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Fusionsolar

Making the Most of Every Ray

*A deep dive into
leading solar markets*

*Paving the way to
a clean power future*

*Green road in
a sea of sand*

*Moving beyond
legacy systems*

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Huawei: Leading the charge to create a new energy system

This is the seventh special edition **pv magazine** has produced in partnership with Huawei. The Shenzhen-based multinational has been one of the leading companies in the transition to an energy system built on clean energy. Photovoltaics will be the bedrock of such a system, at least in countries with plenty of sun. This includes most of Africa, which is blessed with high irradiation and electricity grids that can be complemented by minigrids and microgrids to provide reliable electricity to large swaths of the continent's population that still lack such energy access.

Huawei is actively collaborating with grid operators and other partners to provide safe and reliable energy solutions. If the world wants to keep global warming to 1.5 C compared to pre-industrial levels, then clean energy has to accelerate even faster. This fall's COP28 summit in Abu Dhabi will be a critical step in this process. The toolkit of technologies is there to make this transition: In the field of solar PV, Huawei offers a complete solution at every level, be it residential, community, corporate, or utility scale.

This special edition provides details on these complete solutions for each segment. When it comes to utility-scale PV, Huawei is showing the way to 100% renewable energy. The objective is no longer just "grid-following" and "grid-supporting," but rather "grid-forming," enabling reinforcement of the grid with a high proportion of renewable energy.

In this journey to 100% renewable energy penetration, Huawei has always placed its focus on the long-term performance of the PV power plant. The clear focus is on the leveled cost of energy (LCOE) and the leveled cost of storage (LCOS). At the heart of Huawei's FusionSolar is a very smart approach to building and operating a PV system, which relies on Huawei's mastery of digital technologies, power electronics, solar, and batteries to boost the overall intelligence of the system and drive down costs.

Zooming in on utility-scale plants and the FusionSolar Grid-forming solution, this addresses voltage, frequency, and power angle challenges to enhance the future "built on renewables" grid. It integrates smart PV inverters, smart string energy storage systems (ESS), and smart power control systems (PCS) with algorithms, creating a platform that can drive PV to be the foundation of the new energy system.

On the C&I side, Huawei's upgraded solution includes smart PV inverters plus optimizers plus ESS plus chargers plus smart PV management systems. It is a flexible solution that can be tailored to meet the diverse requirements in the C&I market.

Photo: pv magazine/Thomas Beetz



On the residential front, the combination of PV and battery storage is providing resiliency in the face of more extreme weather events and the desire of homeowners to be self-sufficient in the face of grid constraints and outages. Key features include off-grid backup, intelligent home energy scheduling by the Energy Management Assistant (EMMA), and virtual power plants (VPPs).

This summer I was fortunate to visit Huawei's headquarters in Shenzhen, China. Shenzhen is a leading technology and telecommunications hub in China and globally and is fast emerging as the leading city when it comes to the transition to electric vehicles (EVs). Decarbonization of the transport sector is as important as the decarbonization of electricity grids, and Huawei is also at the forefront of this transition. Naturally, these EVs need to be powered by renewable energy. Huawei's know-how in both sectors will surely provide important synergies. Similarly, smart string ESS in combined PV and battery storage power plants can generate valuable data and signals to provide an analogous margin of safety to PV power plant operators and their investors.

These are important and exciting times for the global transition to clean energy systems, be it in building grids with a higher percentage of renewables or transportation markets with a growing share of EVs. Huawei is leading the charge in both markets, and the company's quest to achieve a world powered by renewables will continue to be a critical contribution to stem global climate change and build a better world for our children.

Eckhart K. Gouras, Publisher, pv magazine

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Photo: Huawei

Moving beyond legacy systems

How FusionSolar is overcoming challenges to achieve Huawei's vision of a 100% clean energy world, with solar-generated electricity as its core driver.

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Photo: Huawei

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Photo: Huawei

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Photo: Huawei

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Making the most of every ray

The transition from “grid-following, grid-supporting” to “grid-forming” technology will enable the reinforcement of the grid with a high proportion of renewable energy. Guoguang Chen, president of the Smart PV and ESS business at Huawei Digital Power, discusses the company’s strategy around FusionSolar and his outlook for the solar and energy storage markets.

Could you please introduce FusionSolar’s new three-pronged strategy and explain its impact?

As a technology-driven company, our focus is on core technology and product solutions. Our strategy revolves around increasing our R&D capabilities, with core technologies including digital technologies, power electronics, solar technology, and battery technology. Moving forward, our strategy converges on three defined scenarios for the next five years.

The first prong of our strategy aims to bring our advanced solutions and technology to more places in the solar market. We want to create more value for our customers by integrating our “4T” (WatT, HeaT, BatTery, and BiT) technologies into various applications. The second prong acknowledges the rapid growth of PV across utility, commercial & industrial (C&I), and residential sectors, accompanied by the adoption of batteries. We strongly believe that the future grid will be powered by renewable energy and supported by power electronics, from generation to distribution and consumption.

Lastly, we view PV as a business based on an ecosystem. We have established partner schematics encompassing industry partners, financial partners, service partners, solution partners, and more. Working together, we aim to further build and expand our ecosystem, fostering collective growth.

Can you please provide more details about the new products Huawei has launched for all scenarios?

We have aligned our product offering with three defined scenarios. For utility applications, our most important solution is the FusionSolar Grid-forming solution. In countries with high renewable penetration, grid instability becomes a concern. This solution addresses voltage, frequency, and power angle challenges, enhancing the future grid as conventional grid generation phases out. It’s the transition from “grid-following, grid-supporting” to “grid-forming” technology, enabling reinforcement of the grid with a high proportion of renewable energy.

By integrating smart PV inverters, smart string ESS (energy storage systems), and smart PCS (power control systems) with algorithms, the solution can accelerate PV to be the primary energy source in the future. It is designed to support up to 100% renewable energy penetration with grid-forming technology. This innovation is our most significant contribution to the utility sector.

We also cater to a wide range of C&I applications. Our upgraded solution for this sector includes the inverter plus optimizer plus ESS plus charger plus smart PV management system solution. This comprehensive solution is tailored to suit the diverse requirements of C&I applications.

In the residential scenario, Huawei aims to advance the evolution of household energy through component innovation and technological upgrades. Through off-grid power backup, intelligent home energy scheduling by the AI Energy Management Assistant (EMMA), and future virtual power plants (VPPs), interconnection will enable power independence and self-sufficiency for homes.

What is your outlook for the PV and storage market this year?

We anticipate significant growth in the PV and energy storage market this year. Last year, solar installations reached around 280 GW to 300 GW globally, and storage installations reached approximately 40 GWh. This year, we expect solar installations to increase by another 100 GW, reaching around 450 GW. We also anticipate storage installations to grow to about 60 GWh, a 50% increase from the previous year.

The World's Largest PV & ESS Microgrid Project

400 MW + 1.3 GWh Microgrid Plant

Red Sea Project, Saudi Arabia

Resilient, 100% renewable energy for people



As more renewable energy sources are integrated into the grid, batteries are being deployed to provide grid support and stability. We have already seen successful deployments of storage systems alongside wind farms in the Netherlands and we expect this trend to continue in more locations.

There is also potential for retrofitting older plants with storage to enhance grid stability and support. To achieve this, grid-forming technology is crucial. We believe it is essential to work with distribution system operators to develop policies that support the deployment of grid-forming technology. This will enable the storage of more renewable energy and help countries achieve their carbon targets without the need for extensive grid reconstruction.

What can we expect from Huawei in the future? How do you balance your vision with customer demands?

At Huawei, we have a comprehensive product roadmap and have unveiled several new products this year. For the utility sector, our focus is on grid-forming technology, which can play a crucial role in achieving a global renewable energy mix of 60%.

In the commercial and industrial sector, we aim to enhance our products and provide a one-stop-shop solution, including hardware, software, and energy management solutions. Each industry has its unique requirements and we strive to meet those demands through continuous improvement and innovation.

For the residential sector, our target is to offer complete solutions that enable consumers to achieve near-100% self-consumption. We have already implemented successful projects, such as one in Spain where a combination of PV and battery systems achieved close to 100% self-consumption.

Overall, we balance our vision for the future with customer demands by closely listening to our customers' needs and aligning our product development and innovation strategies accordingly. [PV](#)

“ We view PV as a business based on an ecosystem ”

Guoguang Chen,
president of the
Smart PV and ESS business
at Huawei Digital Power

Moving beyond legacy systems

Solar power is the key to a 100% clean energy future, whether this means helping businesses to achieve long-term profitability, enabling rural communities to succeed in their economic development, or providing homeowners with control over their own energy use.

The ecological environment has been significantly improved after the completion of a 2.2 GW PV plant in Qinghai, China. Power is generated via the panels as sheep graze happily underneath. An oasis has reappeared in what was once a desert.

Recent numbers from the International Energy Agency show that overall greenhouse gas emissions from energy rose to their highest level in 2021, confirming the need for the energy sector to move away from fossil fuels. The transition to cleaner energy sources cannot happen all at once, however.

After decades of refining the networks that are currently in place for the electric grid, there is an inertia in the current power system that will be difficult to overcome. It will be a sensitive balancing act to connect renewable energy generation facilities to a grid that has had years to establish itself for centralized, fossil fuel-based generation. While the complexity of a global switchover may be a stumbling block, it should not be seen as a brick wall.

FusionSolar vision

Huawei envisions a future in which the power system is digitalized and renewable energy sources supply all the world's needs, and the company's FusionSolar solutions are the building blocks on the road to that future.

At Intersolar Europe 2023, Huawei unveiled the brand-new FusionSolar logo and image for its smart PV and ESS solutions. The new brand represents the integration (Fusion) of technological innovation, as well as joining forces with partners to deliver new possibilities to the industry and calling on more people to join the movement and benefit the ecosystem with the goal of maximizing possibilities (solar).

The sun is so much more than a light source. That's why FusionSolar's aim is



Photo: Huawei

“FusionSolar’s aim is to allow every single ray to shine further, longer, brighter, and warmer”

to allow every single ray to shine further, longer, brighter, and warmer, in addition to generating infinite power and helping the world achieve unlimited development potential.

The question in many minds is, “how can we move to a 100% clean energy system?” There is no single answer to this as every country and every community has its own mix of challenges and opportunities to consider. One thing is certain: Solar power can be the bedrock of this new energy system Huawei hopes to achieve.

It will take a whole host of technologies to meet the varied needs of cities and rural areas alike, as well as light and heavy industrial and commercial facilities around the world. Huawei is making a competitive push to replicate the

legacy systems that people are familiar with and to improve upon these systems to ensure the stability of the grid during this transition.

