Snelladers met batterijbuffer

Een dubbelrol in de energietransitie

HUAWEI

Huawei: Leading provider of ICT infrastructure and smart devices

Vision & mission

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

170+
countries and regions

207,000
employees

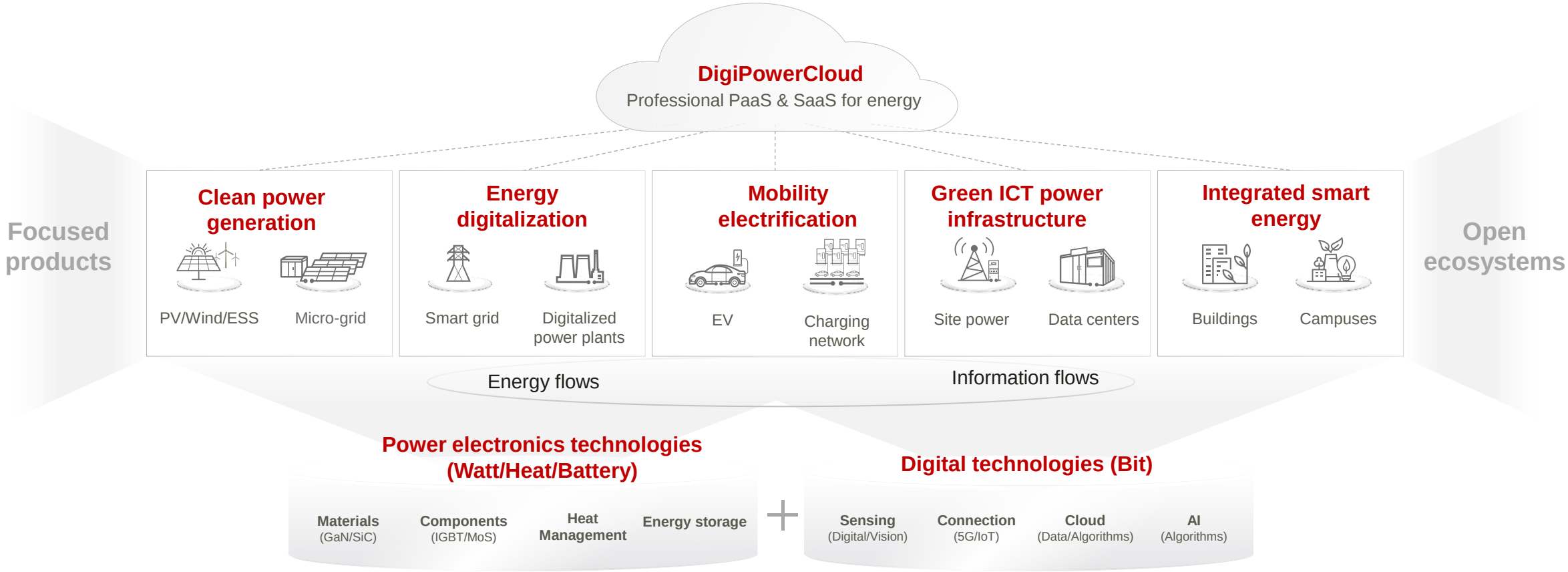
55.4%
of employees work in R&D

No. 4
in global R&D investment

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

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

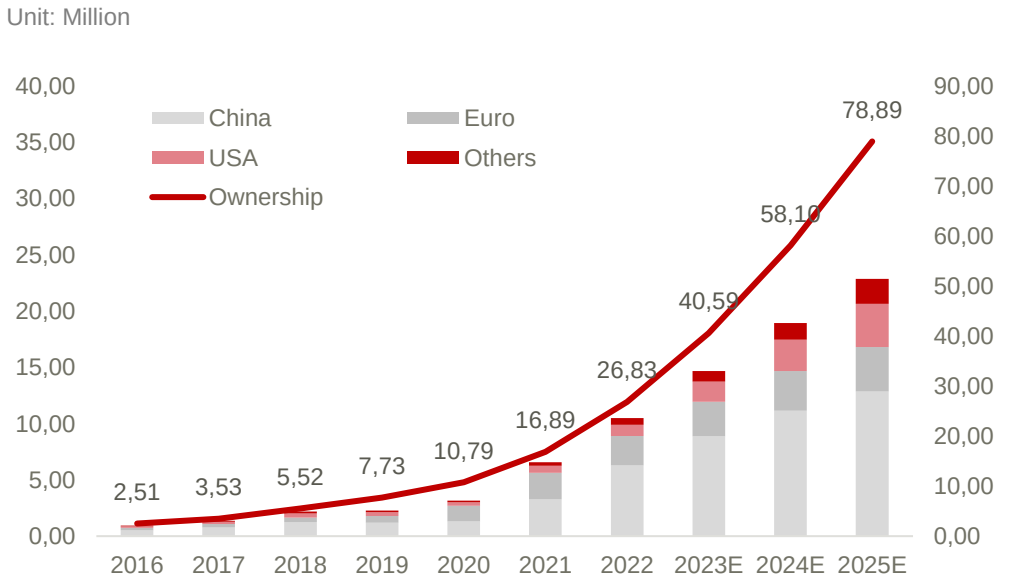


1 Trends and Challenges

HUAWEI

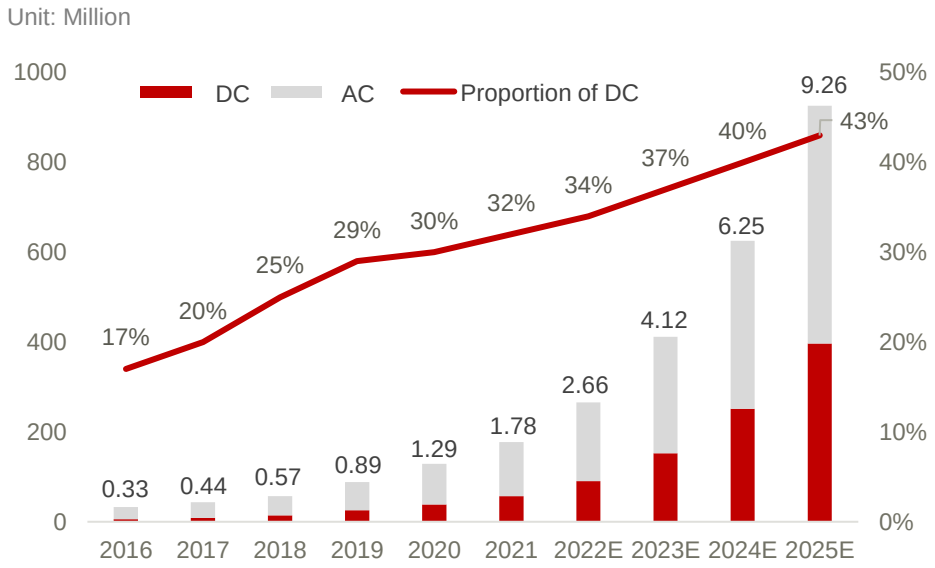
Trend 1：Explosive growth of electric vehicles creates massive demand for charging infrastructure

EV sales grows rapidly,
more than **40 million ownership** @ 2023



*Source：IEA，Industry Report

Huge gap of charging infrastructure supply,
2.5 million DC chargers to be built @ 2024-2025



*Source：IEA，Industry Report

- 10.65M EVs were sold in 2022 globally, YOY growth **55%** meanwhile Chinese market grow **93.4%**
- The proportion of EV sales **>13%**, China **>27.6%**, Euro **>18.2%**

- **DC charging** grows faster than average. 32% @2021 → **43% @2025**
- 0.6 million of DC chargers are to be build up @2023, **2.5 million DC charger** market space within 2024 & 2025.

