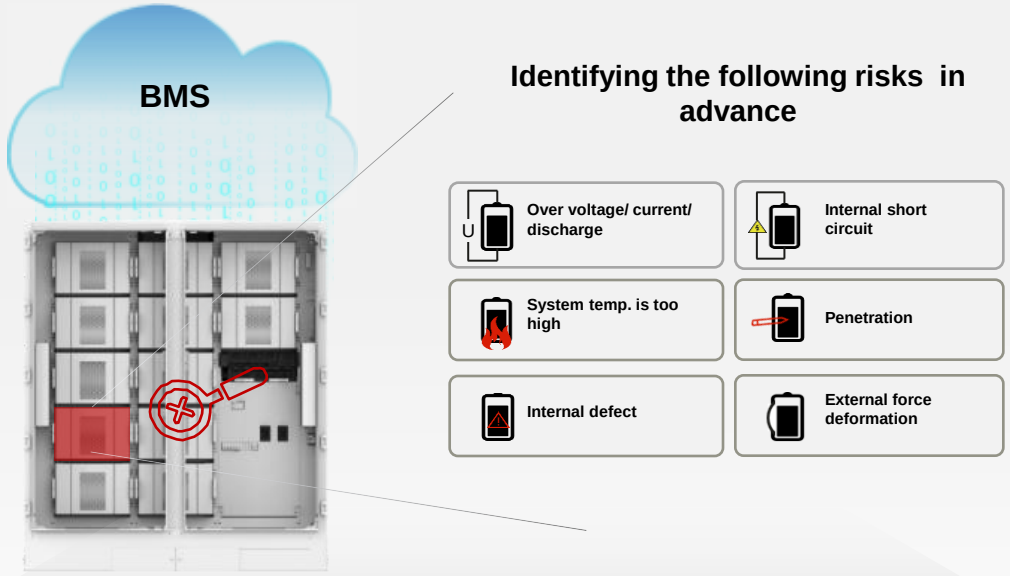
Device Safety

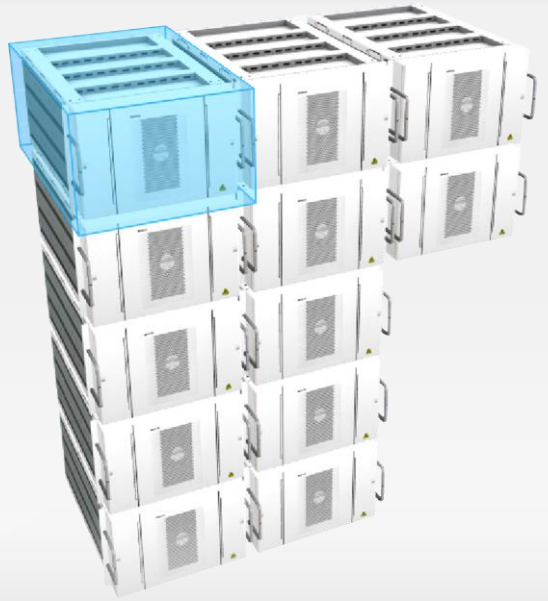
BMS & cell-level monitoring, proactively identifying and alerting risks

Huawei: CBMS, high precision internal short-circuit detection algorithm



- **Remote internal short-circuit detection**, identifying potential risks, and providing a **warning** for thermal runaway