Huawei has integrated its 4T technologies (Bit, Watt, Heat, and Battery), digital and power electronics technologies, information, and energy flows to build the FusionSolar Smart PV Solution to help utilities increase their power generation yields while providing high system availability. By optimizing the performance of each solar module, Huawei also optimizes electricity costs for its commercial and industrial customers.

Huawei sees the combination of PV with energy storage as the enabling force to drive the adoption of green power across all sectors – from utility scale to commercial and industrial, as well as for the residential and microgrid market segments. For rural communities and developing nations, these advanced solutions will be key to boosting both economic recovery and future self-sufficiency.

Building successes

To achieve its vision of smarter energy choices offering more sustainable living options, Huawei has leveraged digital and power electronics technology, integrating its established solutions with PV, energy storage, and grid-forming solutions. The company has embraced the best of what digitalization has to offer the power industry and recognizes its importance for the development of smart renewable energy technologies.

Huawei’s intelligent FusionSolar PV-plus-storage line of products offers solutions for applications from small-scale residential power to large-scale utility and commercial projects. These solutions not only reduce the levelized cost of energy (LCOE) from PV plants, they also harness the power of better sensors, data, and machine learning to optimize performance, improve management, and provide quick troubleshooting to avoid downtime.

With smarter homes and buildings, Huawei is putting consumers in charge of their power supply in a way that was not possible before the internet of things and cloud computing.

Additionally, when businesses have better control of their energy use, coupled with the ability to generate their own power, they improve their long-term profitability – becoming more sustainable not only environmentally, but also financially. Homeowners, too, can profit from this access to intelligent power management devices.

Smart PV solutions with access to massive amounts of critical information also translate to improvements in safety. For example, Huawei launched the world’s first PV inverter that supports smart string-level disconnection, which can accurately detect the current signals of each string. When a fault is detected, the software transmits the switch-off signal to the DC switch, immediately triggering the disconnection and an alarm, which can significantly reduce the risk of fire or other severe problems, which is particularly important given the trend toward high-power modules at PV plants.

Solar future

A green and carbon-neutral life is not just achievable, it’s vital to the future of the planet. The world has already progressed far beyond its ability to meet the energy needs of more than eight billion people through fossil fuels alone. Everyone on the planet can ultimately benefit from the advances made in harnessing the power of data and digitalization.

Instead of continuing to prop up the legacy energy systems of the past with a patchwork of refinements that offer decreasing rates of return, individuals, communities, and nations need to move full speed ahead to embrace the solar-enhanced future that is already establishing itself. The health of the planet cannot wait. PV



A deep dive into leading solar markets

As solar pushes further into the world's energy mix, the approaches favored by different regions highlight the technology's adaptability to fit into a wide range of climate conditions, business models, and political backgrounds. Here we take a look at three regions leading the world for solar installations, and what makes them tick.



Photo: Huawei

25.8 MW distributed rooftop project in Dubai.



Nestlé Middle East launched the ground-mounted private solar plant at its food factory in Dubai in 2019.

The Middle East

Top solar market segments: Large-scale installations connected to the grid

Hotspot: United Arab Emirates

With its abundant solar resource, the Middle East is a natural fit for generating electricity through large-scale PV plants. Solar panels produce a lot of midday power, just as there is high demand for air conditioning in this region. The United Arab Emirates (UAE) is one of the strongest countries in the region when it comes to solar, and has the largest installed capacity. The country is leading the way in the Middle East due to the government's ambition to drive electricity prices as low as possible, with significant offers of tenders, particularly for large-scale projects in the gigawatt range.

Rooftop solar is not currently a hot market segment in the Middle East, as electricity prices are subsidized for end consumers and there's not really an eco-

nomic incentive for other sources to be connected to the grid. Many countries are looking to remove electricity subsidies, however, which will likely increase interest in solar for residential and commercial consumers. Given this background, the UAE government has already implemented a scheme solely focused on rooftop solar installations. The scheme has proven to be fairly popular, especially for commercial rooftop arrays.

The pairing of energy storage solutions with PV installations is not really happening on a large scale as solar plants are mostly grid connected. That said, as countries in this region continue to build very large PV plants, at some point they will need to incorporate storage to balance the grid load and reinforce the electricity network.

IRENA forecasts the UAE's installed PV capacity to reach

44 GW

by 2050

Photo: Wattkraft



One of the largest bifacial agrivoltaic projects in Germany.

**The share of renewables in
Germany's energy mix reached**

57.7%

in the first half of 2023

Europe

Top solar market segments: Residential and commercial solar

Hotspot: Germany

Europe is experiencing growth in all solar power market segments, from residential to the utility scale. The past year's surge in installations throughout the continent is a direct result of the continuing energy crisis, and has been driven further by Europe-wide targets and directives such as the REPowerEU plan. On a country level, electricity prices themselves have prompted a lot of installations.

Germany is one of the fastest accelerating markets in this region, deploying 6.26 GW of solar just in the first half of 2023. Following the shutdown of the country's last three nuclear power plants, the share of electricity being generated by renewable energy technologies has grown to 57.7% of net electricity generation. To ease and speed up the adoption of residential solar, Germany has created new legislation – set to go into effect in January 2024 – that will increase the power generation capacity permitted for balcony PV. The legislation will also remove the requirement for balcony PV system owners to register with local grid operators.

In the small commercial segment in Europe, one of the primary drivers has been corporate environmental, social, and governance initiatives and company targets to decarbonize, leading many to search for ways to use more renewables.

In Germany, an evaluation by the country's solar industry association, BSW-Solar, found that one-third of the country's PV capacity is installed on commercial and private buildings, as well as on open lands.

Energy storage systems are used primarily in conjunction with large, grid-connected or "behind-the-meter" home residential systems. Behind-the-meter storage has grown in several regions. Germany in particular is a leading market, since it offers support for pairing residential PV systems with batteries. In the rest of Europe, energy storage has primarily been profitable to use for ancillary services for the electricity grid. We're now seeing more PV plants being built either with batteries from the start, or already prepared to add energy storage when its costs fall.

Latin America

Top solar market segments: Smaller utility-scale systems (1 MW to 9 MW)

Hotspot: Chile

Traditionally, Latin America has been very much a utility-scale PV region, particularly in Mexico, Chile, and Brazil. In Chile, the country's Pequeños Medios de Generación Distribuida (PMGD) program supports grid-connected installations in the 1 MW to 9 MW segment, which targets smaller utility-scale systems.

Chile is one of the top spots for solar in Latin America, and the country's renewables association, Acera, says that as of June 2023, there were 6.95 GW of renewable energy and storage projects under construction, with about 68% of those being solar. In July 2023, a 180 MW solar plant went online in the Atacama Desert, connected with 112 MWh of storage, and it is now Latin America's largest solar plant to be linked with battery storage.

The solid growth of solar power in Chile has resulted in too much power being generated by PV in certain regions. Some areas are at risk of having too much electricity generated in one location and this needs to be balanced out with the use of storage. To counter this problem, Chile's government has announced plans to establish a tender mechanism for large-scale energy storage facilities. The goal is to tender the storage systems in 2024 to have them online for 2026.

While energy storage systems are not big yet in Latin America as a whole, as more renewables are integrated into the grid system, storage will also need to be connected to support electricity networks, as with the example in Chile. Analysts expect upcoming tenders in all countries of the region to specify that proposed projects should include storage.

As of June 2023, Chile had

6.95 GW

of renewables and energy storage under construction

Arturo Merino Benítez International Airport distributed project in Santiago, Chile.



Photo: Huawei

From strength to strength in Europe's PV market

The European solar market shows no sign of slowing. In 2022, annual additions grew by almost 50%, far outpacing all expectations, but much faster deployment is needed if Europe is to meet its 2030 decarbonization targets.

In a bid to increase its energy independence, Europe is setting clear policy lines. The EU Solar Strategy outlined under the REPowerEU plan sets a target of 320 GW of PV generation capacity by 2025, and almost 600 GW by 2030. “This is ambitious but realistic,” European Commission President Ursula von der Leyen said at a news conference on May 18, 2022.

Last year, solar deployment reached a record 41 GW, SolarPower Europe (SPE) said in its *EU Market Outlook for Solar Power 2022-2026* report. This was more than double what was installed in 2020 and up 47% from 28.1 GW in 2021. Germany led the pack with 7.9 GW installed, followed by Spain with 7.5 GW, and Poland with 4.9 GW. For the first time, the top 10 European solar markets all added at least 1 GW.

Traditionally, the rooftop segment is the largest source of solar installations in the EU. Rooftop PV added 25 GW in 2022, 8 GW more than in 2021, according to SPE. There was a strong increase in the residential and small commercial segment, as such investment decisions can be quickly made, and such small systems

quickly built. In Germany, for instance, new measures were introduced to accelerate rooftop PV deployment, including higher feed-in tariffs (FITs). In addition, the falling trajectory of FIT rates was frozen until 2024 and the limit to feed to the grid only 70% of output from old PV systems – up to 7 kW in size – was scrapped.

Big solar

Simultaneously, several governments across Europe are increasingly looking into solar to reach their climate ambitions, creating demand for large volumes of utility-scale PV via auctions and tenders. Some of the most successful procurement exercises have been conducted in Greece and the Netherlands.

However, in some more mature markets, auction results have been underwhelming. For instance, there was no capacity awarded to solar in the Spanish auction held last November despite 1.8 GW initially allocated to PV.

Such results are not necessarily an ill omen for the sector but rather a general trend toward subsidy-free solar amid current energy market conditions, high wholesale power prices, and increasing demand from businesses looking into procurement from both on-site and off-site PV power plants via power purchase agreements (PPAs). For instance, in Denmark and Spain, corporate solar sourcing has become a key force behind their strong solar deployment figures.

High hurdles

However, Europe is still far from reaching its full potential and there are numerous hurdles on the way. These include labor shortage, specifically certified solar installers, regulatory instability, grid stability issues, as well as burdensome permitting procedures.



Photo: Huawei



The European Union has set itself the ambitious target of 600 GW installed PV capacity by 2030.

“It’s more than high time to take solar seriously. That means tackling barriers head on,” Dries Acke, policy director at SPE, said in December 2022. “We need more electricians and stable electricity market regulation. A solar-powered Europe can only be based on smoother administrative processes, speedier grid connections, and resilient supply chains.”

To face up to the double challenge of producing and deploying solar energy across the EU, member states are urged to analyze the skills gap in the sector and develop training programs, which can attract more women to clean energy jobs. At the EU level, a large-scale skills partnership was set up in March to ensure quality job creation and skills development in the renewables industrial ecosystem.

Full force

To pave the way to the 600 GW target by 2030, the EU has turned to palpable measures, such as making rooftop solar panels mandatory. “By then, solar energy will also be the largest electricity source in the EU, with more than half coming from rooftops,” EU Energy Commissioner Kadri Simson said at a news conference in May.