HUAWEI

Trend 2：Carbon neutrality, energy sovereignty and business value are the three drivers of the energy transition

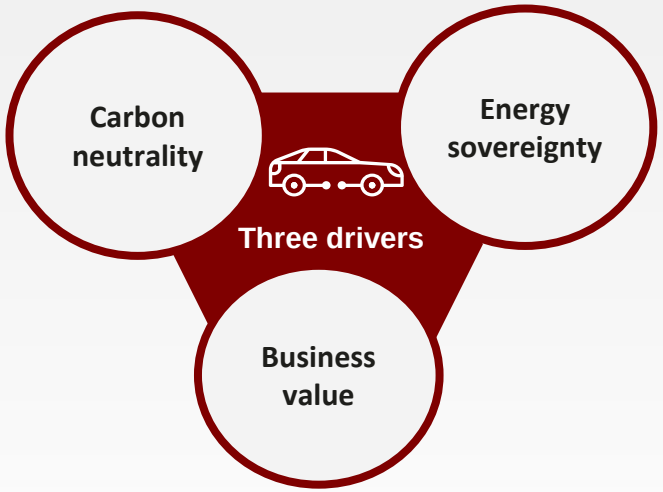
"Three-wheel drive" accelerates clean energy development

Carbon neutrality becomes a global consensus

- **EU:** Carbon neutral in 2050
- **China:** Carbon neutral in 2060
- **Japan:** Carbon neutral in 2050

Russia-Ukraine war highlights the importance of "energy security"

- **EU RePower EU:** Investing €288.2 billion over 22-30 years to phase outof Russian gas



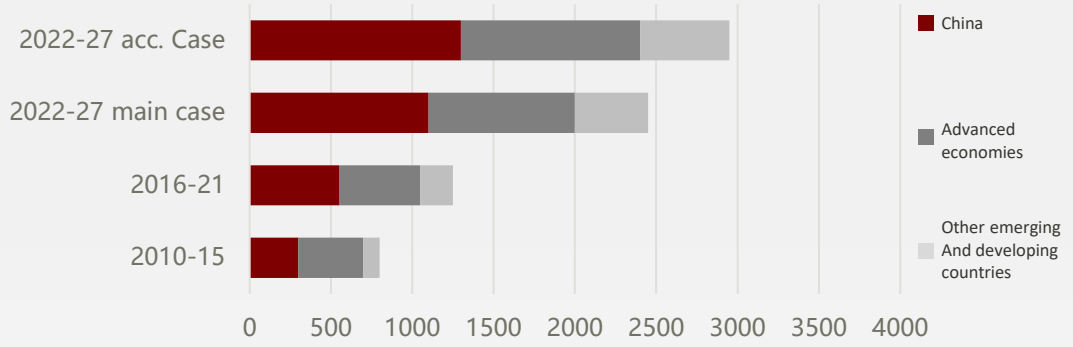
PV become one of the most economical generation technologies

- **generation scenario:** European gas prices in 2022 are 12 times higher than those in 2020
- **Power consumption scenario:** The residential electricity price in Europe is 5.6 times higher in 2022 than in 2020, and the IRR of residential storage investment is greatly increased.

Implementing "Two Alternatives" as a Key Measure to Achieve Carbon-neutral

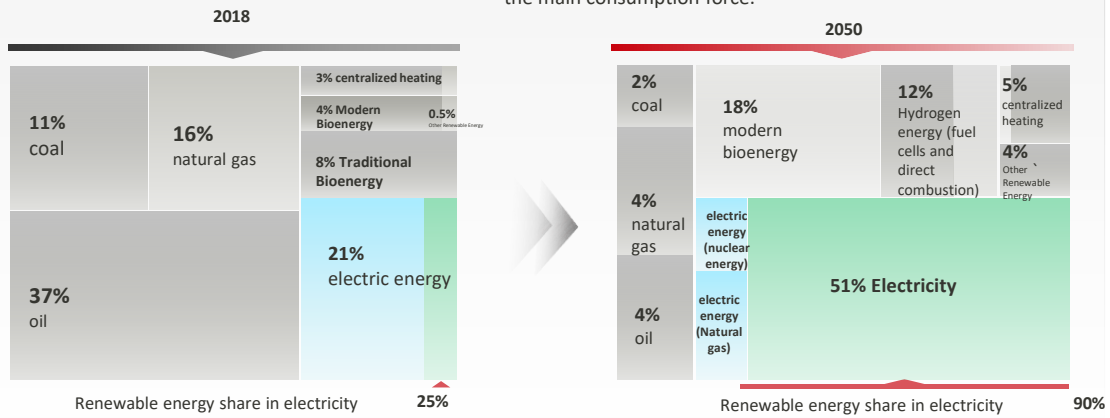
Generation Side Clean Substitute

Between 2022 and 2027, the world will add 2400 GW of renewable energy and 1500 GW of PV.



Energy-side electric energy substitution

By 2050, electricity will account for more than 50% of global energy consumption, and alternative fossil energy will become the main consumption force.



Data source: IEA and IRENA

HUAWEI

Trend 3: Building new power systems become an important trend and will gradually mature

	Transformation of traditional power system Tradditional power supply is still the main power supply 2021 - 2030	**Development period of new power system** New energy gradually becomes the main source 2030 - 2040	**Maturity period of new power system** A fully new power system based on disruptive technologies 2040 - 2050
Electricity source side	Conventional power supply proportion greater than 50% Development of large new energy base Accelerated general power supply flexibility retrofit	new energy The proportion exceeds 60%. Develop new inertial support resources Conversion from conventional power supply to adjustment and support	new energy The proportion exceeds 80%. New energy into hydrogen and other secondary energy sources
Energy storage side	2-4h Electrochemical energy storage, pumped energy storage and other technologies meet short-term equilibrium requirements.	2-4h 24h Large-scale energy storage technology breakthrough, achieving a balance of time scale above day	Electric vehicles and distributed energy storage participate in power system peak regulation
Power grid side	Inter-regional transmission (UHV) and AC power grid interconnection are further expanded.	100% Micro-grid Coexistence of interconnected grids, new energy DC networking, and microgrids	Coexistence of large cross-regional interconnection grids and hydrogen transmission networks
Load side	Mainly single power supply, distributed power supply gradually increasing	Large-scale construction of distributed power supplies to achieve bidirectional energy flow	AI + smart energy system, decoupling of transmission and use

Challenge 1: High penetration rate bring three challenges to the power system, frequency fluctuation, peaking dispatch pressure , and insufficient grid-connected capacity.

