



BESS TREND WATCH

# NEW TRENDS IN BATTERY ENERGY STORAGE SYSTEM DESIGN REQUIRE ROBUST COMPONENTS



# HELPING ENSURE THE RELIABILITY AND DURABILITY OF EQUIPMENT IS KEY

Thanks to modern energy demands — and an increased focus on renewable energy sources — robust, safe, and reliable networks are needed to keep the grid connected and the power supply flowing.

Several trends in the design and manufacture of battery energy storage systems

(BESS) are impacting the type of systems and substations that your customers are demanding and the types of parts and components you need to ensure safe and reliable performance. Battery cell capacity and power density are increasing, as are BESS substation voltage levels. This

means that your customers can get more power from smaller equipment and reduced rack sizes.

Learn more about trends in battery cell capacity and power density and how choosing the right equipment can help ensure reliability and optimized operation for your customers.

## FOCUSING ON GRID-SCALE BESS APPLICATIONS

Of the four types of BESS applications (grid-scale, commercial, industrial, and residential battery systems) grid-scale systems have experienced the most significant changes in recent years. To provide the reliable grid-scale system support to successfully store and distribute the considerable amount of energy harvested from wind and solar farms, BESS substations now require greater battery cell capacity and power density than ever before. This trend has made battery storage a critical element to the success of sustainable, renewable energy sources around the world.

During energy generation and energy transmission, BESS substations are needed to regulate the consumption curve. Increasing the power density, battery cell capacity, and substation capacity means that energy from sustainable sources like solar, wind, and water can be stored longer and more effectively — reducing barriers to more widespread use.

### SUSTAINABLE SUCCESS



Increasing the power density, battery cell capacity, and substation capacity means that energy from sustainable sources can be stored longer and more effectively.



Compared to other BESS applications, grid-scale systems require rugged industrial components and connectors that can handle high power demands and harsh outdoor environments. Connectors used for consumer battery systems are not equipped to handle the demands of industry or grid-scale systems and should not be used in these applications.

When designing these grid-scale systems and choosing the right components, keep these trends in mind.



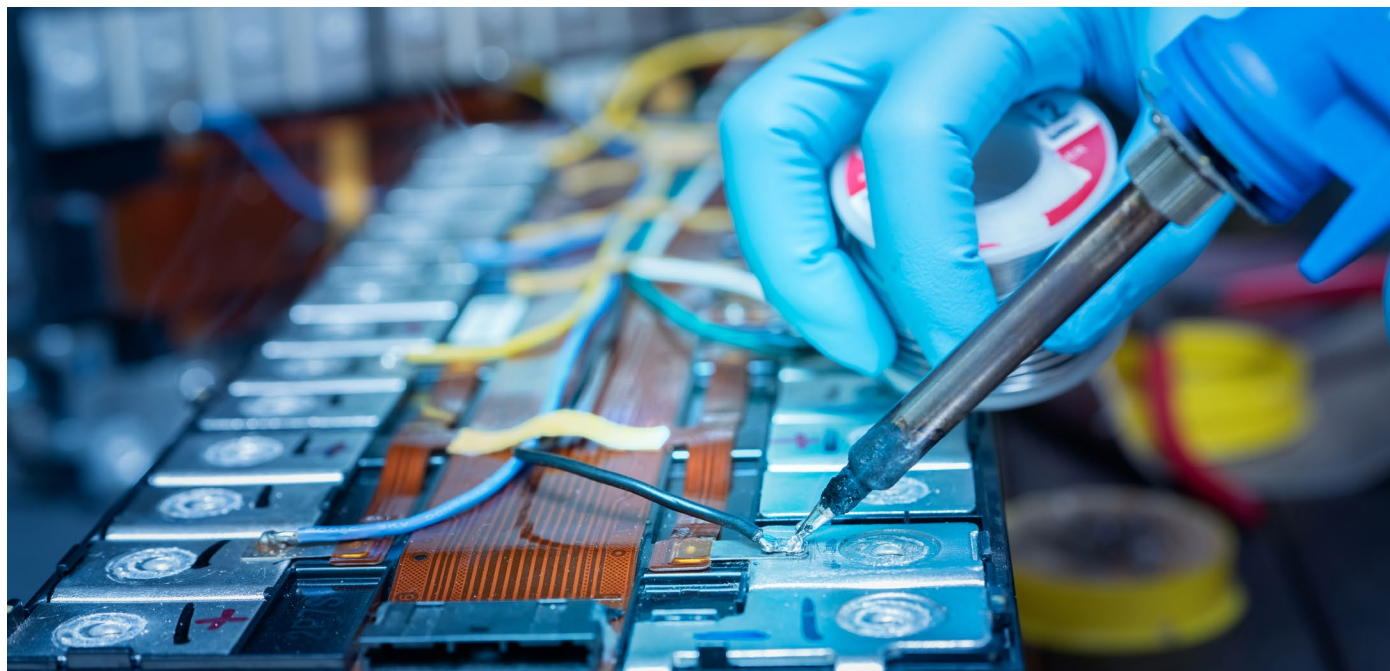
## TREND 1: BATTERY CELL CAPACITY AND POWER DENSITY ARE INCREASING

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For grid-scale systems, the market is demanding high power-range battery storage, often with a power range of more than 1 megawatt (mW) for the batteries themselves. To meet the high voltage and high current requirements necessary, battery system manufacturers must increase the power density of each battery cell. The goal is to contain more energy inside a cell without increasing the battery dimensions. This benefits your customers

because they will get more power while using the same amount of space in their storage facilities.