It is estimated that EU rooftops could provide almost 25% of the bloc’s electricity consumption. To unlock this potential, permitting for all rooftop PV installations will be limited to a maximum of three months, according to the EU Solar Strategy. On top of that, installation of rooftop PV will be made compulsory for all new public and commercial buildings by 2026, all existing public and commercial buildings by 2027, and all new residential buildings by 2029.

Widescale permitting reform was also launched with a view to establishing faster and simpler procedures. Whereas permitting can take even years in some regions today, new EU legislation is in the making to shorten the approval period from 12 months to nine for projects located in renewable acceleration areas.

Outside of such areas, procedures should not take more than 18 months. In addition, permits should be granted within six months for capacity upgrades to existing plants.

“A solar-powered Europe can only be based on smoother administrative processes, speedier grid connections, and resilient supply chains”

“Faster permitting in areas that can yield the best results without harming the environment will allow us to deploy renewable energy in our grids faster,” Jozef Síkela, Czech minister of industry and trade, said in December. “It will also contribute considerably to our climate goals.” [PV](#)

MENA means business

The Middle East and North Africa (MENA) region boasts some of the world's highest levels of solar irradiance, making it ripe with PV potential on every scale. According to the International Renewable Energy Agency (IRENA), the MENA region's transition to renewables is well under way. "Ambitions differ among countries, as do market size and readiness," notes IRENA. "But the overall picture is one of dynamism."

The Middle East Solar Industry Association (MESIA), which covers the entire MENA region, published its "Solar Outlook Report 2023" in January. MESIA Secretary-General Denisa Fainis says the region has set ambitious goals, but the pace of transition needs to accelerate if said goals are to be achieved.

"The solar industry continues to be financially viable," notes Fainis in the report. However, she says more support is needed for distributed solar in the residential and commercial sectors. "Financing will need to be made available through subsidies, grants, and private financing."

Interconnection issues

According to Apricum MENA Director Krzysztof Ignaciuk, the MENA region's proximity to Europe, combined with its

"ample space for solar," means renewable energy development has strong support. "The MENA region's renewables market maturity is closer than many people think," says Ignaciuk. "Algeria and Tunisia are beginning to make moves and others will follow. With the shortages... and potential further shortages – in gas, I think that renewables are a great opportunity for the region."

But Morocco is not the only MENA nation looking to export its solar resources. Ahmed Zahran, CEO and co-founder of Egypt's KarmSolar, says Egypt is on its way to becoming an energy hub and solar is set to play a key role. "Our power grid is already connected to Libya and Saudi Arabia, and there's a big connection in development with Cyprus and Greece. We see ourselves as a main player in those connected grids, going forward," says Zahran.

And there is more interconnection where that came from. Jordan, which currently has 1.5 GW of commercial PV projects under power purchase agreements (PPAs) and 1.03 GW of small-scale installations under net-metering and wheel-

Plentiful land, much of it desert with very high solar irradiation and few other potential uses, means that solar is often an extremely cost-effective solution for the MENA region.



ing schemes, will start operating a minimum 150 MW transmission connection this year.

Greening the region

Egypt has a bumpy history when it comes to solar technology, after a small boom in low-quality solar water heaters in the mid-1990s left a sour taste. “People had the idea that solar was unreliable,” says Zahran, noting that public opinion has now returned to the positive. “Solar is helping agriculture expand in Egypt. We have a lot of available land but it’s desert, which makes it cheap to install solar on your farm, and a lot of people are taking up the opportunity.”

The combination of solar with agricultural pursuits (agrivoltaics) is a growing trend in the MENA region. After all, due to the scarcity of water in desert areas far from grid infrastructure, water must be pumped from deep wells or over long distances. Often this water requires desalination. Solar solutions for water pumping and irrigation are growing increasingly popular, thanks in part to government-funded initiatives encouraging the adoption of new technologies to improve food security – agrivoltaics is one such beneficiary.

Cooling industry

One of the MENA region’s most demanding energy consumers is the cooling industry. And, as temperatures rise, this demand is only going to increase. According to the International Energy Agency (IEA), extrapolating from today’s policies, the average global temperature is likely to rise by approximately 2 C by 2050. “But this would probably result in a median temperature rise of 2.7 C in North Africa,” the organization has stated.

Not only does such increased demand for cooling mean increased demand for energy generators but said generation needs to be as efficient and well-managed as possible.

Green hydrogen

Green hydrogen sourced from solar energy could transform the MENA region into the energy hub of the 21st century. According to Rystad Energy analyst Aashish Mallik, approximately 155 GW of electrolyzer capacity will be installed globally by the end of the decade, 19% of which will be in the MENA region. Egypt, Morocco, Oman, Saudi Arabia, and the United Arab



Emirates all have plans in place to build green hydrogen production plants.

MENA leadership

Not only is the transition to renewables accelerating in the MENA region, but nations including Egypt and the United Arab Emirates are taking a leadership role. The COP27 UN climate change summit took place in Sharm El Sheikh, Egypt, in November 2022. COP28 will take place in Dubai, in the UAE, starting on Nov. 30. Sultan Ahmed Al Jaber, UAE minister of industry and advanced technology and the country’s special envoy for climate change (who is also head of Masdar), has been appointed COP28 president-designate.

“COP27, in Egypt, was a great event and certainly a move in the right direction but I think COP28 is really going to be a groundbreaking event,” says Aprium’s Ignaciuk. PV

“Egypt’s power grid is already connected to Libya and Saudi Arabia, and there’s a big connection in development with Cyprus and Greece”

**Ahmed Zahran,
CEO and co-founder, KarmSolar**

Job creation: the sunny

The 1.2 GW Janaúba solar project has created around 11,000 jobs in the Brazilian state of Minas Gerais. The 20 solar parks will generate enough power to supply the needs of 1.8 million Brazilian households.

Manufacturers supplied 2.2 million bifacial PV modules, with rated capacities of 535 W, 540 W, and 545 W, for the first and second phases.

In Brazil, Elera Renováveis, a subsidiary of Brookfield Renewables, has selected Huawei to supply inverters for the two phases of the 1.2 GW Janaúba solar project in the city of the same name in the Brazilian state of Minas Gerais. It is one of the

largest operational solar generation assets in Latin America.

The Janaúba project consists of 20 plants, each with 50 MW of generating capacity. Grid connection was carried out gradually as each plant was completed.



side of solar in Brazil

The 20 solar parks – which are spread over an area of 3,069 hectares – will generate enough electricity to power 1.8 million Brazilian households and will eliminate more than 4.3 million tons of CO₂ emissions. It is important to note that all of the plants have power purchase agreements (PPAs).

The inverters chosen for the project were Huawei's smart string inverter

SUN2000-185KTL-H1 for the first phase, with 4,116 units, and 1,512 SUN2000-215KTL units for the second phase. In this regard, Alberto Lopes, vice president of engineering and construction at Elera Renováveis, explains that “the Huawei string inverter was chosen by considering the benefit of distributed architecture, compared to other market options.”

“The main advantage is that should an inverter fail, the power loss is not so big, and Huawei inverters have extremely high availability,” adds Lopes.

In addition to this, he points out other particularities of the inverters.

“In the Huawei smart string solution, the technology of the equipment, and its information management facilities are a huge benefit for the quality and reliability of the energy's commercialization.”

The project is located in the city of Janaúba, 553 km from the city of Belo Horizonte, the capital of Minas Gerais, and 879 km from Salvador, the port and capital of Bahia state. Lopes says there were no major logistical problems. “The main difficulty was the lack of specialized local labor for electrical and mechanical activities,” he says. “Elera faced this issue by promoting training for the local labor force in partnership with EPC [engineering, procurement, and construction services] providers.”

Referring to the workforce employed, Lopes puts the figure at 3,689 employees during the construction of the first phase, while the second phase required 2,245 people. “Seventy percent of the workforce was local, from Janaúba and the nearby community of Quem Quem,” he adds. All in all, if indirect jobs are also added, this means the creation of around 11,000 jobs.

Finally, it should be added that the company has invested \$10 million into the neighboring community for environmental and social projects, vocational training, and the rehabilitation of public spaces, among other actions. [pv](#)



Photos: Elera Renováveis

“The technology of the equipment and its information management facilities are a huge benefit for the quality and reliability”

**Alberto Lopes,
vice president of engineering and
construction for Elera Renováveis**



Tackling load shedding in South Africa, one home at a time

Load shedding has been an ongoing challenge for South Africans since 2007. The country currently experiences regular planned power outages, forcing citizens to seek alternate sources of energy. While many solar solution providers in the region focus on commercial & industrial (C&I) installations, Huawei partner Metrowatt concentrates on the residential sector. CEO David Neale discusses his company's partnership, the challenges and opportunities for residential solar in South Africa, and how Metrowatt is helping to ease load shedding.

Could you please tell us about the current state of energy production and supply in South Africa?

Load shedding to reduce the total load on the national energy grid has been a reality in South Africa since 2007. Much of the capacity constraint is due to old and failing infrastructure. Recently South Africa had less than 50% of its traditional coal power production available, which equates to about 20 GW. South Africa's peak electricity demand exceeds 30 GW of electricity.

In addition to insufficient production capacity, infrastructure failures and distribution challenges have become prevalent at the local municipal level, resulting in a significant number of unplanned outages.

Initially load shedding occurred once every few weeks. Today it is much more serious, with power outages occurring as often as three to four times a day, for between 2.5 and 4.5 hours at a time. In the event of an area outage, the electricity can be off for a few days at a time. These challenges have led customers, specifically homeowners, to seek alternative backup solutions, that include solar, battery and inverters, to provide power security.

How does Metrowatt help to resolve load shedding in South Africa?

We see a need for residential customers to have access to backup solutions. However, this can come with a significant capital cost investment. An entry-level solar and battery system for a family home can cost from ZAR 100,000 (\$5,170) to ZAR 130,000. Understandably, customers may be hesitant to make such a commitment due to concerns about the system's suitability, quality, and the potential for incorrect installation and configuration.

The Metrowatt team is expanding, as the company aims to install 2.5 MW of residential solar systems per month by the end of 2023.



Recognizing these concerns, Metrowatt has partnered with Huawei to deliver rental solar solutions for our customers. This removes the initial capital outlay risk for customers, and smooths the path to an integrated solar, inverter and battery system for the homeowner, which includes support and regular monthly payments.

What is the installation process?

Customers can purchase the system outright or rent it. For rental, we charge an up-front installation fee of ZAR 10,000, as standard for Huawei products with solar panels. After that, the homeowner pays a fixed monthly rental from as little as ZAR 1,650. Customers renting a system from Metrowatt receive full technical support.

Photos: Metrowatt



“ We see a need for residential customers to have access to backup solutions ”

**David Neale,
CEO, Metrowatt**

We also help manage and optimize the system so that clients get maximum savings and output.