Power grid frequency stability declined

The increase of the penetration of wind and solar installation leads to the decrease of power system inertia and the increase of system frequency fluctuation.

The peaking dispatch pressure of the system increases

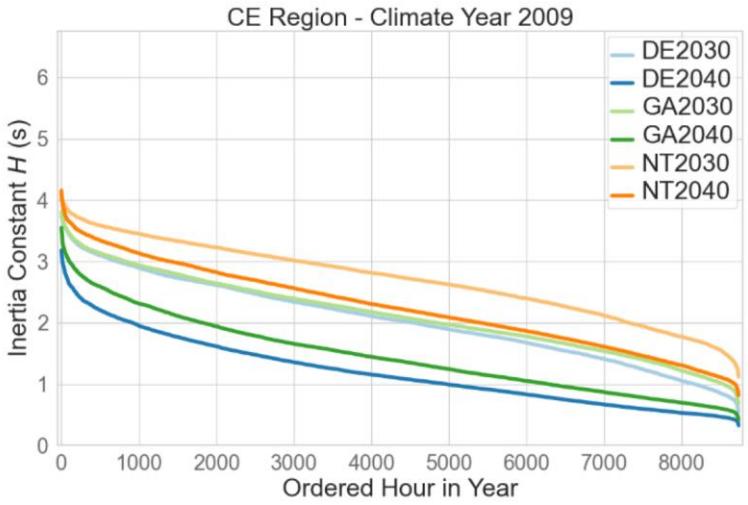
With the increase of the installed capacity of renewable energy such as wind and wind, the peak regulation pressure of the power system after sunset is increasing.

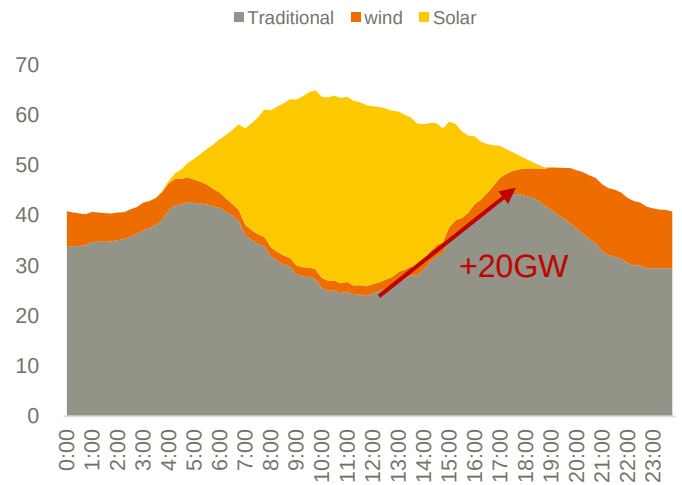
Take Germany as an example: From 12:00 to 17:00 on July 28, the generation power of traditional units needs to be increased by **20 GW**, which brings great challenges to peak load regulation.

Grid Capacity Bottleneck

Due to the long infrastructure construction period and insufficient investment, the grid-connected capacity of new energy in the EU and other countries, such as Portugal, Hungary, Netherlands, and Germany, is becoming more and more limited.

In REPowerEU, EU plans to invest **€29 billion** in power grid expansion






PORTUGAL GOES SUBSIDY-FREE – BUT WILL GRID BOTTLENECKS STOP SOLAR FLOWING?

July 2018

Hungary's power grid can't fit any more photovoltaic capacity

Grid congestion continues to increase in Netherlands

Solar project developers see fewer opportunities to build PV facilities in the northern

Set-up and challenges of Germany's power grid

'Basically no connections being granted': Polish solar sector facing grid headache

Source: AEMO, Australia; Energy-chart

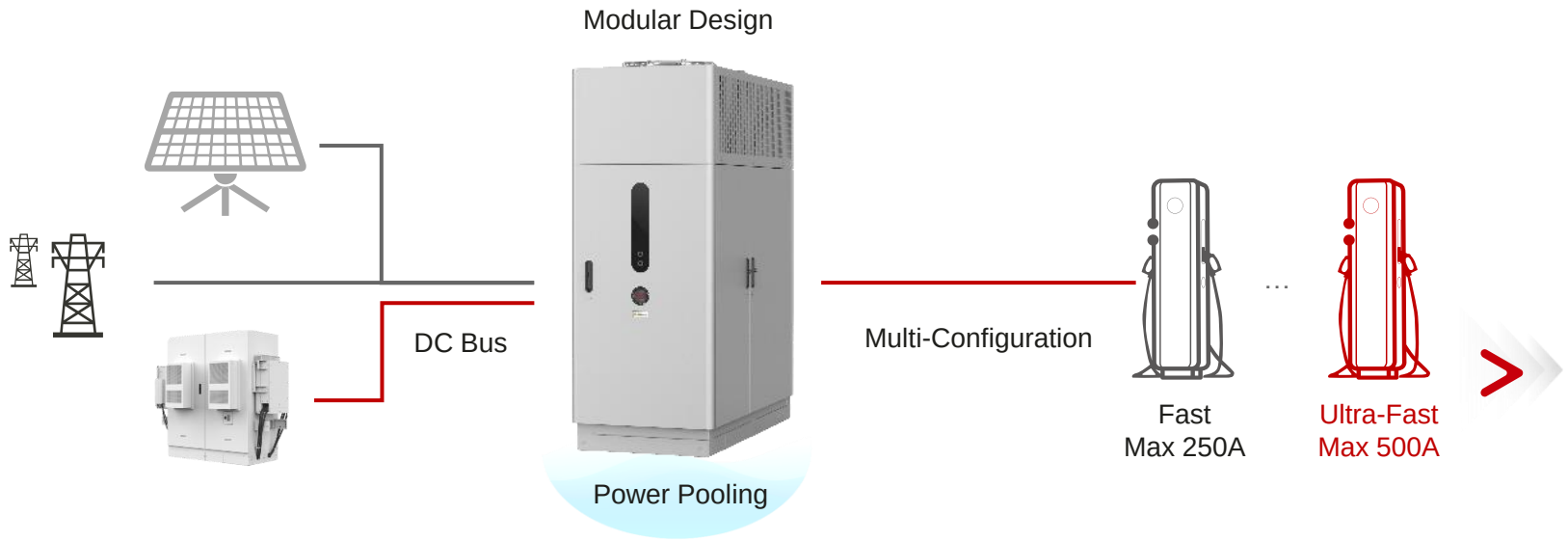
2

Merging EV charging and Battery Storage

HUAWEI

Fully liquid-cooled architecture: better experience, higher quality, better ROI

Fully Liquid-Cooled Ultra-Fast Charging Architecture



Fully Liquid-Cooled	Dual Power Pooling	Power Sharing Matrix	PV + ESS Convergence
10 Years Lifetime Liquid Cooling Design Silent & Reliable	**Upgradable** Power Pool with DC BUS Max. 12 Connector	**Utilization +30 pct.** Automatic Power Sharing & Allocation	**Efficiency +2.5 pct.** Less Conversion Loss Expand Output Power

