Photo: Huawei

Remote monitoring and digital communication between devices are key capabilities pushing higher energy yields from PV plants.

The inevitable path to solar grid parity

Digitization: With the next round of China's Top Runner Program pushing efficiency and energy yield requirements ever higher, digitization – enabling cooperation between intelligent systems – is emerging as a vital development in the industry. Huawei's smart PV solutions have an important role to play here as well.

"In 2017, solar PV achieved grid parity in a number of countries and regions, including India, Latin America, the Middle East, and Africa. The progress is largely attributed to the favorable natural conditions of these regions. To catch up, China still faces huge challenges. Our goal is quite clear: to achieve solar grid parity by developing technologies," said Tony Xu, President of Huawei Smart PV Business, as he shared his thoughts on the key to solar grid parity in China at a seminar on the country's Top Runner Program.

With the first demonstration base established in Datong in 2015, the Top Runner Program has since been rolled out to achieve its original goals: Accelerate the application of new technologies to markets, develop PV technologies and PV industry upgrades; reduce the cost, electricity price, and subsidy for PV generation; and reach grid parity.

The program is now paying off in the preliminary stage by promoting manufacturing technologies and reducing the electricity price. Going forward, digitized and intelligent products and technologies are expected to lead a new round of development in the PV industry.

Simple and efficient

"Many Top Runner Projects need to deal with great challenges posed by natural conditions, including undulating terrain, scattered landmass, and ongoing mine subsidence," says Jian Zhaohui, Deputy General Manager of Power China Guizhou Engineering Corporation. Overcoming such challenges requires high standards from solutions and products. "We prefer inverters that offer a long life cycle, high conversion efficiency, and easy, quick maintenance. The monitoring system should provide proactive reporting, smart analysis, remote monitoring, central management, open interface, and continuous capacity expansion."

Smart inspection, for instance, has huge advantages over manual troubleshooting. According to Pei Yongfeng, Chief Electrical Engineer at Zhongtai Power Plant of Huaneng Shandong Power Generation Limited, the annual energy yield of the Xintai 100 MW solar-agricultural project could rise by 2.433 million kWh, thanks to the Smart I-V Curve Diagnosis function provided by Huawei FusionSolar Smart PV Solution.

Xu says, "With the technology advancement and rapid expansion of scale, the upgrade of PV power generation has transformed from componentled to system-led." He agrees with Wan Hong, Chief Engineer at the Design General Institute of Golden Concord Group Limited (GCL), when he says that smart PV plants should adopt system-level upgrades for future development. For example, a simple circuit system with digitized lights would not make much difference if the switch is not digital. Digitization requires full integration.

Xu explains, "Likewise, the previously interdependent PV module, inverter, and mount cannot sense [each other] or integrate with one another. In this way, the angle of the mount can hardly be adjusted to the geographical location and astronomical algorithm. When bifacial modules are put into use, a fixed algorithm does not work anymore because the reflection varies with the surface, and the intensity of sunlight also varies with the height of the module. The traditional inverter cannot collaborate with the tracker either. To increase energy yield, we should combine the inverter and bifacial module with the tracker by digital integration." According to Xu, the combination of the three devices will be a major achievement of digitization in the next phase of the Top Runner Program.

"The first step is to replace the power supply and communication devices with the string inverter, which will improve reliability, optimize general investment, and most of all maximize energy yield."

Intelligent integration of the tracker and inverter has taken effect in the Huaneng Xintai 100 MW solar-agricultural project. According to Pei, it reduces the workload of building communication and power supply circuits, as well as the communication failure rate.

The capacity of a single PV array is 1,750 kW. Using the Huawei smart string inverter can cut the construction cost by CNY 0.02/W ($0.003) by sparing the dedicated power and communications cables for trackers. According to Wang Mengsong, Product Director at LONGi Solar, joint verification projects have been launched in Xinjiang, Heilongjiang, Guangdong, and Shaanxi to test the performance of bifacial module and string inverter integration at different latitudes, surfaces, and sunlight conditions.