The FusionSolar system is an integrated system. Batteries, inverters, and panels with optimizers can all communicate with each other. This enables us to manage and support the entire installation. We also advise clients about battery and inverter settings, as well as panel usage so that they can get optimal performance from the system during different seasons.

What challenges does Metrowatt face while installing systems?

The main challenge is that every house is unique in its design and its energy usage. This is why FusionSolar products are great products for Metrowatt. The slimline, sleek, cosmetic design, and built-in safety mechanisms make it possible to install a complete solar system within the customer's living space. When space is confined, you can put these systems into places no other systems can go.

In which locations have you currently installed FusionSolar products?

Most Metrowatt customers are based in Johannesburg, Gauteng, with the second largest market being in Cape Town, Western Cape province. We see growing demand in Cape Town and other coastal cities for the installation of solar and batteries in high-density buildings. We have noticed, especially in apartment buildings with multi-dwelling units, that the Huawei iSitePower-M is a great solution for customers given its compact size. The Power-M can easily power apartments and three- or four-bedroom homes.

What is your current installation capacity?

We can install 100 homes per month. A typical home gets installed with about 4-5 kW of solar panels. That's about 500 kW per month that we are adding to the system. We aim to add 500 homes (2.5 MW) a month by the end of 2023.

What is the cost of renting a solar solution for backup power?

A typical household in South Africa spends between ZAR 1,500 and ZAR 3,000 per month, depending on the household size. We pay around ZAR 2.50 to ZAR 3 per kilowatt-hour for electricity.

Will you be looking into the commercial solar segment as well?

We want to focus on residential homes because there isn't enough attention paid to this market. There is a big gap in the load management side in homes and because of the distribution challenges in South Africa, there will be a lot more opportunities in the long term.

What is the future for Metrowatt and FusionSolar?

We have been working closely with Huawei in the research and development of backup solutions. Going forward, we see a huge opportunity to assist customers with load management. As South Africa's new minister responsible for electricity, Kgosientsho Ramokgopa, recently said, "South Africa's challenge is not just power production, it's power distribution that is a big bottleneck." There is a lot of opportunity to have greater coverage from our systems if we can balance loads better for individual households. In the long run, we see further opportunities to create virtual power plants and grids. [PV](#)

An agrivoltaic framework

In March 2023, France passed a law to accelerate the production of renewable energy, with a framework for the dual use of land for agriculture and solar energy. Bertrand Drouot L'Hermine, deputy general manager of business development for project developer TSE, discusses the important role that agrivoltaics will play in weaning the country off fossil fuels and providing benefits to France's farmers.

What is the potential for the development of agrivoltaic projects in France?

We are at the end of a first cycle of ground-mounted solar development in France. For the past 15 years, the government has been favoring large-scale solar power plants on degraded land. Now these sites are becoming increasingly rare with more and more challenges, particularly with regard to environmental issues. To accelerate the development of solar energy, several interests must coexist on the same project, whether on ecological or agricultural matters. Agrivoltaics is an important element for the development of photovoltaics in France. But it must be well conceived, meaning the PV installation is beneficial for the activity with which it coexists, beyond simple remuneration.

How can the combination with solar be beneficial for agricultural land and activities?

The combination of solar energy source with cultivated land or a livestock farm provides different benefits. First of all, it offers the crop a protection against climatic hazards such as hail or extreme temperatures by creating a rotating shade. This allows the regulation of temperature and watering to better manage heat stress on the plants. It

With wide spacing between poles, TSE's systems allow access for almost all types of agricultural machinery – a key concern for farmers considering agrivoltaics.



for France

also reduces evapotranspiration and, as a result, water consumption. For example, on the first soybean harvest of our project in Amance, we reported a 75% reduction in water stress under the system compared to the reference plot. Each developer has a specific set of requirements. TSE has developed a range of products that meet specific needs and field constraints to provide agri-PV solutions for crops, livestock sites, fallow land, and so on.

What are the technological features to be considered?

The main constraints are related to the orientation of the plots, their typology, their topography, and of course, to the traditional requirements of solar power plants. What makes TSE's solutions specific is that they are designed based on the needs of the agricultural activity. The challenge for us is to provide the farmer with a service that adapts to their farming practices, whether in terms of cultivation or mechanization. Our canopy allows the passage of almost all agricultural machinery thanks to an inter-pole space of 27 meters in the direction of cultivation with a low point at five meters.

Who are your different partners and how do you work with them?

We are developing large volumes of projects in line with the incredible challenge facing the country. We rely on partners who are both well established locally and capable of industrializing large volumes, like Huawei for our inverters.


How can agrivoltaics help to achieve the objectives of energy transition in France?

The energy crisis in which France has been immersed for the past two years is more related to a capacity crisis than anything else. France needs to develop its electricity production capacity exponentially over the next 10 to 15 years for three reasons: first, we need to decarbonize our energy mix, which is still 61% fossil fuel. This will involve the electrification of uses and the development of decarbonized energy sources such as hydrogen; secondly, we need to replace the huge nuclear capacity that will be phased out between 2030 and 2035 – in the hope that these plants will operate until then under acceptable conditions in terms of cost and availability; and finally, because we want to reindustrialize the country, solar energy – as the cheapest, quickest to deploy, and most accepted source of energy – will be the best possible answer to complement our historic nuclear fleet.

In France, the law on the acceleration of renewable energy production of March 10, 2023, provides a framework for photovoltaic installations on agricultural land. What does this change for the industry?

Although imperfect, this law has a double value. It is the first law dedicated to renewable energies, showing the will to accelerate. It also provides a clear and binding framework for what agrivoltaics is and should be: the coexistence of two activities, with solar energy production providing a benefit to agriculture that is not only financial.

What are the milestones you aim to achieve in the coming years?

We are committed to developing more pilot projects with the best technical partners, chambers of agriculture, cooperatives such as Dijon Céréales, INRAE (the National Institute for Agricultural Research), the Purpan agronomy school, or the Institut de l'Élevage, to demonstrate the services our solutions provide. On the other hand, we are developing our solutions more widely throughout the country. TSE is the solar energy producer with the strongest territorial granularity. We develop projects everywhere in France. 



“ We are committed to developing more pilot projects with the best technical partners ”

**Bertrand Drouot L'Hermine,
deputy general manager
business development, TSE**

Green road in a sea of sand

In October 2021, the Kubuqi PV sand-control project – with a total generation capacity of 2 GW in China’s Inner Mongolia region – officially announced the start of construction. The project is one of the first large-scale, wind/solar power bases to be built. It is also the largest PV sand-control project to be installed thus far in China. These wind and solar power bases, planned in China’s different desert regions, will add up to 100 GW of generation capacity.

The Kubuqi Desert is the seventh largest in China, located on the southern bank of the Yellow River in the Loop Plain. The region suffers from severe soil erosion and is one of three major sources of sand and wind, whose effects can reach Beijing. For more than a hundred years, locals have continued to explore various ideas and methods to co-exist with the sand and wind. The emergence of PV as a combined measure of sand control has improved the lives of local people.

“The emergence of PV as a combined measure of sand control has improved the lives of local people”

Although the total investment amount has not been finalized, the Kubuqi project is expected to cover a total area of nearly 70 km², including 52 km² for the core area of PV power generation and 15 km² for the adjacent desert sand restoration area. After the project is completed, desert vegetation coverage in this area is expected to soar from less than 3% to more than 60%.

This will not be the first PV sand-control project built in the Kubuqi Desert. Back in 2018, a local provincial branch of China’s state-owned power enterprise

invested in the Dalat PV Power Top-Runner Base No. 1 and No. 4 projects and built a 300 MW desert PV power plant in 133 days. The developer made full use of the color difference between the surrounding low vegetation and yellow sand, using more than 196,000 PV modules to form a picture of a galloping horse in the desert. The “Horse” power station became the largest desert PV plant in China at the time and was also certified by Guinness World Records as the world’s largest photovoltaic panel-graphic power station.

Ground control

The Kubuqi project will adopt the proven five-in-one cyclic industrial development model, which was explained as “power generation on the board, planting under the board, breeding between the boards, sand control and soil conversion by the boards, and revitalization of the countryside with PV,” to balance resource utilization and ecological restoration and improvement of the desert, and to eventually form a comprehensive, cyclic development pattern of “light, electricity, vegetables, grass, medicine, livestock, and poultry.”

Various factors have to be taken into account in designing this kind of PV sand control project. Higher laying density of PV modules will effectively lower wind speed and arrest the movement of sand and dust. Meanwhile, the PV panels can absorb sunshine, reduce land temperature, reduce evaporation, and increase the accumulation of soil moisture. This shade on the ground will improve the environmental conditions for plant growth and promote the recovery and growth of desert vegetation. In addition, the runoff from washing the photovoltaic panels during operation and maintenance can irrigate the surrounding grass and foster plant growth.

The developer will plant low shrubs under the PV panels and between the rows – including dwarf date palm and astraga-



The “Horse” project was among the first to be developed in China’s Kubuqi Desert region. Now, plans are moving ahead for larger PV projects with measures to control sand and wind.

lus, as well as some herbal plants such as licorice and *Cistanche deserticola* – with a spacing of 2 meters by 3 meters. The planting of vegetation can fix and reduce the amount of sand and restore the ecological benefits of vegetation. At the same time, the combination of desert management with forestry and agricultural economic industry can provide additional economic income for local people.

The Kubuqi Desert is in Inner Mongolia, which is a Tier 1 resource area for solar radiation in China, with more than 3,000 hours of sunshine throughout the year, including up to 3,180 hours at the project site. The project is expected to total more than 1,700 hours of power generation per year, which is far more than the average value of other areas. This is also another power generation advantage of the PV sand control project.

The project developer expects that after the Kubuqi project is completed and put into operation, annual power generation will reach 4.1 TWh, which can meet the annual electricity demand of more than 1.6 million households and can save 1.26

million tons of standard coal while reducing carbon dioxide emissions by around 3.21 million tons per year, compared with coal-fired power plants of the same scale.

As the world’s leading PV inverter manufacturer, Huawei has provided the Kubuqi PV sand control project with a complete set of intelligent PV solutions including intelligent string inverters, power line communication, Smart I-V Curve Diagnostics, Smart PV Management System, and other advanced technologies and products. Huawei inverters with a multiple MPPT (maximum power point tracking) design can provide higher power generation than conventional inverters. Huawei’s mature technologies, such as fuse-free and wear-free parts, enable the inverters to operate stably and reliably in the high temperature and sandy environment of the site and are less prone to failure. Using Huawei’s intelligent I-V diagnosis technology, the plant’s “health” can be understood as quickly as a CT scan, allowing the plant’s operation and maintenance to be more efficient and easier. PV

Powering rural Nigeria

Nigeria's Rural Electrification Agency (REA) was established to tackle electricity challenges in rural parts of the country. As the organization that manages electric power in remote areas, the REA is committed to resolving the problem of power access for its constituents. It focuses on new power generation, microgrids, and the construction of distribution networks. Abba Aliyu, the head of project management for the REA's Nigeria Electrification Project (NEP), says that much has already been achieved, but challenges remain.