** Reserved to upgrade*

Better **ROI**

Utilization +30 pct.
Twice of Industry

* Data from use case on highway in Guangdong, China

Higher **Quality**

10 Years Lifetime
Twice of Industry

0.5% Failure Rate
Airtight Power Cabinet

Better **Experience**

200km in 5 mins
Ultra-Fast Max 500A

60dB (Power unit)
Silent Mode 55dB
Standard Mode 60dB

HUAWEI

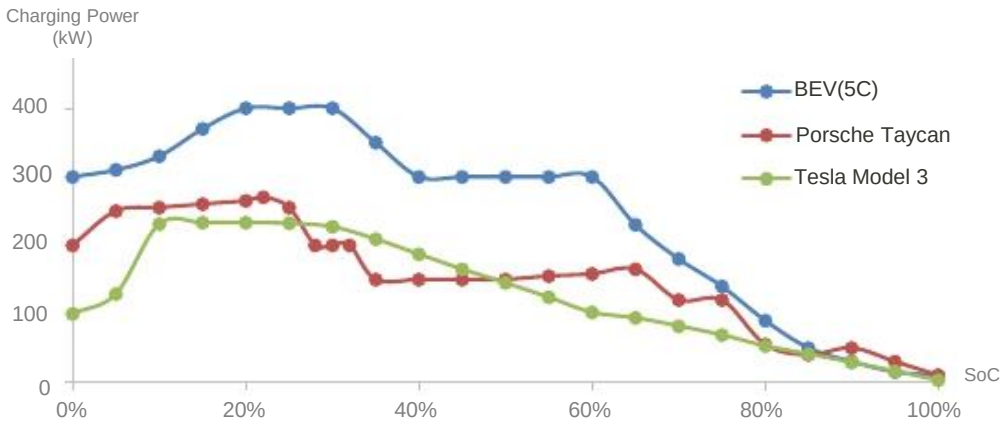
Power Sharing Matrix + Intelligent Power Allocation, the key to improve utilization rate of parking space and grid capacity

Peak Power will only last for 5-10 mins

Charging power is related to SoC

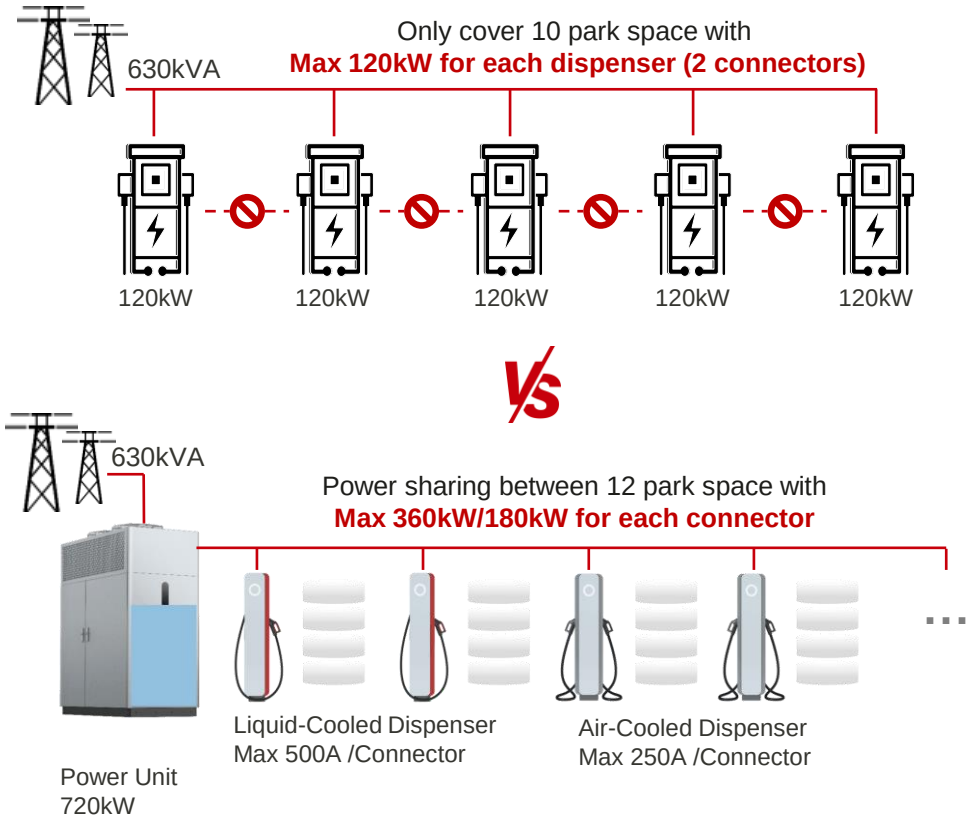
The Power demand of the EV changes continuously. The charging power allocated to each parking space needs to be dynamically matched to **maximize the use of the total Power installed**.

Typical Ultra-Fast Charging Curve



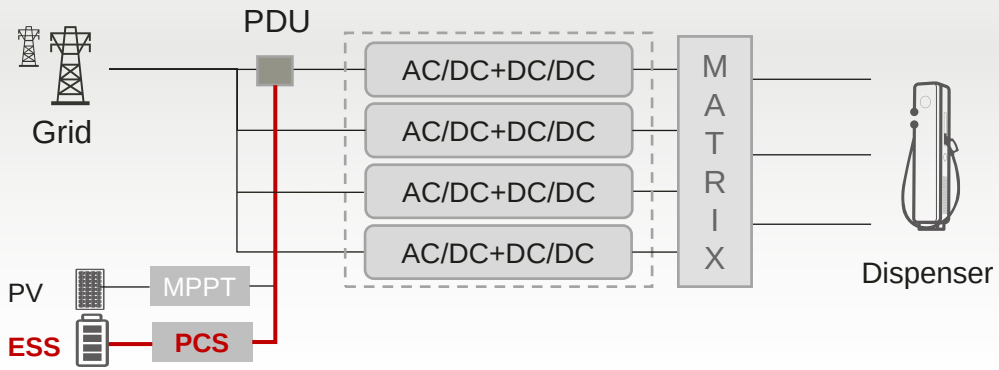
Distributed Architecture offers higher utilization rate