Huawei: Cell-level monitoring, real-time visual & manageable battery cell data

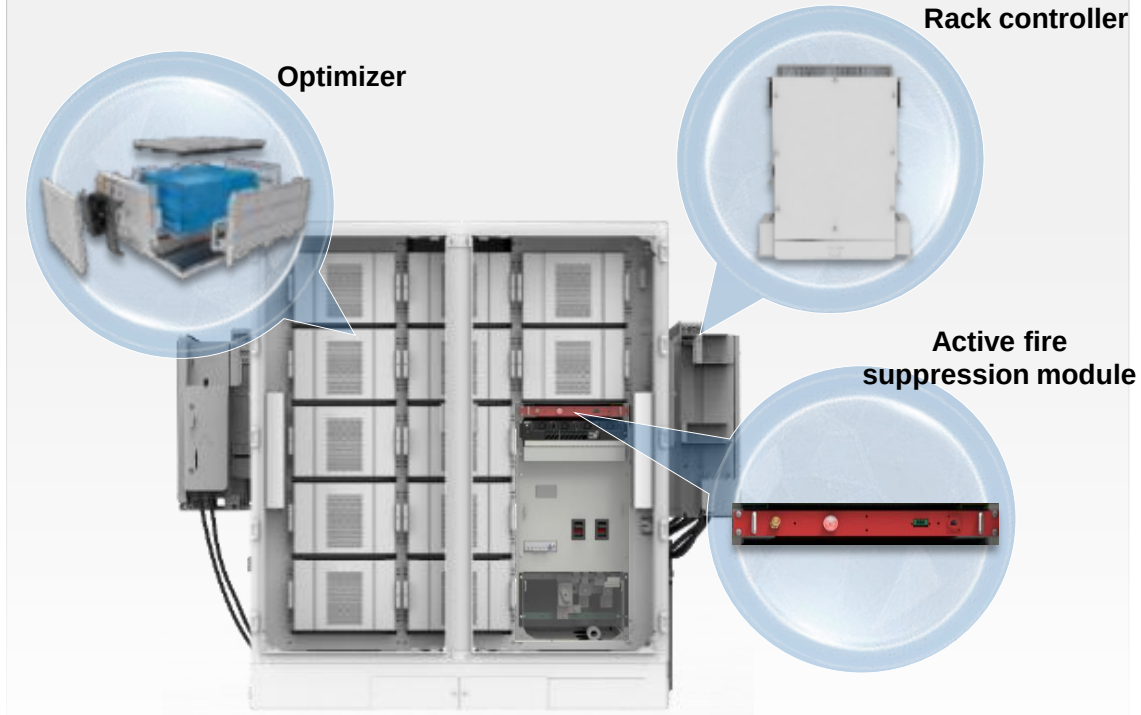


- **Real-time monitoring of battery cell data,** including SOH, SOC, voltage, current, number of cycles
- Cell data is visible and manageable on the **SmartPVMS**

Asset Safety

Optimizer + rack controller & active fire suppression module, quickly extinguishing fires

Multi protection



Huawei: Multiple interlocks, active disconnection & fast isolation, quickly suppress the danger

- **Optimizer** actively bypasses faulty battery packs
- **Rack controller** provides overcurrent/ short circuit protection
- **Active fire suppression module** automatically senses in extreme situations and extinguishes fire quickly within **10s**

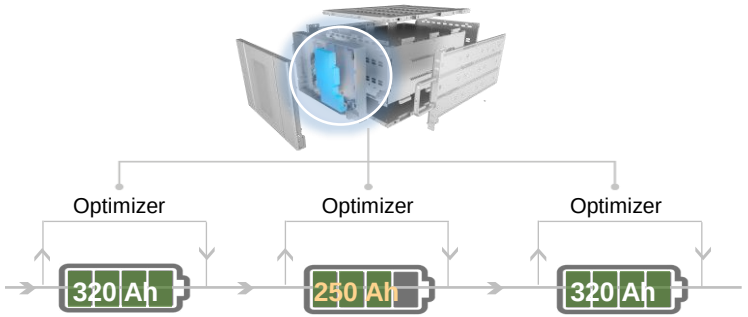
More energy, pack-level optimization to achieve 5% more usable energy

Traditional: Low available capacity

One poor battery **affects all** batteries, **low available capacity**

VS

Huawei: Pack-level optimization



One poor battery **will not affect others** achieving **5%** more energy

8% more power by profitable ESS Solution @China

- TOU business mode
- Discharge mode: 2 times/day

Energy Yield

8% more power

Electricity Cost

$17,400/year

Automatic SOC Calibration, No Need for On-site SOC Calibration

Traditional: On-site visit

- **On-site** SOC calibration
- **Battery data is invisible.** Fault location requires on-site visit

$1680/year	4 times/year	Low accuracy
Cost	Site visit	Manual calibration

VS

Huawei: Automatic SOC calibration

- **Automatic SOC calibration**, free of site visit
- **Cell-level monitoring**, remote fault location

0	0	High accuracy
Cost	Site visit	Automatic calibration

* On-site SOC calibration: $420/time

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Smart String ESS

Beyond Modular Design

C&I Project Already Deployed
Sweden 2024

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HUAWEI FUSIONSOLAR PARTNER for CEE, Scandinavia, Baltics and Eurasia

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Umeå

- Model: 2000kWh-97KWH-2H1
- Application - Frequency regulation and Pv-Storage
- Capacity: 100kW
- Location: Umeå
- Date: 14.03.2024