What's the relationship between the NEP and the REA?

The REA is Nigeria's federal government agency that was created to facilitate off-grid development. Initially, the country's power sector was integrated with a monopolistic arrangement. The sector was recently unbundled, based on the promulgation of the Electricity Power Sector Reform Act (EPSRA), and transmission, generation, and distribution were all separated. Private sector participation was encouraged by the act, and it led to the creation of the REA with the mandate of facilitating the Rural Electrification Fund and the development of off-grid electrification for rural and unserved areas. As part of the implementation of the REA, the federal government, in collaboration with the agency, secured \$250 million in funding from the World Bank and \$200 million from the African Development Bank for the Nigerian Electrification Project (NEP). The project was designed to incentivize private sector participation and facilitate the development of sustainable electricity.

What's the current state of rural electrification in Nigeria?

There's a lot that needs to be done. Figures provided by the World Bank show that over 85 million people in Nigeria are either not served or are underserved in electricity, with most of them living in rural areas. A lot still needs to be done to provide electricity in rural areas.

What government policies are there to support the REA?

EPSRA provided the enabling ground for private sector participation. The federal government's Vision 2030 has a framework where renewable energy is an integral part of the country. The Rural Electrification Strategy and Implementation Plan (RESIP) provides details for how the REA operates within the country and provides an operational framework.

“The Nigerian project has been a trailblazer. We have been the pace-setter and other African countries come to us to learn how we implemented our projects”

**Abba Aliyu,
Nigeria Electrification Project**



Photo: REA Nigeria

What's the role of Huawei and other partners in achieving the REA's goals?

We have different components designed to target specific areas of need. In all of these, there is a need for a huge provision of inverters, batteries, solar systems, PV panels, communication, and appliances that ensure mini-grids are working and communicating with a system that monitors their performance. The relationship with Huawei is the provision of these key requirements to build the minigrids. We have seen lots of participation and collaboration with Huawei. This is because of the company's presence in the country and because they have after-sales support systems that are attractive to EPC (engineering, procurement, and construction services) companies.

How many households, institutions, or businesses will benefit from the project?

To date we have built 83 minigrids covering over 26,000 connections. We have over 200,000 connections in the pipeline, and we have over 1.4 million connections impacting over six million Nigerians for solar home systems. We are currently in the process of energizing seven federal universities and two affiliated teaching hospitals. This will benefit over 150,000 students, creating a conducive learning environment.

How will people pay for electricity? What system is in place?

Based on our learning from phase one, which is implemented, we had to develop a sustainability plan to make the project a hybrid whereby there is a connection with the distribution network. It's a hybrid system to ensure sustainability during the nighttime when there is no solar irradiation. The system is connected to the distribution network at night and relies on grid provision during the day. There's a provision for metering for payment for all connections. There is adequate monitoring of all connections to ensure payment and utilization within the operational framework designed for the minigrids.


What challenges do you face?

If you look at implementation in Africa, the Nigerian project has been a trailblazer. We have been the pace-setter and other African countries come to us to learn how we implemented our projects. Initially, it was challenging to have developers trust the system and buy into the idea. Many modifications and engagements had to be made to get the private sector in. At this moment, the private sector has seen the operating framework and has trusted the system. The challenge now is expansion because there is a lot of demand from the private sector to partner. Our challenge is having adequate funds to meet the demand.

What role do you see for technology and innovation in improving access to power in remote areas, and how is the REA leveraging these tools to achieve its goals?

We have seen the effectiveness of technology in implementing the NEP. Without technology, some of the NEP's key objectives wouldn't have been achieved. We use technology to verify the connections, monitor the performance of the minigrids, and ensure we reduce commercial and technical losses. Without technology, nothing can be achieved under the NEP. If you look at the cost of PV panels 10 years ago compared to now, there is a massive reduction in price due to technological improvements. Without these, we would never have achieved even 10% of our accomplishments. I see technology as continually playing a role in shaping how we work, reducing costs, and making work easier.

Can you tell us about success stories?

We have deployed 83 functional minigrids, distributed countrywide, with over 1.4 million solar home systems that are working. We've also stimulated private sector participation and have improved the economy by creating direct and indirect job opportunities. 

The Nigeria Electrification Project has built**83*****minigrids in rural regions across the country***

Ripe for entrepreneurial

Thailand has seen strong, stable growth in its solar market in recent years, leading it to become one of Southeast Asia's most secure demand centers for renewable technology. Polytechnology Thailand, a diverse company with an expansive and growing green energy division, has more than doubled its solar inverter sales every year since 2016. Today, the company holds the biggest share of Thailand's solar inverter market.

Polytechnology Thailand President Narratchai Leeraphant says solar's strong uptake in the country means the market is ready for next-generation technologies such as batteries, electric vehicle chargers, solar optimizers, and "full stack" product bundles.

Recent changes to Thai safety standards and regulations for solar system rapid shutdown will make optimizers a growing trend in the country, Leeraphant says. "So we can up our sell, from only inverters to inverters plus optimizers, for which

our solution is the most advanced in the market," he adds.

Solar is so established in Thailand that it is already tricky to install more rooftop systems in some areas, Leeraphant says, so technology to store and use the resultant abundance of green energy is increasingly required.

Polytechnology has been partnering with Huawei since 2014, starting as the brand's inverter distributor in Thailand and today offering the latter's range of battery energy storage systems and data-cent-

Polytechnology Thailand began its partnership with Huawei in 2014. Every year since 2016, the company has more than doubled its sales of solar inverters.



Photos: Polytechnology

spirit

ter products. “Polytechnology and Huawei have dealt with price, customer expectation, and what current battery technology can offer,” Leeraphant adds, in reference to battery systems.

He says the next step is to educate the market about safety and the value of advanced battery technologies, in order to bring the energy storage market to maturity.

While Asia’s rooftop market still tends to be dominated by commercial and industrial installations, Leeraphant says demand among households is booming. The primary barrier for the residential segment is the fact most people are not actually at home during the daytime to use the solar power their panels would generate. Leeraphant believes Huawei’s LUNA2000 home battery, which Polytechnology introduced into the Thai market in 2022, will close this gap, enabling households to shift their solar energy to consume later in the day.

There is also growing demand for integrated renewable technology product bundles. This full stack strategy is becoming increasingly popular among both solar manufacturers and retailers worldwide and is particularly valuable in Southeast Asia, where electricity networks remain a challenge. These integrated product suites are easier to install and more user friendly – especially important for a region where renewable technology has burst onto the scene a bit later than in Europe, the US, and Australia.

Full stack bundles are valuable for engineering, procurement, and construction (EPC) firms, Leeraphant says. “Installing rooftop solar, sometimes the price is very tough because there are lots of players, so adding EV [electric vehicle] charging adds more value, compared to other competitors,” he explains.

Added value is often on Leeraphant’s mind – alongside heading up Polytechnology he owns a multinational restaurant franchise business and the Thai International School. While, on the surface, these endeavors would appear to have little in common with the solar industry, Leeraphant sees plenty of crossover. The restaurant business has provided lessons in how

to manage the energy sector’s sub tiers of dealers, Leeraphant says, while the school has afforded both a platform to teach a generation of students about renewable technology, and also an opportunity to showcase products to parents who make up a cohort of top managers and business owners.

For Leeraphant, the key to good business is staying open to new technology, even if it disrupts companies. While Polytechnology has long been involved in the energy sector, its roots are in oil and gas. Despite that, the company entered into new green markets back in 2011 and, two years later, installed Thailand’s first public EV charger, long before EVs and charging products were mainstream. “Polytech had been studying the EV business since 2011, long before other companies,” says Leeraphant.

Since 2020, demand for EVs and related charging equipment has surged, Leeraphant says, putting Polytechnology in a position to use its knowledge in the sector. Leeraphant sees especially big growth potential for public DC (direct current) chargers, of which Leeraphant’s company has already installed around 450 nationwide. In 2021, the company delivered 120 MW of DC charging capacity and almost quadrupled that volume last year, when it reached 450 MW. The demand for home and office chargers is also spiking in Thailand, Leeraphant says.

With nations across the globe committing to carbon neutrality, and Asia expected to experience a big upswing in electricity demand, Leeraphant is confident that demand for solar, EVs, and battery products – today’s main suite of decarbonization technologies – will continue to boom.

“We see our growth will still sharply increase in these next years if we come with the right partners,” he says. “The key factor for success is you must be open to new technology or new alliances all the time. Maybe it is not the right time yet but when the time comes, you have to be ready and be the first who sets the market direction, otherwise you can be only a market follower.” PV



“The key factor for success is you must be open to new technology or new alliances all the time”

**Narratchai Leeraphant,
president, Polytechnology Thailand**



This 1 GW project in Sichuan, China, is the world's largest and highest-altitude hydro-photovoltaic hybrid power station. Average annual power generation is 2 billion kWh, which can reduce carbon dioxide emissions by more than 1.6 million tons.



This floating PV project is scattered across seven sites in Jiangxi province, China. All of them are in water areas, which is very challenging for O&M. The innovation of a Smart Co-Diagnosis System was adopted to achieve more accurate fault location and loss quantification, while completing full-coverage inspection and saving 80% of O&M time.



Mahidol University, one of the top public universities in Thailand, installed a 15 MW PV power plant and 600 kWh energy storage system in 2022. The university plays a leading role in promoting low-carbon tech on its campus.