Compared with integrated architecture

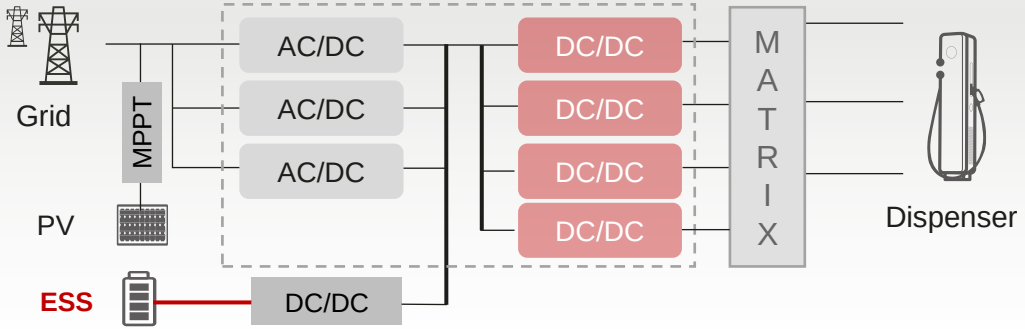


PV + ESS Convergence, fill the gap of grid capacity in an efficient and cost-effective way

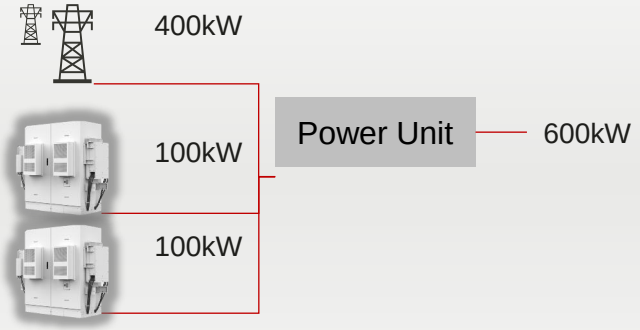
ESS connected on AC Side



ESS connected on DC Bus

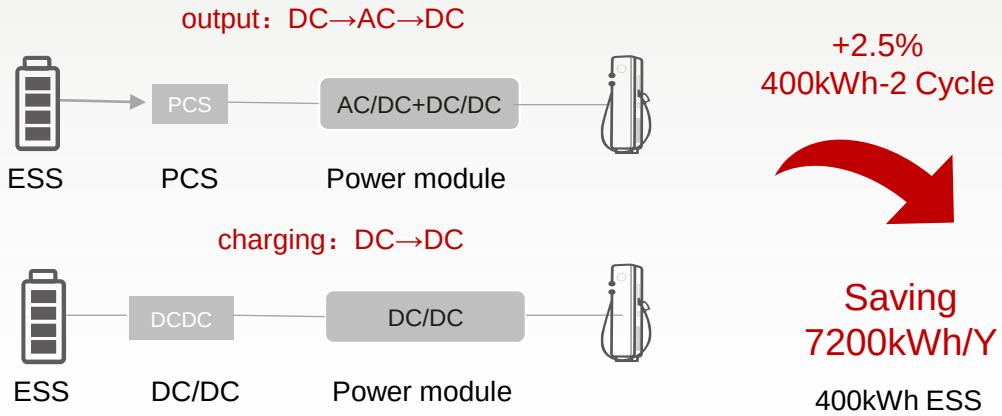


ESS fill the gap of grid to promote output power



- 1-4 ESS(200kWh) per power unit
- Peak shaving with smart strategy
- Expand output power on DC side

DC + ESS: Less energy loss, saving 2.5% power



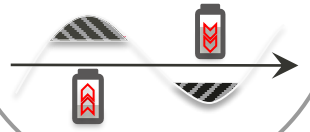
HUAWEI

Five Business Models of ESS to Support Value Implementation in Business

Five Business Models of ESS to Support Value Implementation. Multiple Mode is Supported

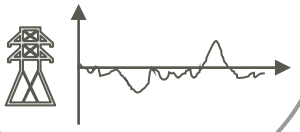
TOU

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



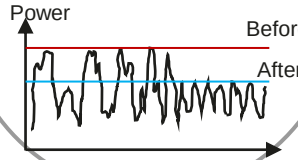
Ancillary Services

Frequency regulation cost > $18/MW/h, ROI < 5 years



Demand Management

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

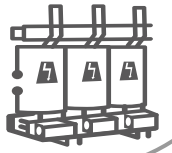


Maximum Self-Consumption

Elec. Cost > $0.3, ROI < 5 years

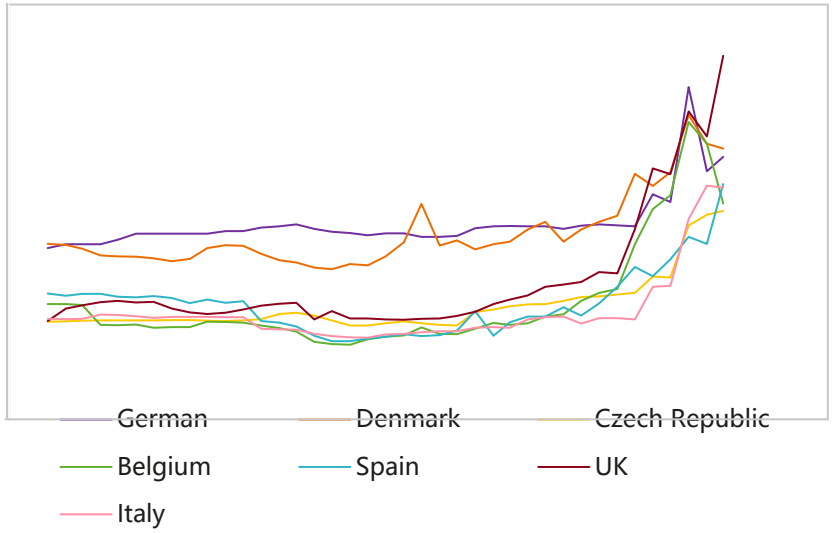
Avoid grid reconstruction

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



Maximum Self-consumption Can Achieve Value Implementation in Areas with High Elec. Price

Surging Electricity Prices in Europe have Led to Rising Electricity Costs for Companies



