

# BATTERY ENERGY STORAGE IN THE CAPITAL



Are battery storage costs based on long-term planning models? Battery storage costs have evolved rapidly over the past several years, necessitating an update to storage cost projections used in long-term planning models and other activities. This work documents the development of these projections, which are based on recent publications of storage costs.



How much does battery storage cost? The costs of installing and operating large-scale battery storage systems in the United States have declined in recent years. Average battery energy storage capital costs in 2019 were \$589 per kilowatthour(kWh), and battery storage costs fell by 72% between 2015 and 2019, a 27% per year rate of decline.



What is the bottom-up cost model for battery energy storage systems? Current costs for utility-scale battery energy storage systems (BESS) are based on a bottom-up cost model using the data and methodology for utility-scale BESS in (Feldman et al., 2021). The bottom-up BESS model accounts for major components, including the LIB pack, inverter, and the balance of system (BOS) needed for the installation.



Does battery storage cost reduce over time? The projections are developed from an analysis of recent publications that consider utility-scale storage costs. The suite of publications demonstrates wide variation in projected cost reductions for battery storage over time.



How much energy does a battery storage system use? The average for the long-duration battery storage systems was 21.2 MWh, between three and five times more than the average energy capacity of short- and medium-duration battery storage systems. Table 1. Sample characteristics of capital cost estimates for large-scale battery storage by duration (2013-2019)

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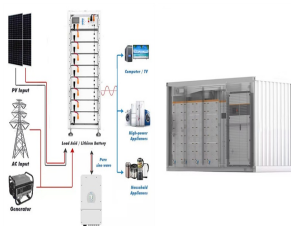
What are base year costs for utility-scale battery energy storage systems? Base year costs for utility-scale battery energy storage systems (BESSs) are based on a bottom-up cost model using the data and methodology for utility-scale BESS in (Ramasamy et al., 2023). The bottom-up BESS model accounts for major components, including the LIB pack, the inverter, and the balance of system (BOS) needed for the installation.



Base year installed capital costs for BESS decrease with duration (for direct storage, measured in \$/kWh), while system costs (in \$/kW) increase. This inverse behavior is observed for all energy storage technologies and highlights the importance of distinguishing the two types of battery capacity when discussing the cost of energy storage.



For battery energy storage systems (BESS), the analysis was done for systems with rated power of 1, 10, and 100 megawatts (MW), with duration of 2, 4, 6, 8, and 10 hours. For PSH, 100 and 1,000 MW systems the highest capital costs, primarily due to greater impact of stacks and powerhouse, respectively.



Neoen today announced construction has begun on its 100 MW/200 MWh Capital Battery, which doubled from its initial 50 MW capacity proposed last year. The battery is to be built 10km southeast of the Australian capital, Canberra. A 1 MW community-owned battery energy storage system could earn the operators up to \$250,000 in revenue each year



The bottom-up battery energy storage systems (BESS) model accounts for major components, including the LIB pack, inverter, and the balance of system (BOS) needed for the installation. Capital Cost Components for Commercial Building-Scale Battery Systems. Model Component \$/kWh \$/kW: Lithium-ion battery: 192: 768: Battery central inverter: 15

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Battery electricity storage is a key technology in the world's transition to a sustainable energy system. Battery systems can support a wide range of services needed for the transition, from providing frequency response, reserve capacity, black-start capability and other grid services, to storing power in electric vehicles, upgrading mini-grids and supporting "self-consumption" of



0.09 \$/kWh/energy throughput 0.12 \$/kWh/energy throughput Operational cost for low charge rate applications (above C10 ??? Grid scale long duration 0.10 \$/kWh/energy throughput 0.15 \$/kWh/energy throughput 0.20 \$/kWh/energy throughput 0.25 \$/kWh/energy throughput Operational cost for high charge rate applications (C10 or faster BTMS



The Capital Battery is a 100 MW stand-alone battery capable of storing up to 200 MWh of energy with up to 2 hours of power in reserve. 50 MW was committed as part of the ACT Government's 2020 renewable energy auction, with a further 50 MW yet to be contracted.

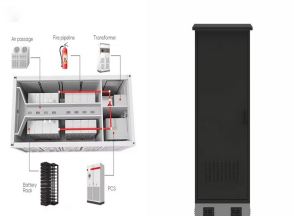


Average battery energy storage capital costs in 2019 were \$589 per kilowatthour (kWh), and battery storage costs fell by 72% between 2015 and 2019, a 27% per year rate of decline. These lower costs support more capacity to store energy at ???



energy storage until the end of the decade and beyond, driven by a substantial ramp-up in manufacturing capacity by Chinese, American and European battery makers and the use of ever larger prismatic cells for energy storage, allowing for more energy storage capacity per unit and greater system integration efficiency.

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This report updates those cost projections with data published in 2021, 2022, and early 2023. The projections in this work focus on utility-scale lithium-ion battery systems for use in capacity ???