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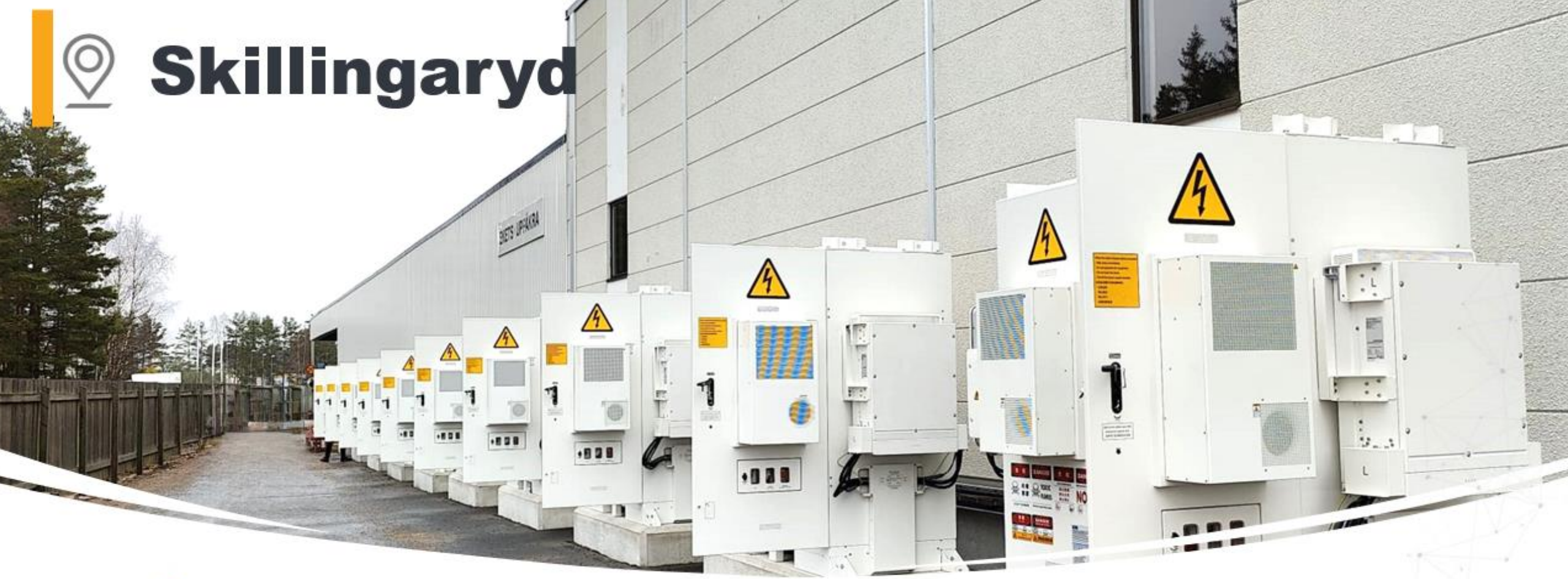
Hovmantorp

- Model: 2000kWh-97KWH-2H1
- Application- Frequency regulation and Pv-Storage
- Capacity: 100kW
- Location: Hovmantorp
- Date: 7.03.2024.

Skillingaryd



- Model: 2000kwh-129KWH-2H1
- Application- Frequency regulation and Pv-Storage
- Capacity: 1MW
- Storage: 1.29MWH
- Location: Skillingaryd
- Date: 22.03.2024

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Saudi Arabia Red Sea Project

World's Largest 100% PV + ESS Microgrid Project

400 MW PV **+ 1.3 GWh** BESS

Serving 100% PV + ESS power supply for 1 million people in Red Sea new city

Grid Forming enabling 100% PV & ESS grid

Online: 16MWh ready around Dec. 2022,
400MWh ready by May. 2023

Sembcorp BESS Project in Singapore

Largest BESS Project in Southeast Asia
(Spinning Reserve, Frequency Regulation)

115 MW power **+ 146 MWh** capacity

Huawei BESS technology enhances grid resilience by actively managing mismatches between electricity supply and demand

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What technical service does Photomate provide for the battery energy storage projects?

