

Private 5G networks and edge data centres are transforming renewable energy production in Sichuan

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To combat the effects of climate change, almost two-thirds of electricity needs to come from renewable sources by 2030, requiring an increase in renewable generating capacity of 12% each year – double the current rate.¹ Consequently, around USD4 trillion a year needs to be invested in renewable energy until 2030 to allow the world to reach net-zero emissions by 2050.² Investments in technology and infrastructure are critical to this effort.

Recent geopolitical and economic crises have put pressure on global energy supplies, with costs unlikely to return to pre-2022 levels. These pressures have intensified the efforts of policy makers in many countries to encourage the exploration and investment in domestically produced green energy solutions. According to the International Energy Agency (IEA), more than 500GW of renewable generation capacity will be added in 2023; a new record.³

China has positioned itself as a world leader in renewable energy; it nearly doubled its hydropower, solar and wind capacity between 2022 and 2023. The Sichuan province is important because it has an abundance of renewable energy resources, and has been at the centre of developing new hydropower plants over the last decade. The province is home to 4063 hydropower plants with hydropower installed capacity of 89.47 million kilowatts (30% of China's total hydroelectric generation). The province relies on hydropower for 81.6% of its total electricity production, and it generated 3.6 times more electricity in 2022 than Sweden's total electricity consumption in the same year.

However, there are challenges; the installed hydropower capacity is growing in Sichuan, but the average number of operating hours of the plants has decreased, leading to an increase in unused hydropower resources. To tackle this problem, networking vendor ZTE has partnered with a national telecoms operator to deploy a range of networking and data-centre solutions to improve the utilisation and management of renewable energy in the province.

ZTE's edge data centres are increasing efficient use of Sichuan's hydropower and reducing emissions

Most of the hydropower stations in Sichuan are small and located in remote, difficult-to-access areas. This presents challenges in terms of operations management and the efficient use of generated power.

To overcome these challenges, ZTE has worked with partners to deploy low-cost edge data centres, which are housed in shipping containers at the remote hydropower plants. These data centres can use renewable electricity that was previously wasted, by converting the local power to compute power. This power is then relayed via

¹ International Energy Agency (October 2023), [The World Energy Outlook 2023](#).

² United Nations, [Renewable energy – powering a safer future](#).

³ International Energy Agency (October 2023), [The World Energy Outlook 2023](#).

fibre-optic cables to the computing power network. So far, over 100 of these data centres have been deployed, with plans to increase this number to 30 000. Compared to using China's coal-dominated national grid, this solution could save as much as 5.83MtCO₂ per year when applied to 30 000 centres, each using 23.4kWh of electricity annually, because electricity produced by hydropower does not emit greenhouse gases.

The collaboration also targets benefits in operational improvements and plant safety

The benefits of the project go further than increasing hydropower efficiency and utilisation. In return for renewable electricity for their edge data centres, ZTE and its operator partner have implemented 5G private networks (using a hybrid cloud architecture) at several hydropower plants in Sichuan, helping to improve operational efficiency and safety, while also reducing the need for on-site personnel. The private networks are planned and optimised using several of ZTE's solutions and technologies including the following.

- A 5G ultra-long-range connectivity system delivering coverage of up to 60km. The solution greatly reduces network infrastructure requirements, which is valuable when deploying hydropower plant networks in remote and rugged terrains. The solution also integrates 5G+GPS positioning technology, contributing to the safety of on-site personnel by tracking the location of workers and alerting authorities in emergencies.
- 5G-enabled drones and robots are used to automate inspections and surveillance checks at the hydropower stations. For instance, 5G-enabled underwater robots can capture pictures and videos of the hydrodam walls, which can be transmitted in real time to control centres via 5G networks. This helps to identify areas of the walls that require repair, enabling an immediate response and reducing the need for manual inspections. This can reduce the time to undertake, and cost of, inspections by up to USD96 000 a year. The 5G-enabled drones can build 3D maps of the dam surface to further aid inspections. These 5G-enabled technologies have improved the efficiency of hydropower station monitoring by up to 70%.
- The PowerPilot Pro, an intelligent and self-adaptive energy-saving solution, uses AI and big data technology to put base stations into deep hibernation (with standby capacity of less than 5W) when there are no drone inspections taking place, helping to reduce the energy consumption of the network significantly.

5G private networks are also helping to boost the productivity of photovoltaic factories in Sichuan

In addition to hydropower, Sichuan is a major producer of crystalline silicon photovoltaic cells, a highly efficient solar technology. By 2027, Sichuan aims to be a global leader in producing these cells, targeting revenue of over USD70 billion. To boost the efficiency of solar production and contribute to reaching these goals, ZTE has deployed 5G standalone private networks within Sichuan's silicon photovoltaic factories. These networks enhance the efficiency of in-factory logistics by supporting the following.

- **Ultra-low latency.** Many core factory operations are enabled by automated guided vehicles (AGVs), which require ultra-low-latency connectivity. Photovoltaic factories in Sichuan are using ZTE's 5G time-sensitive network (TSN) to support customised AGVs and management systems, enabling the AGVs to respond promptly to changing environmental conditions and unexpected obstacles. This has increased the dispatch efficiency of the factories by 50%. Deployed at the edge of the network, 5G TSN also achieves ultra-low jitter within a few microseconds.

- **Ultra-high reliability.** Wireless links can be degraded by signal fluctuation and interference. To improve the reliability of data transmission during production, the 5G network incorporates ZTE's frame replication and elimination for reliability (FRER) technology, which sends data in two independent user plane channels to avoid service interruption if one channel fails. Coupled with dual-band Wi-Fi, the FRER solution achieves 99.999% reliability.

Since the deployment of 5G private networks, the productivity of photovoltaic factories has increased by over 10%. With the capacity enhancement facilitated by 5G, the industry could increase renewable energy capacity by tens of gigawatts.

ZTE's collaboration provides an interesting case study of how 5G technology can be an enabler for the effective utilisation and generation of renewable energy. However, the impact could be felt well beyond Sichuan because the technology can be replicated to support similar operations in other regions and countries, and can be adapted to support other renewable energy scenarios.

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