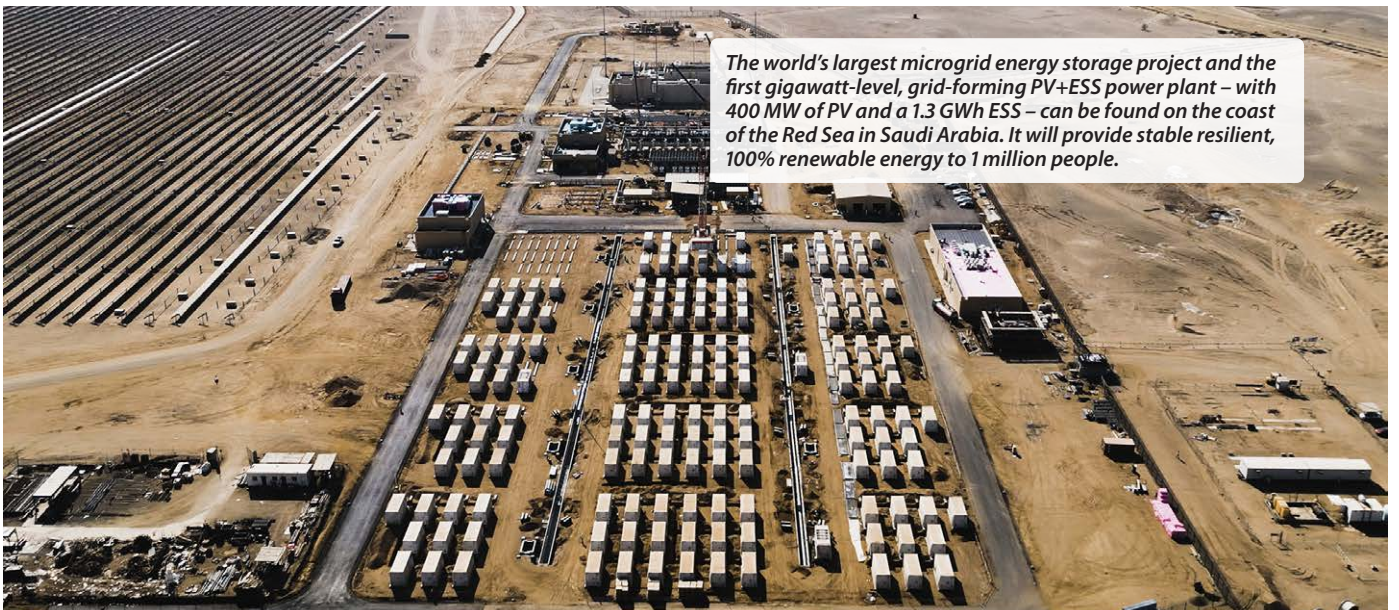
Photos: Huawei



Southeast Asia's largest energy storage system covers 2 hectares of land on Jurong Island, Singapore. It can power around 24,000, four-room Housing & Development Board households for a period of one day with a single discharge.



This large detached home in Germany – powered entirely by solar energy using FusionSolar residential solutions – includes inverters and an energy storage system. The 11 kW of PV and 10 kW ESS provide electricity for daily consumption, so the house can achieve energy independence.



The world's largest microgrid energy storage project and the first gigawatt-level, grid-forming PV+ESS power plant – with 400 MW of PV and a 1.3 GWh ESS – can be found on the coast of the Red Sea in Saudi Arabia. It will provide stable resilient, 100% renewable energy to 1 million people.

Paving the way to a clean

Solutions such as Huawei's FusionSolar Grid-forming technology will help to usher in more grid-connected renewables, while also strengthening and stabilizing the grid for everyone.

According to a recent report by Solar Power Europe, utility-scale solar PV installations globally reached 121 GW in 2022, up 41% from the previous year. In *Global Market Outlook for Solar Power 2023-2027*, the industry body notes that “the cost-competitiveness of combining solar power with storage, in comparison to using gas turbines to meet peak demand, is unquestionable.” With global temperatures now rising and extreme climate events causing disruptions throughout the world, the widespread adoption of solar has become vital.

mission line's limit. Normally, to address those problems, synchronous condensers are deployed to provide the reactive power adjustment capability to maintain grid stability. However, high cost and complex operation and maintenance (O&M) are the two barriers.

Virtual inertia

To cope with the preceding challenges, Huawei launched its innovative FusionSolar Grid-forming solution. Based on string architecture, the solution is developed from Huawei's Smart PV Inverter, Smart String ESS, Smart ESS Controller (PCS), Smart Power Plant Controller (PPC), and algorithms. It is one of the core technologies in the process of building a new power system to maintain power grid stability and increase the proportion of new energy consumption to 80% and above. The solution mimics the characteristics of synchronous condensers through the intelligent collaboration between ESS, PCS, and inverter – realizing “Triple Restructuring” in voltage, frequency, and power angle – to stabilize the grid.

The grid-forming solution adopts the DC/DC and DC/AC bipolar conversion architecture. When the power grid voltage increases, the overvoltage is conducted to the DC bus side of the converter. However, the voltage boost does not affect the battery voltage. Therefore, the active power can be more stable during high-voltage ride-through (HVRT).

The FusionSolar Grid-forming solution can easily detect frequency changes in the system caused by unbalanced power. When these effects are detected, the solution can actively and quickly – within 10 milliseconds – inject electromagnetic power into the power grid to imitate the changes in the kinetic energy of the rotor and implement inertia support for the system. The virtual inertia and damping coefficient of the solution

“As the proportion of connected renewable energy increases, the power grid faces many challenges”

As the proportion of connected renewable energy increases, the power grid faces many challenges. Problems can include wideband oscillation, transient overvoltage, power quality deterioration, and the instability of power supply for islanded PV and energy storage systems. Faulty AC power lines, which transmit power flow at a large scale and over a long distance, can result in a sudden increase in impedance that causes a reduction in the trans-

power future

can be set to adapt to different operation scenarios and to improve the frequency control of the system.

Under active disturbance, conventional PV and ESS solutions – which use a non-synchronous power supply – cannot provide inertia support and, therefore, also cannot slow down changes in frequency. The weak inertia support increases the rotor angle difference between the “transmit” and “receive” ends, and in serious cases, this can make the power supply unstable. By supplying virtual inertia to the system, functioning as a synchronous generator, the FusionSolar Grid-forming solution eliminates this worry.

New era

In January 2023, Huawei cooperated with China Electric Power Research Institute, China Electric Power Research Institute (Qinghai), and China Resources Power for the first onsite MW-scale test of grid-forming, with a full range of testing scope following the test. The test, which took place in Qinghai, China, covering over 180 test items, proved that the solution can play a key role in strengthening the power grid and facilitating an increase in the proportion of renewable energy technologies connected to the grid.

Starting in 2022, Huawei participated in the construction of the world's largest microgrid project in the new city of Red Sea in Saudi Arabia, with a 400 MW PV plant and 1.3 GWh BESS. The FusionSolar grid-forming solution has been adopted with key features catering to the requirements of the harsh local environment, such as gigawatt-level black start and multiple faults ride-through, among others.


As the popularity of renewable technologies continues to grow, and more and more solar becomes integrated with the power grid, solutions like the FusionSolar Grid-forming technology will play a crucial role in bringing stability to the grid. Huawei's continuous innovation will usher in a new era, in which renewable energy sources provide most of the world's electricity demand and no one need wonder when the lights will go out next. 



Photo: Red Sea Global

Huawei's grid-forming solution is also being used at the Red Sea Resort. The tourism mega-project is now under construction in Saudi Arabia and is set to include a 400 MW PV plant and 1.3 GWh BESS. A July update from developer Red Sea Global said that a total of 760,000 PV panels have been installed at the site and are already powering resort facilities.



Photo: Huawei

Huawei and its partners in China conducted a megawatt-scale grid-forming test covering 180 test items. They managed to prove that the technology can also strengthen larger grids and facilitate higher renewable energy penetration.

Optimizing BESS through string architecture

The role of battery energy storage systems (BESS) in the energy transition cannot be overstated, but the industry is struggling to deliver on promises of low cost and guaranteed safety. Cutting-edge solutions are tackling these challenges head on.

The need for energy storage is growing at an unprecedented pace, as renewables become an increasingly dominant power source worldwide. With ambitious decarbonization targets in place, grid owners and operators are faced with a challenging task of balancing the intermittent nature of wind and solar. In so doing, BESS have proved to be a key asset in enabling a much-needed flexibility for the clean energy supply.

However, the BESS industry is not without its own challenges. Decreasing cost is an imperative for battery manufacturers, but fluctuating raw material and battery component prices are making things difficult. Furthermore, safety is a major concern due to battery system issues, such as manufacturing defects, external and internal short circuits, and battery monitoring failure, which can eventually lead to hazardous fires that are difficult to put out. Other challenges include short service life and complex operations and maintenance (O&M). Finally, there is a need for a constant improvement of the energy

efficiency of BESS to ensure that as little energy as possible is lost in the storage process.

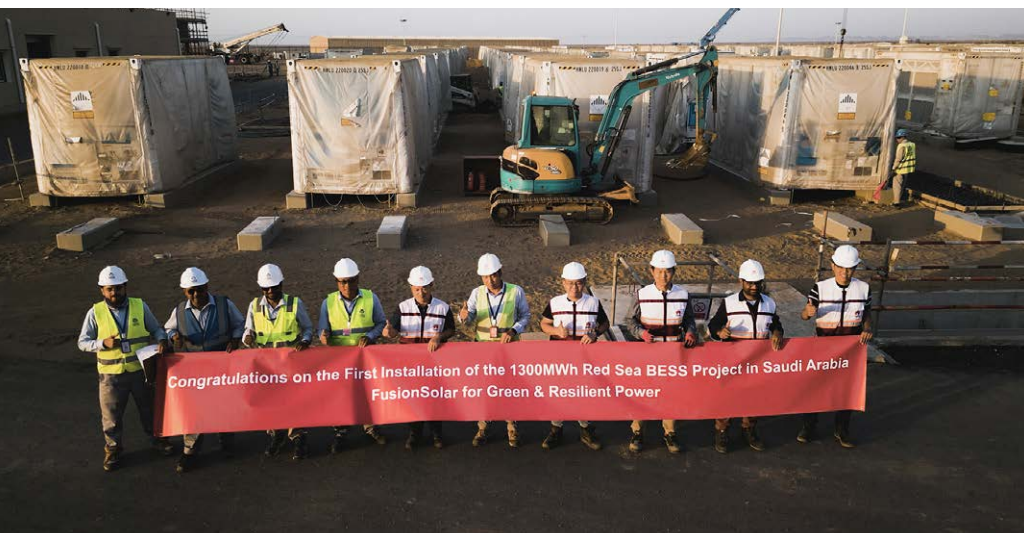
Unlike traditional BESS, Huawei's Smart String energy storage system solution is tackling all these challenges through its unique design concept and string architecture. A decade ago, the Chinese PV industry heavyweight took the lead in the transition from central to string architecture in inverter and project design. Today, string inverters have become the absolute mainstream with more than 70% market share. Now, Huawei is once again proposing string architecture, this time in the BESS domain, in a bid to make battery systems safer and more efficient. By means of refined management of battery cells, packs and racks, and an accurate control of battery charge and discharge, its Smart String ESS technology improves the lifetime throughput and safety of the BESS and simplifies O&M.

LCOS is king

While people tend to evaluate projects based on initial capital expenditure (CapEx) or BESS price tag, the key figure which needs to be considered when making technology choices is the cost of storage over the lifetime of the project. The levelized cost of storage (LCOS) is a comprehensive metric which takes into consideration all cost influencers, such as initial costs, operational expenses, and the total amount of energy that the system can store and discharge during its operational life. It is therefore the most reliable metric that stakeholders can use to compare different storage technologies in a targeted application and make an educated investment decision.