UK +126%

Italy +71%

Czech Republic +60%

Spain +52%

Belgium +51%

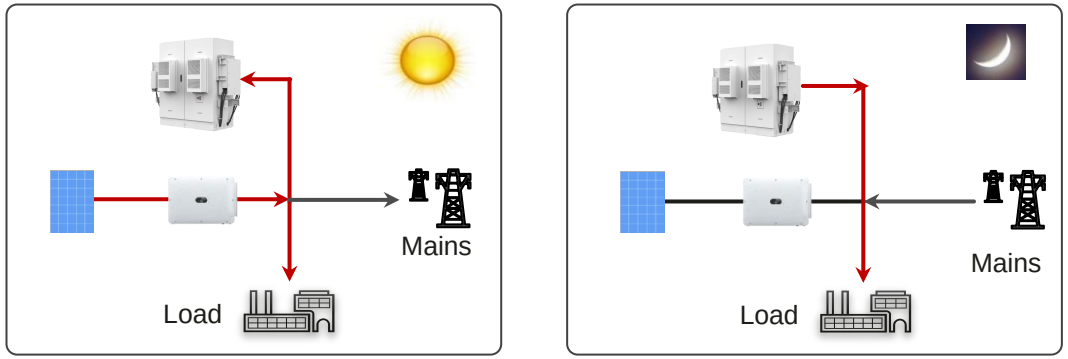
Denmark +39%

German +34%

- Under the impact of soaring electricity prices in Europe, aluminum, zinc, steel and other industries have set off a wave of reduction and suspension of production.
- Compared with large industrial users, small C&I users are in a tougher situation. The electricity bill for a bakery in Belgium rose from €1860/month to €11,836/month.

PV+ESS Solution Improves the Self-use Rate. Value Implementation in Business is Available in Areas with High Elec. Prices

ESS Discharges at Night, Improving the Self-use Rate



PV+ESS in Maximum Self-Consumption Mode-ROI 2.3Years @Greece

Compared with PV only solution, the revenue of PV+ESS solution increases by 19%, and the ROI difference is only 0.5 year

	PV only	PV+ESS
PV kW	575 kW	575kw
Avg. load power kW	479 kW	479 kW
ESS kWh	0	400kWh
Elec. price USD/kWh	0.37	0.37
Cost saved USD/year	243,467	289,267
ROI Year	**1.7**	**2.3**

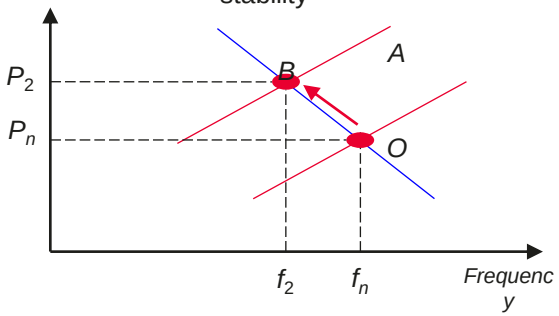
HUAWEI

Ancillary Services: The Need for Frequency and Peak Regulation Increase, ESS Frequency Regulation ROI < 2 Years @Sweden

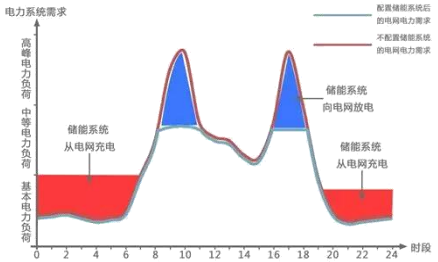
The Proportion of New Energy Continues to Grow, and the Demand for Frequency & Peak Regulation is Strong

What is Frequency & Peak Regulation?

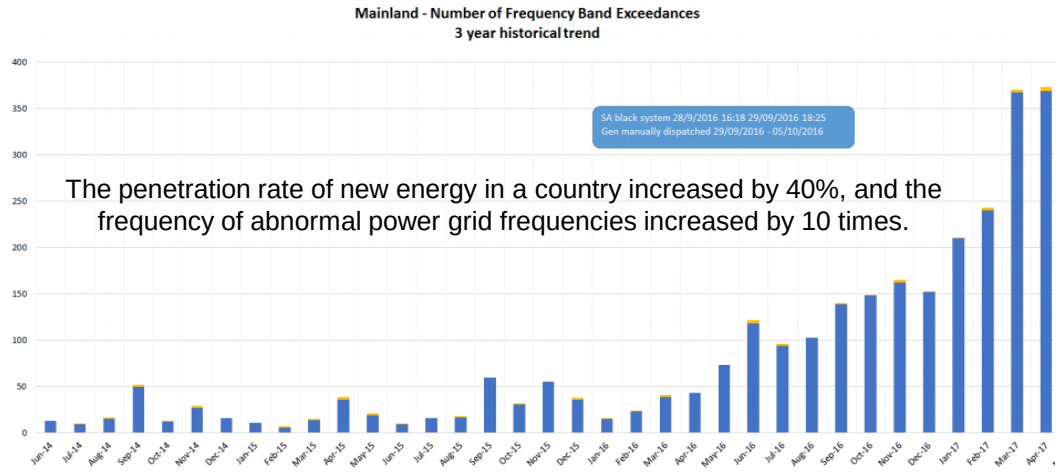
Frequency regulation: Process for maintaining supply grid frequency stability



Peak regulation: Adjusting power supply during peak and valley periods



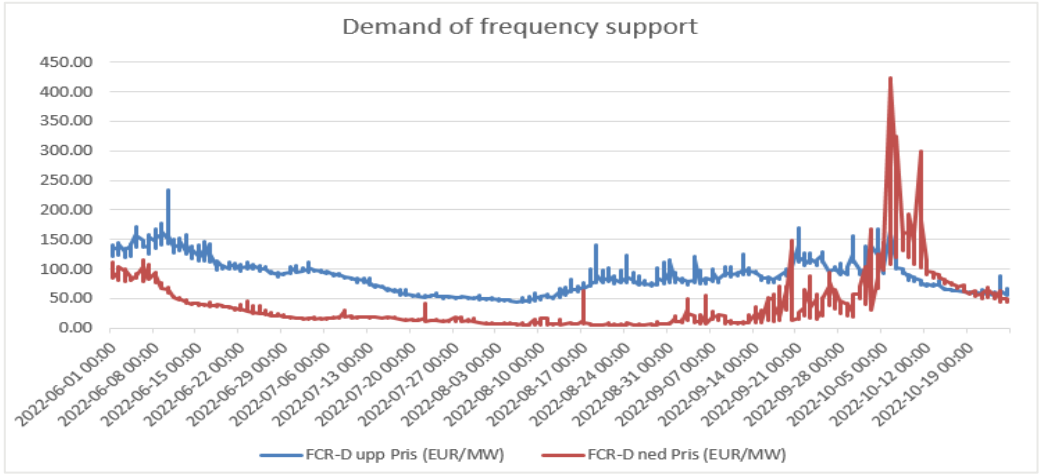
The Increase in the Penetration Rate of New Energy Affects the Stability of the Power Grid. Frequency & Peak Regulation Are Important



The penetration rate of new energy in a country increased by 40%, and the frequency of abnormal power grid frequencies increased by 10 times.

