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Amid this dynamic energy landscape, energy storage may emerge as an important tool to address these challenges, potentially revolutionizing how electricity is generated, managed, and consumed. Technological breakthroughs and evolving market dynamics have triggered a remarkable surge in energy storage deployment across the electric grid in front of and behind-the-meter (BTM). Battery-based energy storage capacity installations soared more than 1200% between 2018 and 1H2023, reflecting its rapid ascent as a game changer for the electric power sector.3

Energy storage growth can be portrayed in three different eras (figure 2), driven by technological advances and progressing from short-duration solutions to a mix of short- and long-duration energy storage technologies.13

The key objective of this dimension is to minimize curtailment, maximize utilization, and optimize the use of renewable energy in electric grids by considering the following storage strategies:

Electric power companies can deploy grid-scale storage to help reduce renewable energy curtailment by shifting excess output from the time of generation to the time of need. Energy storage enables excess renewable energy generation to be captured, thereby reducing GHG emissions that would have occurred if conventional fossil fuel-fired backup generation was used. If the renewably generated electricity curtailed in CAISO in 2022 could have been stored for later use, over 534,000 metric tons (mTCO2) of carbon emissions would have been avoided.20

Deploy hybrid renewable energy + storage systems to maximize renewable energy penetration: Electric companies can maximize renewable resource penetration by installing hybrid21 systems that pair renewable generation with energy storage components. This approach could efficiently manage variable renewable generation, helping ensure electricity is delivered to the grid when and where needed.

Electric power companies can use this approach for greenfield sites or to replace retiring fossil power plants, giving the new plant access to connected infrastructure.22 At least 38 GW of planned solar and wind energy in the current project pipeline are expected to have colocated energy storage.23 Many states have set renewable energy targets or clean energy standards, and companies can more easily meet these requirements by integrating storage with renewable energy sources.

The key objective of this dimension is to enhance grid flexibility, reliability, and resilience to accommodate the growing complexity of balancing supply and demand; it could involve the following storage strategies: