Harness the sun

Words: Justin Kolbe, Director of Market Strategy for Power and Industrial Automation at Henkel

Henkel is dedicated to developing materials that offer formulations, which support sustainable practices for solar system developers. This commitment stems from its belief that the reliability of power conversion and energy storage is crucial to harnessing the advantages of solar power.

Human flourishing depends on three things: water, food, and energy, and their affordable access. Energy, the final component in this interconnected system, plays a crucial role in the effective acquisition, advancement, and dissemination of the remaining two elements. Accessible energy is not universally available, and there is room for improvement, even in developed nations with established energy grids. There is significant potential for enhancing the efficiency and sustainability of energy generation and utilization. Alternative energy sources contribute to the equity and economic puzzle, providing renewable solutions in less-developed areas and supporting advanced energy distribution infrastructures with regenerative sources.

Nature's abundant energy, saved for later

Our amazing planet produces, and renews, its energy from multiple sources, including wind, sun, water, biomass, and geothermal. Arguably, the two most publicised renewables are wind and solar, both of which have seen steady growth, though the energy generated by wind has consistently outpaced solar for three decades.

Nonetheless, solar panels are considerably more practical for office buildings and residential purposes, thanks to various factors, most notably their size and virtually maintenance-free nature in comparison to turbines. Because the sun isn't always shining, capturing its direct current (DC) via solar panels, efficiently converting it to usable alternate current (AC), and then storing it for use when required is what makes solar viable.

And all those systems working reliably for a long time is what makes solar efficient, effective, and affordable.

The inverters and optimizers, which are available in various types and are often not matched, are responsible for handling the DC power produced by the solar panel. Their role is to maximize the capture of energy that can be harnessed, and then they convert or invert this DC power into AC power. This converted power is then stored for later use.

There are many ways to store energy, including lead-acid batteries, lithium-ion (Li-I) batteries, and flywheels, among others. For solar, the most common storage solution is Li-I batteries, like those used in electric vehicles (EVs), mobile phones, and PCs. Their high power density ratings are why they are popular energy storage systems.

Plus, in recent years, the cost of Li-I batteries has decreased significantly, contributing to the solar efficiency equation and the list of reasons why reliable energy storage delivers tremendous value. Achieving the correct storage solution fulfils numerous objectives. One of these is economics. Peak generation rates don't often align with utilisation, so generating during abundance, storing, and selling back to the grid at high demand makes good economic sense.

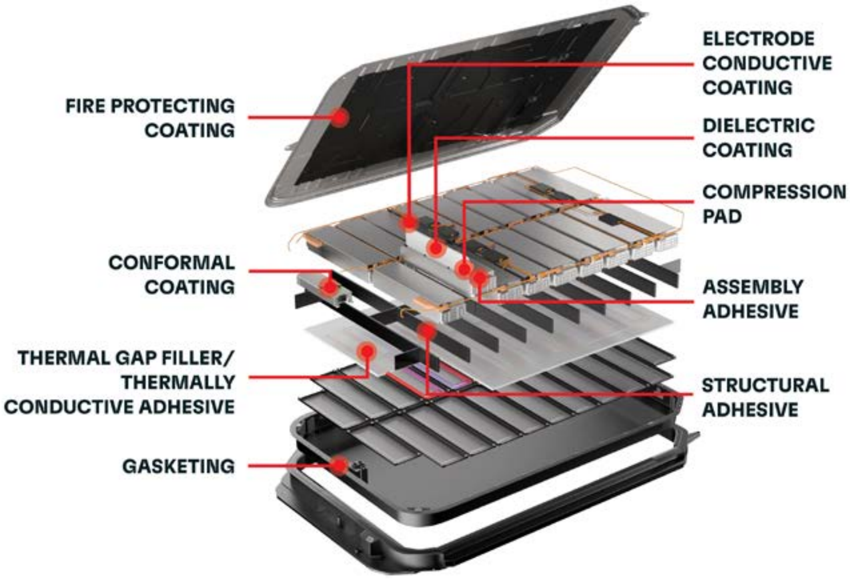
Energy security is enhanced to, and in regions with unstable grid systems, an alternative source as a backup is vital.