- Technical Support and Consultation
- Installation and Commissioning
- Monitoring and Maintenance
- Performance Optimization

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Basic supervision service from Photomate

Before commissioning	All necessary support and technical consultations about: -installation site, EPC work; -electrical and communication line design; -compatibility of the products & 3rd party devices -necessary 3rd party products (if needed); -obligatory permissions and agreements (local).
Duration	6 hours
On-site commissioning	-verification of components assembly; -basic electrical safety measurements*; -powering on system; -Smartlogger/SACU commissioning; -firmware upgrades; -connection to with FusionSolar PVMS -testing working modes and features; -defect elimination (if needed)**; -basic how to use training (2hours);
Duration	1 day
After commissioning	-standard (real) remote technical support 8x5; -12 online inspections every 6 months from installation with provided report* *FusionSolar Cloud connection needed
Duration	6 hours

HUAWEI

A dedicated professional team is indispensable for making the product of ultimate value for it`s users – let's join the journey for the Green Energy Transition together!

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Vilka Produkter vill ni se i snara framtiden?

HUAWEI Enterprise Partner Service

Visit our Roadshow truck outside!

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Knowledge Data Center

- **Visit us on:** photomate.zendesk.com
- **Visit our website:** photomate.eu
- **Call our Hotline:**
  08-50282345
  07.00-16.00
  Monday-Friday

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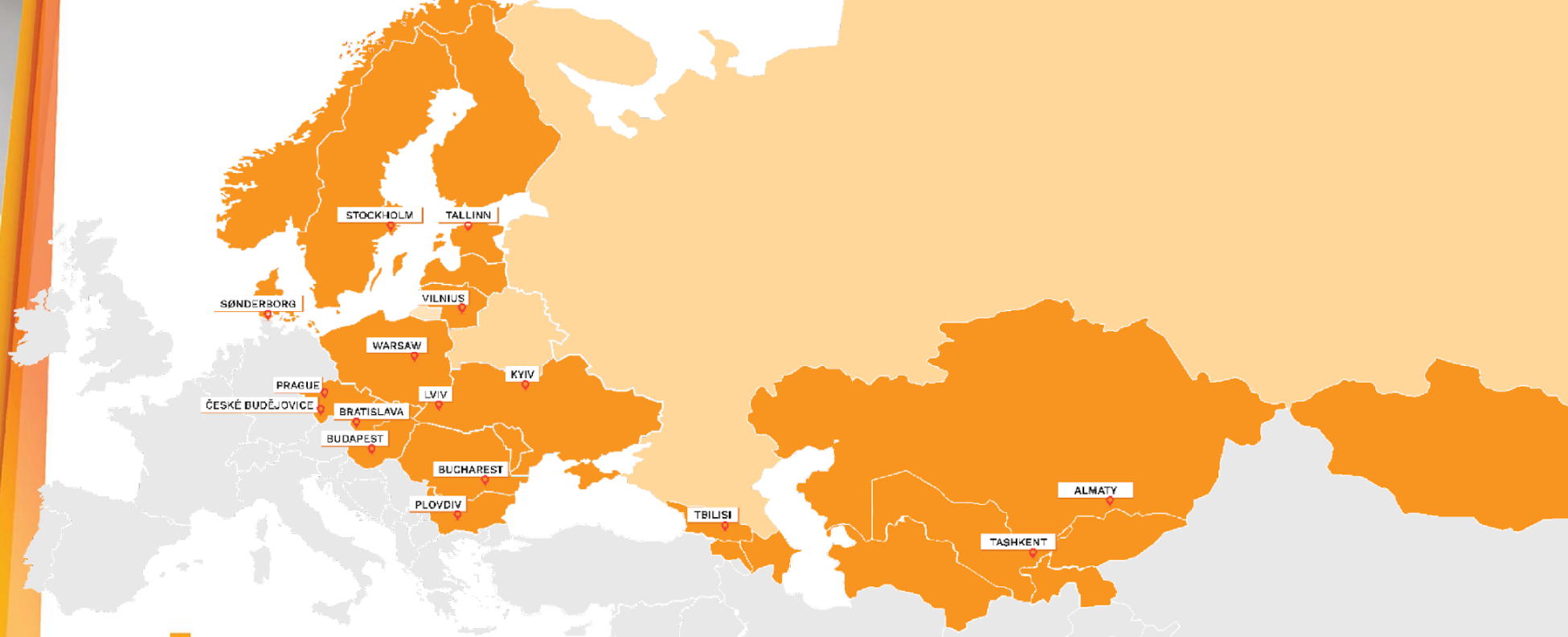

Thank you!

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