Peak & Frequency Regulation Cost is High. ESS Frequency Regulation ROI 1.8Years @Sweden

Swedish FCR-D UP Price up to €51.9/MW/h



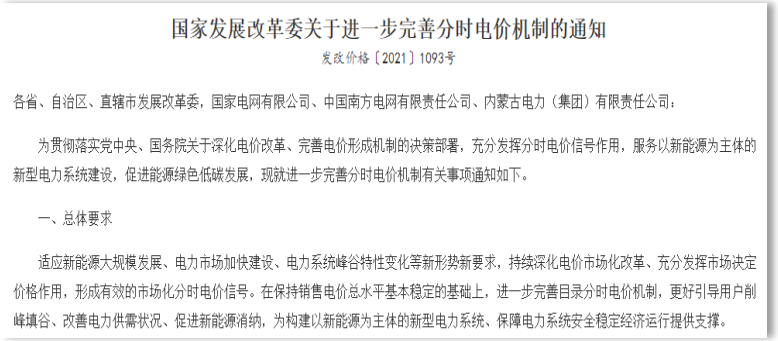
ESS Frequency Regulation ROI 1.8Years @Sweden

49.9~49.5Hz Frequency Regulation Price ($/mW/h)	55.4
50.1~50.5HzFrequency Regulation Price ($/mW/h)	44.9
ESS kWh	200
Wining Hours h/Year	7,008
Revenue $/Year	70,290
ROI Year	**1.8**

TOU Mode: Peak-to-valley Price Diff. Continues to Increase, ESS Becomes a Revenue-generating Asset

Peak-to-valley Price Diff. Continues to Increase, Encouraging Off-peak Electricity Consumption

China: 28 provinces and cities have peak and valley electricity prices, and the price difference will be further increased in the future.



国家发展改革委关于进一步完善分时电价机制的通知

发改价格〔2021〕1093号

各省、自治区、直辖市发展改革委，国家电网有限公司、中国南方电网有限责任公司、内蒙古电力（集团）有限责任公司：

为贯彻落实党中央、国务院关于深化电价改革、完善电价形成机制的决策部署，充分发挥分时电价信号作用，服务以新能源为主体的新型电力系统建设，促进能源绿色低碳发展，现就进一步完善分时电价机制有关事项通知如下。

一、总体要求

适应新能源大规模发展、电力市场加快建设、电力系统峰谷特性变化等新形势新要求，持续深化电价市场化改革、充分发挥市场决定价格作用，形成有效的市场化分时电价信号。在保持销售电价总水平基本稳定的基础上，进一步完善目录分时电价机制，更好引导用户削峰填谷、改善电力供需状况、促进新能源消纳，为构建以新能源为主体的新型电力系统、保障电力系统安全稳定经济运行提供支撑。

National Development and Reform Commission: Where the peak-valley difference ratio of the previous year exceeds 40%, the peak-valley difference cannot be less than 4:1.

Global: Spain, Portugal, and Thailand all implement peak-to-valley tariffs and encourage off-peak power consumption.

Portugal

Peak electricity price: $0.26
Valley electricity price: $0.07

Spain

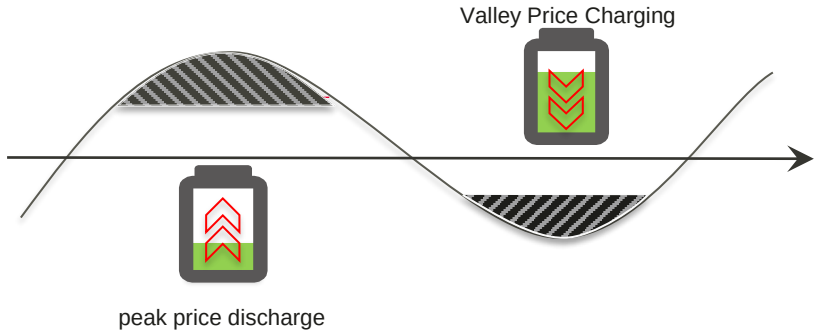
Peak electricity price: $0.33
Valley electricity price: $0.16

Thailand

Peak electricity price: $0.13
Valley electricity Price: $0.079

Elec. Price Diff. >$0.11/kWh, ROI in TOU Mode < 8 Years

ESS is switched from standby to active, reducing electricity costs by using the peak-valley price difference.



Peak-to-valley electricity price difference > 0.11 USD/kwh, energy storage investment ROI < 8 years@Europe

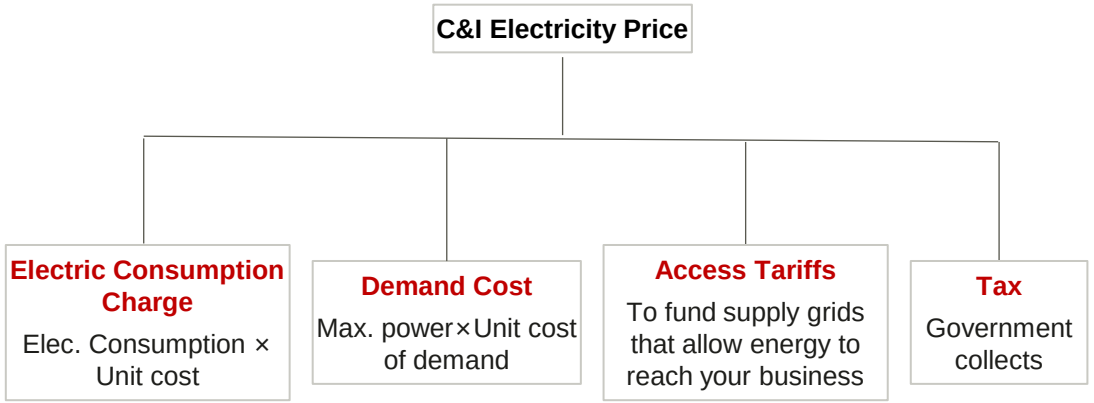
Load power	100-200 kW
peak-valley price differential	0.11 USD/kWh
ESS Configuration and Operation Strategy	100kWh, 2 charge and 2 discharges a day
Electricity Cost Savings Benefits	13,768 USD/kWh
ROI	~ 7.8 years

HUAWEI

Demand Management: Demand Cost is Reduced by Smart Peak Shaving for Lower Peak Load Power

The Demand for ESS Peak Shaving to Reduce Demand Cost is Strong in High Demand Scenarios

C&I Electricity Charges in Most Regions of the World Include Demand Cost. ESS Peak Shaving can Effectively Reduce Client's Electricity Cost