It also delivers better resilience. Even in industrial countries, the loads on energy grids are immense. As demand continues to increase with the addition of EV charging infrastructure and more, alternative energy sourcing and reliable storage help build resilience and robustness into the grid.

Durability and duration

Improving solar energy efficiency and system longevity are key drivers to lowering costs and encouraging widespread adoption. Inverters and battery storage systems have led the charge. Photovoltaic inverters were among the first adopters of gallium nitride (GaN) wide bandgap semiconductors (WBGS) for power conversion.

The redesign of inverters with WBGS technology has enabled substantive efficiency gains, allowing operation at higher voltages, currents, and temperatures. Li-I battery designs have also progressed, delivering higher power densities than their



predecessors. Advances like these in power switching, storage performance, and dependability improvements are critical for future solar energy success.

With solar arrays expected to last 25 to 30 years and battery storage systems pushing 15 years in some cases, strategies to improve dependable operation and keep elements like dust and moisture out are essential. System design innovations are made even more impactful by performance-enhancing and protective materials integrated to optimise function, safeguard against harsh outdoor environments, and facilitate reliability for lifetime expectancy.

For example, thermal management solutions are vital for high-performance power conversion and storage. WBGS run at much higher voltages with very high power densities, necessitating effective heat dissipation. Li-I batteries' charge and discharge rates also generate substantive heat, requiring displacement of that thermal load to avoid catastrophic events.

Thermal interface materials are the go-to heat-dissipating solution, enabling thorough heat transfer away from heat-generating components. Likewise, gasketing and sealing materials ensure structures and systems, located in outdoor, unpredictable environments, inside the housing remain robust and protected against the elements by allowing service access, while filling gaps to prevent ingress.

Over the horizon

Photovoltaic energy has proven its effectiveness and will continue to expand as an essential piece of the energy supply puzzle. What happens, though, when a solar array's useful life is complete? Recyclability is clearly the next big hurdle for solar. With more than 850 GW of solar capacity installed globally, a viable recycling strategy is imperative.

Extending the lifetime of solar arrays through reliability and protection improvements has aided in the sustainability of the technology. Indeed, on the materials front, there is progress in this area. Our company, for example, is committed to innovating materials that provide solar systems developers with formulations that support sustainable practices.

Examples include isocyanate-free gasketing materials that reduce exposure to substances of very high concern (SVHCs), using renewable carbon-based feedstocks to replace fossil fuel-based polymer systems, and developing chemistries that enable circularity. Circularity, repairability, and recyclability are the next bridges to cross for solar evolution. The world must contend with the realities of solar panel, and wind turbine, too, for that matter, end-of-life.

Henkel materials have been central to ensuring optimised solar power conversion, storage efficiency, and system reliability, contributing significantly to alternative energy's advance. We hope to be part of the re-use and safe disposal solution, too, for the good of generations to come.

www.henkel-adhesives.com

About the author

Justin Kolbe is Henkel's Director of Market Strategy for Power and Industrial Automation within the company's Adhesive Technology business unit.

He is focused on setting broad strategic guidance and market insights.

In 1996, Kolbe joined The Bergquist Company, acquired by Henkel in 2014, as a Process Engineer and has since worked in various capacities including process development, applications engineering, R&D and marketing.

A chemical engineer by training, he has extensive experience in thermal management solutions and electronic materials development and processing.

With an impressive professional track record and a long history of providing reliable solutions for customers in multiple markets including power conversion, automotive, industrial automation and power electronics, Kolbe is passionate about ensuring Henkel materials not only deliver on performance, but also on cost and sustainability objectives.

Based in Henkel's Chanhassen, MN facility, Kolbe holds a Bachelor's degree in Chemical Engineering from the University of Minnesota.