

What is the prospect of solar photovoltaic power generation



Overview

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Solar photovoltaic (PV) technology is indispensable for realizing a global low-carbon energy system and, eventually, carbon neutrality. Benefiting from the technological developments in the PV industry, the levelized cost of electricity (LCOE) of PV energy has been reduced by 85% over the past decade. Today, PV energy is one of the most cost-effective electrical power sources worldwide. For instance, a PV power price of merely 0.0104 USD·(kW·h)⁻¹ was achieved in Saudi Arabia in April 2021. In the coming years, innovative technological developments should help further boost the PV power conversion efficiency (PCE), reduce the PV energy cost, and expand the PV industry. With the ever-increasing proportion of PV in the energy system, the challenges posed by the regional intermittence and randomness of PV energy will manifest and provide opportunities for new technologies, including the integration of PV with other forms of energy and/or various energy storage techniques. We believe that, in the long term, extended PV systems with the active participation of green hydrogen energy are key to the deep decarbonization and sustainable development of our society. High PCE and low LCOE, which ensure the competitiveness of PV energy, rely extensively on the development of PV technologies. Wafer-based crystalline silicon (c-Si) solar cells have been the dominant PV technology since the 1960s and are still undergoing considerable progress, with multiple technological breakthroughs in both academia and the industry over the past decade (Fig. 1,,,). For example, in research, the charge carrier-selective contact—that is, the tunneling oxide passivating contact (TOPCon, also called polycrystalline silicon on oxides (POLO)), initiated by Fraunhofer ISE in 2013, —shows enhanced surface passivation and carrier extraction, compared to th...

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