By virtue of its smart string architecture, Huawei's ESS solution can discharge more usable energy, so its LCOS is more than 15% lower compared to conventional solutions. Specifically, the solution's pack-level and rack-level optimization in combination with distributed cooling ensure more energy from a single device, increas-

This 1.3 GWh BESS installation has been completed at a site on Saudi Arabia's Red Sea coast. Developer Red Sea Global says the system is already delivering power.





FusionSolar Smart String ESS installed at the Red Sea project. In this harsh desert environment, the BESS will have to deal with high temperatures, as well as humidity and salinity.

ing discharge capacity by 15%. Battery pack optimizers help achieve full charge and discharge of each pack individually to avoid series mismatch, while battery rack controllers balance the capacity of battery racks during charge and discharge, preventing current circulation between battery racks.

Another major cost factor for BESS is O&M. For instance, regular state of charge (SOC) calibration by professional staff, which is usually carried out every six months, is estimated to amount to more than €1.7 million for a 100 MW/200 MWh BESS project over a 10-year lifespan. With Huawei's Smart String ESS solution, the calibration of SOC is automated, eliminating the need for expert site visits and resulting in major cost savings. Finally, the optimal investment profile is reflected in the smart rack controller's ability to enable phased battery augmentation and allow for new and old batteries to be mixed, while eliminating the need for an AC-side device.

Safety first

While cost remains a key driver propelling the battery evolution, safety is paramount for BESS project owners and operators. To optimize safety features, Huawei has combined a broad range of proac-

tive alarm and active safety mechanisms. These include a smart internal short circuit diagnosis, fire risk point monitoring, live insulation monitoring, multi-level shutdown and protection, rapid system disconnect, active gas release, and quick fire suppression.

Since no technology to date has been able to promise a 100% safe BESS, early detection of a failing battery cell is critical, allowing for implementation of active countermeasures. Huawei's smart Battery Management System (BMS) can give an accurate diagnosis, detects potential malfunctions, and triggers a proactive warning.

Within the Smart String ESS, faulty packs and racks are disconnected and isolated, whereas the entire system can be disconnected in case thermal runaway is identified. Thermal runaway, which occurs when a cell reaches an elevated temperature due to thermal or mechanical failure, internal/external short circuiting, and/or electrochemical abuse, can result in extremely high temperatures, violent cell venting, smoke, and fire. That is why the Smart String ESS features multiple temperature, humidity, and smoke sensors, which enable an active combustible gas release to avoid explosion, as well as quick fire extin-

guishing capability to prevent the accident from escalating.

Broad potential

In the ultimate proof of its robustness, Huawei is deploying its Smart String ESS technology in the world's largest microgrid project on the Red Sea coast of Saudi Arabia. Billed as the world's most ambitious regenerative tourism development, the project will feature a 400 MW solar array and a 1.3 GWh BESS with the goal of having the mega development 100% powered by renewable energy. The technology was chosen by a consortium of developers – led by ACWA Power – for its capability to withstand harsh environmental conditions, including high temperatures, high humidity, and high salinity.

Other features of the Smart String ESS include GW-level black start and multiple fault ride through capabilities ensuring a stable power output. Therefore, Huawei's ESS was also the technology of choice for Singapore-based renewables developer Sembcorp when building the largest BESS plant in Southeast Asia. The project, located on Jurong Island, will complement Singapore's efforts in maximizing solar adoption and marks the achievement of the country's 2025 energy storage target ahead of time. [PV](#)

Giving a boost to commercial systems

A look at Huawei's PV and storage solutions for the commercial and industrial (C&I) segment shows that efficiency benefits from intelligent features. Huawei's C&I solar PV and storage solutions have resulted in a 30% higher energy yield by using an optimizer with two strings per maximum power point tracker (MPPT), rather than the standard string solutions, according to the company's internal research.

Huawei's suite of FusionSolar C&I solutions include the SUN2000 inverter, which features multiple MPPT channels for versatile power adaptations. This allows for intelligent management and seamless troubleshooting. The commercial and industrial inverter, like its utility-scale counterpart, is configurable in anything from two to 10 MPPT configurations for different PV array deployments in 1,100 V or 1,500 V DC.

Intelligent DC switching brings flexibility to inverter design, where it is possible to deal with the backflow problems in prior inverter layouts by connecting more than three strings. Huawei's intelligent switch can solve backflow and protection problems. Additional remote decoupling can be applied to distributed-generation systems to form a more reliable opera-

tion and maintenance (O&M) cycle and reduce the requirements for user-operation in emergency situations. Huawei's Smart PV Optimizer can provide lossless rooftop PV performance for those projects where shading factors inevitably come into play. Without management on the power electronics side, losses caused by partial or uneven shading can quickly add up, and even reach as high as 50%.

Seamless communication between components is enabled by the Smartlogger 3000B series device, capable of managing up to 150 string inverters and a total of 200 interconnected PV devices in one system at speeds of up to 1,000 megabytes per second.

Fault detection

The impact of potential induced degradation (PID) can be amplified by temperature and humidity factors in the environment, which contribute to degradation in various ways caused by objects that are electrically conductive, acidic, or ionic. Huawei's SmartPID module is installed in its Smart Array Controller cabinet to reduce the negative effects of degradation and support 1,000 V DC to 1,500 V DC systems. When the inverter is in standby mode, at night, offset direct current voltage is applied between the PV inverter and the ground, which effectively increases the voltage of the PV string system overall, a highlight of Huawei's resilient PV and storage solutions.

Huawei's Smart I-V Curve Diagnosis identifies string faults, evaluates power loss, and recommends repair solutions while completing full online inspection of a 100 MW power plant in just 15 minutes. The diagnosis enhances operation and maintenance functions while increasing power generation. In Malaysia, about 2,000 hours of workload are saved every



Huawei's Smart I-V Curve Diagnosis can complete full online inspections of 100 MW solar projects in just 15 minutes.



Huawei's optimizers allow for PV systems affected by shading to reduce their losses, which can go as high as 50% in some scenarios.



Huawei's C&I inverters are configurable in anything from two to 10 MPPT setups for PV array deployments with voltages of 1,100 V to 1,500 V (DC).

year on a 30 MW project by using the curve technology.

PV safety

Huawei has developed its innovative Smart String-Level Disconnecter Technology (SSLD-TECH) which minimizes the safety hazards of direct-current faults, enabling a total shutdown in milliseconds to prevent system failures or damage. Germany's TÜV SÜD, IEC 60947-2, and China's certifications ensure PV plant safety compliance.

In early 2023, the SSLD-TECH system received low-voltage circuit breaker certificate IEC 60947-2 from DEKRA and Intertek. Huawei became the first vendor to be certified for the smart string shutdown technology. The SSLD can accurately identify faults from the DC side of PV systems such as reverse polarity connection, backflow current, and short circuits, and it can implement automatic string-level shutdown in milliseconds, which rapidly improves the safety capability of PV plants.

Developed by Huawei, the intelligent grid connection algorithm enables a PV system to be adapted to various grid scenarios, improving voltage and power control functionality. At a low short circuit ratio of 1.2, its grid-forming function ensures the inverter runs at full power without derating and successfully passes through high and low voltage continu-

ously, delivering a 30% increase in new energy access.

Intelligent boost

Huawei's arc fault circuit interruptor (AFCI) solution supports a detection range of 200 m for inverters to detect signals in all scenarios. The detection range of the conventional AFCI solution is only 80 m. Equipped with DC arc detection and emergency disconnection, Huawei's Smart PV Solution cuts off faults with high precision and provides fast response for enhanced safety.

Huawei used the software algorithms of weak grid operations in PV arrays and, using big data to train the optimal grid connection control algorithms, ensures seamless and consistent solar inverter generation. Its Intelligent Boost solution for impedance reshaping integrates multiple algorithms for dynamic damping for series compensation and active harmonic suppression. The Intelligent Boost system has made a notable difference in large, multiple megawatt PV systems, remote projects, and areas with weak grids.

The company's Pinpoint Arc Fault Positioning report leads to problem resolution within a single solar cell among a large, 100 kW rooftop solar array, providing a smartphone-readable solution that, under manual detection, would require up to two days to locate in the same solar array.

Smart String ESS

Huawei's Smart String energy storage system (ESS) addresses limited capacity, short service life, complex O&M, and the inherent safety risks of conventional energy storage. The company's ESS system uses a smart string structure that integrates digital, power electronics, and energy storage technologies, overcoming traditional limitations associated with lithium-ion batteries. This system utilizes pack- and rack-level optimization, distributed cooling, and modular design, enabling full battery charging and discharging potential and providing an optimal leveled cost of energy for solar projects.

The ESS system offers comprehensive safety with four layers of protection covering cellular short circuit detection, pack-level safety shutdown, overcurrent protection, and fault isolation, as well as smart fire suppression over the ESS system.

Use case results

A 29.96 MW Nissan solar carport in Guangzhou, China, deployed with Huawei's FusionSolar two-stringed maximum power point tracking (MPPT) solar PV and storage system, resulted in a 1.69% power yield increase over a six-month case study, while adhering to stringent standards for grid-connected PV systems. [pv](#)

A shiny home with a smart

The use cases for residential PV systems are as versatile as the homes they power. But the requirements for system safety, quality, and functionality are very similar, whether for a large family home on the northern sections of the Rhine River in Germany, or a building-integrated PV solution on a terracotta roof in sun-kissed Italy.

“Choosing the correct battery is essential for running a safe and reliable installation”

In the town of Xanten, Germany, where the Rhine River flows into the Netherlands, a big white family home features a new PV system. The house belongs to Svenja Woge, CEO of PV wholesaling business Varus Energy, and she is visibly pleased with her decision to install the 11 kW PV system on her family home’s roof. With the unique roof structure featuring dormers and multiple pitches and the load profile of the three family members, she chose a set of two Huawei inverters with power capacities of 5 kW and 6 kW, as well as a 10 kWh Luna storage battery, also provided by Huawei.

“We definitely needed the storage battery because we have a heat pump, and we want to charge our electric vehicle with the PV system,” says Woge. EVs and heat pumps are becoming commonplace in Germany and Europe, resulting from an uptick in residential PV adoption. Between January and May 2023, 55% of newly built homes in Germany installed heat pumps. It is a similar story with EVs: Last year, more than 800,000 new electric cars were registered on German roads, representing 59% year-on-year growth.

Storage needed

Owning a PV system means energy independence and subsequently lower household energy cost. The financial benefits of using an EV come into play when it is charged at home using the rooftop PV system as the primary energy source. A storage battery allows charging to take place in the evening hours, minimizing the need for grid power and further reducing the cost of using an EV. Choosing the correct battery is essential for running a safe and reliable installation. The Luna battery Woge uses features energy optimizers for each battery module, which increases the available energy capacity of the battery.

