Simarpreet Singh, director and CEO, Hartek Solar Pvt Ltd, shares his insights on the battery technology trends in the renewable energy space, as well as the challenges related to battery deployment, and more.

EB: Evaluating batteries for renewable energy systems

The first and foremost consideration while weighing one's battery options for renewable energy systems should be a thorough cost-benefit analysis. The affordability and other associated benefits of a particular type of battery will determine whether or not you should go for it. The other product specifications that merit attention are the battery capacity, power ratings, depth of discharge, round-trip efficiency, battery life and the warranty period.

The battery capacity and its power ratings would depend more on your specific needs and usage pattern. If you plan to run your entire premises on solar energy, you will need a bigger battery with higher power ratings.

The depth of discharge refers to the maximum battery capacity that should ideally be used for optimal performance before the next recharge. So, a higher depth of discharge is worth considering as it enables you to use more of the battery's capacity. Likewise, you should opt for a battery with higher round-trip efficiency as it allows you to derive maximum electricity from the power you have fed into the storage device, and thus get more value for money.

EB: The best battery for renewable energy systems

While upcoming solar parks are increasingly employing new energy storage technologies, lithium-ion batteries are still the most preferred due to their efficiency, versatility, affordability and longer life span. Backed by constant technological upgrades, mass production and declining prices, these batteries will continue to drive the renewable energy storage solutions market, at least for the next one decade.

The cost of Li-ion batteries has dropped by more than 85 per cent in the past ten years, and this trend will continue. Making room for major improvements, Li-ion batteries are fast evolving with the times. For instance, experimenting with different materials for the cathode, like cobalt, nickel and manganese, has increased the energy-holding capacity of these batteries, which are being used in electric cars and being connected to the power grid, like never before. There has been another notable technological breakthrough that has enhanced the energy storage capacity of Li-ion batteries by 20 per cent. This was achieved by fashioning a silicon based powder into an anode. With silicon able to hold more lithium than the carbon in graphite, the most common anode material, the new development helps store more energy.

EB: Technological advances in renewable energy batteries

Rapid advances are taking place in energy storage technologies. Billed as the likely successor to Li-ion batteries, solid-state batteries, which have a higher energy density and fewer safety concerns than lithium, are getting better and better. Several companies are working on improving their performance and lowering their costs. Unlike lithium batteries, solid-state batteries do not have any flammable liquid that can cause laptops or cars to catch fire. Toyota Motor Corp. is working on solid-state batteries to drive its long-range electric vehicles which can travel up to 500 miles on a single charge. Incidentally, the company has the highest number of patents for solid-state batteries. In order to meet the growing requirement for storing renewable energy on a larger scale, CCT Energy Storage, a company based in South Australia has developed the world's first operational thermal energy device which can store six times more energy than Li-ion batteries. Completely recyclable, cheaper and longer-lasting, these batteries can take any form of electrical input to convert it to thermal energy.

In yet another notable advancement, Saurea, a France-based start-up, has developed the world's first autonomous photovoltaic motor, an energy storage device that can convert solar power directly into mechanical motion without relying on power electronics or batteries. The device can operate water pumps and ventilation systems for more than 20 years, and that too without maintenance. Another promising technological breakthrough that scientists at the University of Illinois, Chicago, claimed to have achieved is the development of lithium-CO_2 storage devices which have seven times higher performance and energy density than lithium-ion devices. Overcoming the stability problems associated with the lithium-CO_2 device, scientists now claim that it remains stable over 500 cycles. Next on the cards are hydrogen-based energy storage technologies with solid-oxide fuel cells and reflow batteries, which are expected to revolutionise the market.

EB: Challenges faced in the deployment of battery systems

Apart from the challenge of keeping up with the rapid pace at which energy storage technologies are advancing, the large scale deployment and application of these technologies faces multiple challenges. To begin with, advances in energy storage technologies require innovations and breakthroughs in capacity, longer life span, lower costs and safety (applicable for electrochemical energy storage). Developing storage technologies with higher efficiency and lower costs is a formidable task in view of the high R&D expenses. Second, research in this area should focus on energy storage simulation and operation optimisation in multiple applications, which can help develop demonstration projects so as to promote the industrialisation and commercialisation of energy storage.

The other challenges facing the energy storage industry include lack of policy support in the form of incentives and subsidies, lack of standardisation, high costs, lack of clarity about applications and the unregulated market. The government should take effective steps to promote R&D in energy storage, expand the scope of its applications, establish a sustainable development model, and create a conducive environment that encourages the adoption and operation of energy storage on a commercial scale. EB