On most occasions, the ground surface for a bifacial module cannot be chosen. "The ground reflection index varies with the season, since grass grows in summer and withers in winter. There is no way to adjust the angle of the tracker by any algorithm. The digital string inverter, however, can detect the optimal power given a reflection index. The module can also send the real-time power back to the inverter. Then the angle of the tracker can be adjusted by an adapting algorithm."

Digital integration enables interworking between systems. As for the seamless integration of the inverter, tracker, and bifacial module, Huawei has been a leader in the industry. Based on big data platform analysis, it has developed a leading smart design toolkit for the bifacial module. The toolkit combines an all-scenario, adapting and auto-learning "bifacial module + tracker" smart algorithm with the most efficient PV module maximum power point (MPP) intelligent tracking algorithm. Compared with the normal solution design, the toolkit helps reduce the electricity cost of a PV plant by CNY 0.08/W and raise the energy yield by more than 3.9%.

Raising the system energy yield

Xu uses a metaphor to illustrate the importance of reliability to digitization: "We use a kettle basically to boil water. To make it smart, we install a sensor and turn it into a digital kettle. If the sensor often breaks down and we can't even boil water, no one would appreciate this type of digitization. The tracker is not widely used, mainly because the motor has a high fault rate. It is our ultimate goal that the machine serves the human, not the other way around."

"A Top Runner project in Wuhai, Inner Mongolia, is located in a mining subsidence area with unstable terrain and large dust emission," says Wan of GCL. "It adopted the Huawei string inverters with a high protection level and wireless transmission to adapt to the terrain. The project has maintained a device fault rate lower than 0.5% and an energy yield rise of more than 2%, reducing the device maintenance workload."

"To be a top runner, a PV plant should focus on efficiency. For long distance, however, it should put priority on reliability, which is determined by the device fault rate," adds Ji Zhenshuang, Deputy Director of the China General Certification Center. The center collected the data of 150 PV plants for reliability analysis in the first half of 2017. "Taking the inverter for example, the energy yield loss rate incurred by faults is around 1.5% on average, and 0.5% for some quality products. The industry benchmark, represented by Huawei, is below 0.3%. So there is still plenty of room to improve reliability or reduce the loss rate incurred by faults."

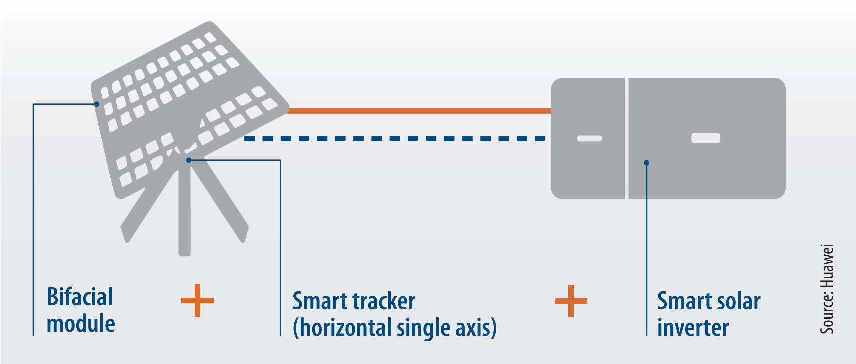
With regard to the reliability of the PV plant monitoring system, Ji says, "We usually evaluate the system function by the completeness rate of the monitored items and data collection. The figure is 85% for the industry's average level, but more competitive companies like Huawei can reach above 95%."

In December 2017, China's National Energy Administration released the project list of the third-phase Top Runner program, including 10 application bases.

It is required that the bases started the bidding by March 31, 2018, start the construction by June 30, and complete the capacity building and connect to the power grid by December 31, 2018. The three deadlines for the technology bases are April 30, 2018; March 31, 2019; and June 30, 2019.

The third-phase Top Runner program is about to begin. With a total capacity of 6.5 GW and more projects involved, the scenarios will be more complicated. Digitization and intelligent components are driving the optimization and development of the PV ecosystem. ◆

Intelligently integrated PV system diagram



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