“For me, it was important that if the power goes out, we want to make sure our computer and phones keep running,” says Woge. Huawei’s inverters can also supply

home loads without the grid. Not all inverters can achieve that, as they need to create their own 50 Hz grid in the house and keep it stable. Svenja Woge and her family will not even notice that a power outage occurred.

Smart scheduling

Apart from safety and compatibility, Woge says she chose Huawei because the FusionSolar app that manages the various units is straightforward to use. Owner configuration is necessary since, for example, an electric car can be charged from the PV system, the battery, or the grid. Sometimes, an owner may want a slower or partial charge using only PV to save cost and use carbon-free electricity. In other instances, a fast and full charge is necessary. The app also lets Woge get an overview of her system’s energy yield, storage level, and even carbon emission savings.

Combining components from one supplier allows for a deep level of system integration, which benefits the array’s overall efficiency. Huawei says machine learning algorithms can even predict energy consumption patterns and include these patterns in its smart scheduling, which can help boost self-consumption rates up to 95%. Including weather forecast data and learned consumption patterns, the ecosystem can decide to delay EV charging to a more opportune moment, when PV power is available, rather than commencing to charge as soon as the cable has been plugged into the car.

Optimal yield

To generate the most energy from the rooftop system, all modules should ideally have the same tilt. Svenja Woge’s roof, however, features multiple pitches, dormers, and chimneys, creating a challenging environment. If only one PV module in a string is partially shaded, its power loss drags down output for the entire string. All other modules in that string

approach to sustainability

Photos: Huawei



With built-in optimizers, a battery achieves cell-level protection from electrical failures, such as overcharging, overcurrent, or overvoltage.

will reduce their power level to match that of the weakest module in the string.

This effect can be overcome with the help of power optimizers. These devices are fitted behind each module, where they individually modulate the DC power for each module. It is a module-level optimization. Huawei says deploying its optimizers will likely increase energy yield by 5% to 30%.

High safety and chic design

Battery safety is also a concern among homeowners, so choosing the correct battery should include consideration of the device's protection level. With built-in optimizers, a battery achieves cell-level protection from electrical failures, such as overcharging, overcurrent, or overvoltage. A battery should also come with a high level of ingress protection to prevent dust particles or humidity from reaching the interior, which can cause short circuits or even corrosion of critical parts. Huawei's Luna battery features IP 66 protection, meaning that the casing is dust tight and will withstand powerful waterjets.

International standards for PV plant safety are considered an essential requirement for PV manufacturers and equipment suppliers. Currently, there are

relevant DC arc detection and shutdown standards, such as UL1699B-2011, UL1699B-2018, IEC 63027, and CGC/GF 175:2020.

Arc Fault Circuit Interrupter (AFCI) devices are critical to keep homes safe, as electric arcs pose a severe fire risk. In the past, arc fault detection devices struggled to identify arcs. Huawei has leveraged its technology capabilities to achieve a detection scope, precision, and shutdown response time that matches the norm of a CGC/GF L4 level arc protection. An industry first, says FusionSolar.

Should something still go wrong, FusionSolar's inverters in combination with the optimizers provide module-level rapid shutdown. In the event of a detected fault the array de-energizes in no time to safety voltage, ensuring the safety of any firefighting personnel handling water around the array.

Lastly, Svenja Woge had one more consideration. Like a piece of furniture, the smart power system is visible inside the house. "I think the design of the inverter is ideal because it is not very conspicuous; it looks chic and isn't bulky," says Woge. "You could set it up in your hallway or living room; I really think they look great." [pv](#)



With optimizers connected to each PV module, installations covering multiple rooftop pitches and orientations are easy to manage.

Safety evolution for

As utility-scale solar installations proliferate and PV plants grapple with ever increasing capacity, inverter technology is evolving to incorporate intelligent fault detection capabilities, with Huawei leading the way.

With global energy costs continuing to rise, and the negative effects of climate change becoming ever more visible, it should come as no surprise that utilities have steadily been turning to renewable energy solutions. According to the latest report by the International Renewable Energy Agency (IRENA), the total global capacity of installed PV passed 1 TW at the end of 2022. Additionally, the International Energy Agency noted in its September 2022 solar report that utility-scale plants were responsible for 52% of global PV capacity additions in 2021.

As the currents and voltages in PV systems increase, and the technology finds more complex and diverse application scenarios, industry-wide attention is shifting to safety. When it comes to PV plant safety, multiple issues spring to mind, including electrical safety, grid-connection safety, power supply safety, cybersecurity, and ecological safety. Electrical safety is also a key concern, and often a top priority, as it is closely related to personal safety for staff and technicians, and potential damage to plant infrastructure.

There are many types of electrical faults

Huawei inverters perform multi-level protection based on the accurate perception of system current, voltage, resistance, and temperature.



Photo: Huawei

utility-scale PV

that can occur in a PV plant, including issues with grounding, insulation, DC reverse connection, terminal contacts, short circuits, and arcing. To prevent serious accidents and lengthy power interruptions, it is important for inverters to be able to not only detect faults, but also to communicate exact locations to enable speedy repairs.

Traditionally, inverters detect current and voltage at the string level. However, traditional inverters cannot determine the specific point when ground insulation failures happen – this needs to be performed manually. Troubleshooting becomes more difficult and time-consuming with utility-scale systems as the power of PV inverters and the number of PV strings increase.

Built-in safety

With its innovative inverter design concept, Huawei integrates digital technologies to diagnose the status via the changing trend of a PV system's current, voltage, resistance, temperature, and other characteristics. Huawei's FusionSolar Smart String PV inverters outperform traditional inverters when it comes to safety features, particularly due to their comprehensive safety protection design.

Ground insulation failure is a common fault in PV plants, especially in damp areas such as sea surfaces and drainage basins. Huawei's MPPT-level DC insulation diagnosis technology greatly improves location accuracy for insulation faults, as it enables inverters to scan the insulation of each MPPT circuit. In addition, the technology significantly shortens the time to locate faults, using intelligent detection to find voltage changes, even if faults occur on a single point.


Most faults in PV plants happen on the DC side, which is why Huawei's Smart String-Level Disconnect technology (SSLD-TECH) implements string-level protection and active disconnection on the DC side. The SSLD-TECH consists of three parts: an inverter detection and logic judgment system, a tripping control system, and a DC switch system. The SSLD-TECH can accurately detect and identify different faults based on changes in characteristics such as current and voltage, and

it can trigger shutdowns in milliseconds to protect system safety.

As the current of PV modules and the power of single inverters continue to increase, harmful arc faults are becoming common. The FusionSolar inverter's integrated algorithm package aids in arc detection on the DC side, featuring noise adaptability that can distinguish between arcs no matter the environmental noise. Additionally, the smart arc fault circuit interrupter (AFCI) feature can support a maximum maximum input cable length of 200 meters and rapid shutdown within 0.5 seconds. In 2020, the solution obtained the highest L4 certification issued by the China General Certification Center. The feature was widely adopted in Huawei's solution for distributed PV scenarios, and it will also be introduced into the utility-scale PV scenario in the future.

In traditional inverters, loose or damaged connections can occur because the DC connectors are fixed on external mechanical parts and are routed through cable harnesses and DC switches until they reach the printed circuit boards (PCBs). Huawei's innovative on-board connector design, where connectors are directly soldered on PCBs, reduces the risk of poor DC connector connection, which can cause damagingly high temperatures. Huawei's Smart Connector Level Detection technology (SCLD-TECH) can accurately detect temperature increases due to connection problems and trigger an automatic shutdown to protect the safety of the whole system.

Industry recognition

Huawei's leading technologies related to smart safety, such as SSLD, smart DC arc detection, and Smart I-V Curve Diagnosis, have been recognized and applied in the industry. For example, the new generation of Huawei SUN2000-330K-H1/2 inverters recently won the 2023 Intersolar Award, and it was the only inverter among the three winners. In utility-scale scenarios, Huawei recognizes that using digital technologies to achieve active safety is an inherent requirement for the healthy development of the entire PV industry. 

“The SSLD-TECH can accurately detect and identify different faults and can trigger shutdowns in milliseconds to protect system safety”

Optimizing for the future

Guoguang Chen, president of the Smart PV and ESS Business at Huawei Digital Power

Photo: Huawei



Our new slogan – “Making the Most of Every Ray” – captures the essence of what we aim to achieve with FusionSolar products. The FusionSolar brand embodies our core concept of converged innovation and its pursuit of making the most of every ray, in order to provide more value for customers, partners, the industry, and society.

The use of optimizers with the latest electronic functionalities is crucial in our approach. Rooftops vary in shape, angles, and shading.

Our optimizers, with integrated safety features including rapid shutdown, enable the full use of rooftops and ensure high yield for commercial and industrial (C&I) applications. Furthermore, our inverters offer arc fault protection, allowing for higher voltage and current handling.

Battery technology advancements offer flexibility in charging, discharging, and power conversion systems. This ensures a range of backup time spans, even in extreme cases, such as the 10-hour outages that occur in South Africa.

For the utility sector, our focus is on grid-forming technology, which can play a crucial role in achieving a renewable energy mix of 60% or even higher. In looking at industries that consume high amounts of energy, deploying PV on rooftops alone might not suffice. Therefore, to achieve 100% green power and safe con-

sumption, it becomes necessary to also tap into virtual power plants. That’s why we provide a one-stop solution that includes building-integrated PV to utilize every possible surface for generation.

In the C&I sector, we recognize that each industry has its unique requirements and we strive to meet those demands through continuous improvement and innovation, particularly in the use of optimizers. For the residential sector, we’ve upgraded our technology and increased battery capacity so that homeowners can achieve near 100% self-consumption of green power, even during power outages or when the grid is unavailable.

We’ve observed PV’s significant impact on expanding off-grid applications, which is why our FusionSolar technology is applicable to both on-grid and off-grid scenarios. We want to bring the power of the sun to any location, regardless of grid connectivity.

We are even expanding beyond rooftop applications to wall installations and gardens, utilizing any sunlit space as a potential resource.

To really achieve the vision of making the most of every ray, it is vital to look holistically at the entire range of available spaces on which the sun shines, taking advantage of every usable square meter of every surface and creating the technology that will help us optimize our way to a 100% clean energy future. [PV](#)

Fusionsolar

FusionSolar Residential Smart PV Solution A Home that Always Shines

Shine on Active Safety | Shine on Full Journey Convenience | Shine on Energy-using Prospect




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Fusionsolar

FusionSolar for A Sustainable Business

Active Safety | Optimal Electricity Cost | Intelligent Power Usage
High Reliability | Smart O&M