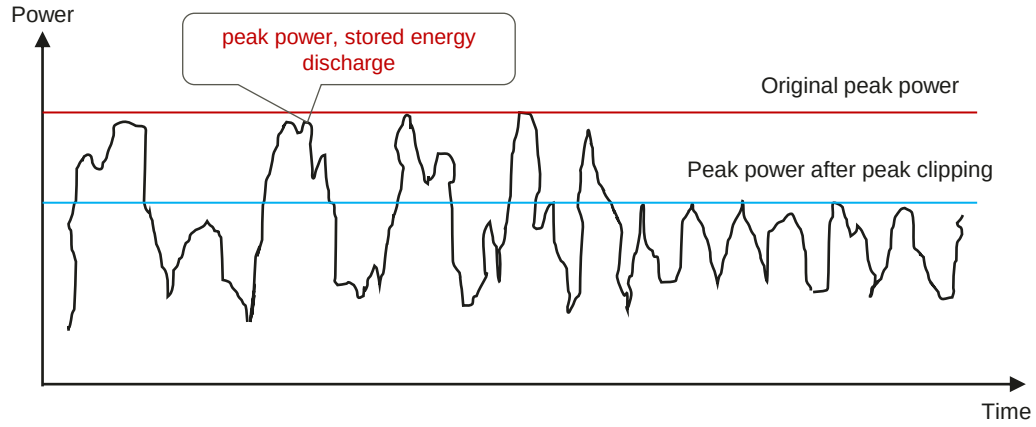


High Demand Cost. Demand Cost of 200kW Load Reaches &40,000/Year @German

Countries	Unit price of demand cost	Demand cost for 200kW Load
German	$120~200/kw/Year	$24,000~40,000/Year
Japan	$170/kw/Year	$34,000/Year
Spain	$120/kw/Year	$24,000/Year
Australia	$120/kw/Year	$24,000/Year

The Benefit is Significant in High Demand Scenarios

Intelligent peak cutting for energy storage, reducing peak power and demand costs



Demand Cost > $147/kw/Year, ESS Peak Shaving ROI < 8 Years

Calculation of Peak Shaving Earnings for Medium-sized C&I Owners in German

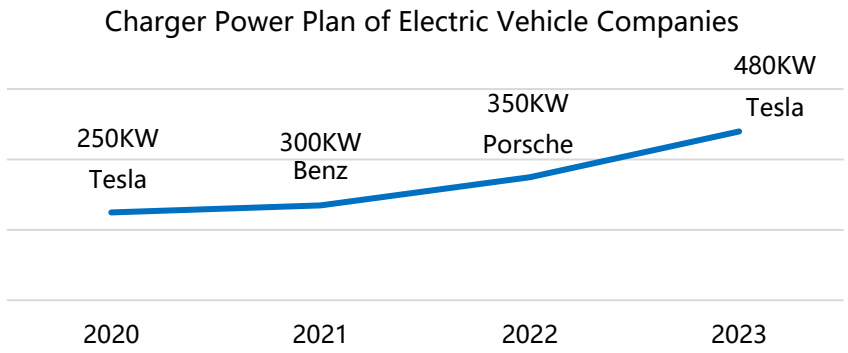
ESS	200kWh
Load peak power	Before, 447kW; After， 347kW
Demand cost	$147/kW/year
Revenue	$147,00/year (demand cost)
ROI	~8 years

HUAWEI

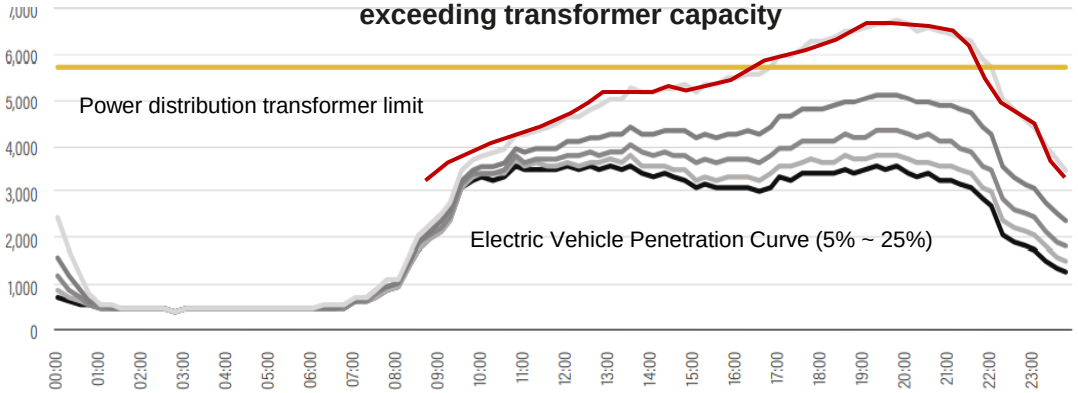
With ESS Smart Peak Shaving, the Grid Reconstruction Can Be Avoided

Explosive Growth of Electrical Vehicles & Insufficient Distribution Capacity of Existing Supply Grids

Higher Power and Faster Charging are the Main Trends of Electric Vehicle Charger. The Capacity Requirement of Supply Grid is High.



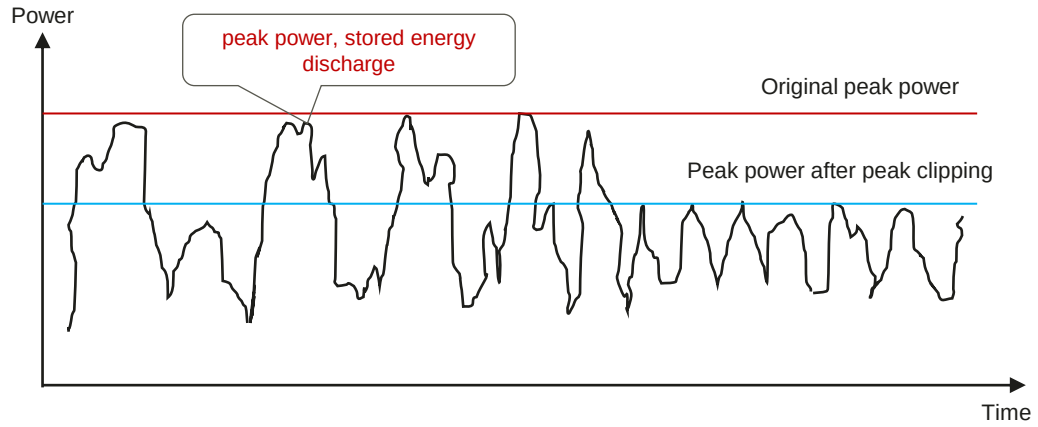
High penetration rate of electric vehicles, charging load exceeding transformer capacity



** Load curve analysis for different vehicle penetration rates in a shopping mall*

ESS Smart Peak Shaving, Avoiding Grid Reconstruction, Reducing Reconstruction Cost by $20K

ESS Smart Peak Shaving, Reducing Peak Power and Demand Costs



Traditional Grid Reconstruction

TTM > 6 Months

Application, Negotiation & Construction

Reconstruction cost €74k + €18k/year capacity cost

* Transformer reconstruction :250kVA→350kVA

VS

ESS Smart Peak Shaving

TTM 1 Week

No reconstruction cost

Brought by ESS, TOU benefit& lower demand cost

HUAWEI

Thank you.

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