For system OEMs, batteries with more capacity reduce the number of components used while still producing the same energy levels, therefore reducing the overall cost. This can also simplify the installation process and save time during integration.





## TREND 2: POWER GENERATION AND SUBSTATION REQUIREMENTS ARE INCREASING

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Interconnected with the trend of increasing battery cell capacity and power density is the increase in the total voltage needed for power substations used in grid-scale systems. The greater battery cell capacity and power density of individual batteries means that storage systems at the macro level also need to increase in size, capacity, and power. System integrators are already seeing this trend. Many BESS substations in the grid-scale system are upgrading their voltages from 1 kilowatt (kW) to 1.5 kW.

This has another implication as well: more precise battery management systems (BMS). Connecting individual batteries at the substation requires a BMS. The increasing capacity of individual battery cells means that battery manufacturers and system integrators must provide a BMS that can more precisely monitor system temperatures due

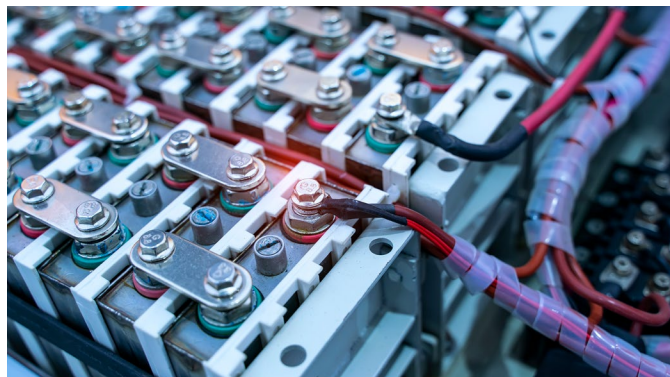
to the higher currents and voltages involved. To do this, the control unit becomes very important. Electronic components such as resistors and relays are also crucial in the performance and necessary power switching of the BMS. As voltage and current requirements of the substations increase, current and voltage ratings for DC contactors and resistors must also be upgraded. All of the components become much more critical with the high power density and high voltage of the BESS.

In addition, safety, reliability, and a longer life cycle have become even more crucial compared to systems of the past. OEMs should upgrade all elements in their systems to meet these new requirements and help ensure that the whole system is safer and more reliable for customers.

## TREND 3: SYSTEM COOLING METHODS ARE CHANGING

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In the past, simple fans and air circulation were enough to cool batteries and storage systems. But the increased power range of newer battery systems requires different cooling methods, and attention to safety becomes even more critical due to the increased system power.



Many customers are transitioning to liquid-cooled solutions to replace traditional air-cooled solutions for battery systems. However, a switch to liquid-cooled solutions may require rethinking components in the system, such as choosing signal connectors that offer added features like water resistance and humidity protection.

Liquid cooling can offer several advantages compared to air cooling, including greater efficiency and safety. Liquid cooling can also decrease costs over the lifetime of the system due to reduced maintenance. Keep in mind, however, that liquid-cooled systems have more required components and are a more expensive investment at the outset, and the systems

are more complicated to design and install — requiring more expertise and engineering capabilities upfront.

With that being said, liquid cooling is the direction of the future for grid-scale battery energy storage due to the high voltage and power density involved.

## A LOOK AHEAD AT BATTERY SYSTEMS



As the use of renewable energy grows, the ability to better store and manage this energy makes better use of it from a sustainability perspective. Therefore, the coming years will likely bring continued increases in battery cell capacity, power density, and system voltage ratings. These changes will bring cost efficiency and operating efficiency to BESS solutions.

Previous systems required transformers to convert the lower voltage from battery energy storage systems into the higher voltage required for substation energy delivery. But by increasing the voltages on the battery side, there will now be the same voltage ratings as on the grid side. This reduces waste in energy conversion and improves efficiency in the process. It also saves costs by virtually eliminating the conversion elements from the middle of the process that were required by previous systems.

Developments in the sensors used inside the BESS will also likely lead to improvements in preventive maintenance and the ability to use intelligent system information to better monitor performance and troubleshooting for improved battery system management.

**The bottom line: Your customers will see improved performance, more power and capacity, and a more efficient and cost-effective process. And components must keep pace.**

# PREPARING FOR BESS CHANGES

Ensuring that your system components and connectors can handle these increasing power demands is a key step in preparing for the changes and providing systems your customers need.

Solutions from TE Connectivity (TE) help deliver more precise BMS for heat dissipation and thermal management. Products in TE's Dynamic connector series are examples of components that excel at providing the electromagnetic resistance that these systems need for relays, DC contactors, and board connectors and the wide operating temperature range of -40°C to 140°C.

Among the new offerings from TE for BESS applications are high-power connectors with different current ratings, DC filters, and HV board connectors in the Voltron series. DC contactor options include ECK 150, ECK 200, and ECK 250, as well as ECP 150, ECP 250, and ECP 350 contactors. The latest DC filter offerings are in the TE Corcom filters EVX series, while connectors include the ERNI Voltron 1000 connectors and HPC 200 and HPC 350 power connectors.

Because grid connectivity and reliability matter, connect with TE experts today to find robust and powerful solutions that help ensure efficient, more reliable, and safe performance in your BMS and BESS offerings.

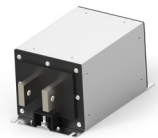
MAIN DC CONTACTORS



BOARD CONNECTORS



CORCOM DC FILTERS



POWER CONNECTORS



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