Simulated trajectory for lithium-ion LCOES (\$ per kWh) as a function of duration (hours) for the years 2013, 2019, and 2023. For energy storage systems based on stationary lithium-ion batteries



Battery-based energy storage systems (ESSs) will likely continue to be widely deployed, and advances in battery technologies are expected to enable increased capacity, efficiency, and cost-effectiveness. Its estimated cost would be US\$120 million, compared to the US\$700 million capital cost for a wire-based solution. In addition,

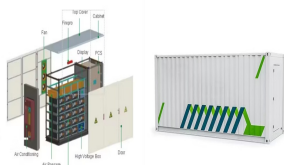


EIP has invested in several battery storage companies, such as Stem, Inc., a leader in artificial intelligence-driven energy storage, and Highview Power, which is developing liquid air energy



esVolta, an energy storage project developer, completed a \$110 million tax equity transaction with Greenprint Capital Management to develop and construct the 300 MWh Hummingbird battery energy storage project in San Jose, California.. The project is currently under construction and is expected to be completed in 2025. The project will provide Pacific ???

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NineDot Energy is leading community-scale, battery storage development in the New York City metropolitan region. NineDot's first-of-its-kind project will demonstrate how to provide power where it's needed, when it's needed, by combining bi-directional EV chargers with energy-dense and cost-effective mobile storage units, providing both grid, and field-deployed temporary ???



In this work we describe the development of cost and performance projections for utility-scale lithium-ion battery systems, with a focus on 4-hour duration systems. The projections are ???



VIENNA, VA, Jan. 24, 2024??? SolaREIT ???, a solar and storage real estate investment fund, is launching a suite of capital solutions for battery energy storage systems (BESS) developers. The company now offers land purchases, lease purchases and battery storage land loans to BESS developers across the nation. With this expansion to battery



Current installed capital costs for BESS in terms of \$/kWh decrease with duration, and costs in \$/kW increase. This inverse behavior is observed for all energy storage technologies and ???



Developers expect to bring more than 300 utility-scale battery storage projects on line in the United States by 2025, and around 50% of the planned capacity installations will be ???

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The Clean Fight is thrilled to announce the selection of six innovative energy storage projects for the Energy Storage Capital Challenge. These development-stage projects bring business model and technology innovations to the New York energy storage market, helping to accelerate the State towards its goal of 6 GW by 2030.



Technologically, battery capabilities have improved; logistically, the large amount of invested capital and human ingenuity during the past decade has helped to advance mining, refining, manufacturing and deploying capabilities for the energy storage sector; and regulatorily, governments around the world have been passing legislation to make battery energy storage ???



Its pipeline has grown substantially from 24GWh of solar and storage projects as of 2020, as reported by Energy-Storage.news at the time. Energy-Storage.news" publisher Solar Media will host the eighth annual Energy Storage Summit EU next week in London, 22-23 February 2023. A few weeks later comes the 5th Energy Storage Summit USA, 28-29



EXCELSIOR, Minn. -- Business Wire --Excelsior Energy Capital ("Excelsior" or "the firm"), a leading renewable energy infrastructure investor, today announced it has entered into a multiyear agreement with Fluence Energy Inc. (NASDAQ: FLNC), a global provider of energy storage systems, to develop 2.2 GWh of battery energy storage system (BESS) infrastructure in ???



The Capital Battery is a grid-scale battery that will connect into Australia's national electricity grid via the transmission network. As an industrial sized battery energy storage system, the Capital Battery will provide grid stability for Canberrans by dispatching stored energy to the grid during peak times of demand.



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114KWh ESS



In addition, Vistra is a large purchaser of wind power. The company owns and operates the 400-MW/1,600-MWh battery energy storage system in Moss Landing, California, the largest of its kind in the world. Vistra is guided by four core principles: we do business the right way, we work as a team, we compete to win, and we care about our



Battery energy storage systems can address the challenge of intermittent renewable energy. But innovative financial models are needed to encourage deployment. IEA states that capital flows for BESS are concentrated in China and the developed world because of the high cost of capital for clean energy projects in emerging economies. Here



The use of battery energy storage in power systems is increasing. But while approximately 192GW of solar and 75GW of wind were installed globally in 2022, only 16GW/35GWh (gigawatt hours) of new storage systems were deployed. To meet our Net Zero ambitions of 2050, annual additions of grid-scale battery energy storage globally must rise to ???



Battery energy storage developer Eku Energy has reached a financial close for 250MW/500MWh battery energy storage system (BESS) in Canberra, the Australian Capital Territory (ACT). Most Popular. Queensland government pulls plug on ???



After solid growth in 2022, battery energy storage investment is expected to hit another record high and exceed USD 35 billion in 2023, based on the existing pipeline of projects and new capacity targets set by governments. Cost of Capital Observatory Case Study. Country report ??? February 2024 World Energy Investment 2023. Flagship report

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U.S. battery storage capacity has been growing since 2021 and could increase by 89% by the end of 2024 if developers bring all of the energy storage systems they have planned on line by their intended commercial operation dates. Developers currently plan to expand U.S. battery capacity to more than 30 gigawatts (GW) by the end of 2024, a capacity that would ???



The national agency will fund A\$495,000 of the total A\$1.18 million expected cost of Monash University's study, exploring alternative energy market designs that could encourage investment into energy storage and ensure Australia gets the energy storage it needs to transition from centralised fossil fuel generation to renewable and distributed



Battery Storage: 2023 Update. Wesley Cole and Akash Karmakar. (shown in black). Figure ES-2 shows the overall capital cost for a 4-hour battery system based on those projections, with storage costs of \$245/kWh, \$326/kWh, and New York's 6 GW Energy Storage Roadmap (NYDPS and NYSERDA 2022) E Source Jaffe (2022)