Battery market forecast to 2030: Pricing, capacity, and supply and demand

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March 15, 2022

Key takeaways

- The price per kilowatt-hour (kWh) of an automotive cell is likely to fall from its 2021 high of about $160 to $80 by 2030, driving substantial cost reductions for EVs.
- Lithium ion (Li-ion) is the most critical potential bottleneck in battery production.
- Manufacturers of Li-ion cells need to invest hundreds of billions of dollars to increase production capacity to keep pace with global demand.

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The battery market is a critical piece of our global energy future, and it's growing at an unprecedented rate. The electrification of the transportation industry, the use of battery systems to provide energy storage and demand management for the grid, and the batterification of many devices continues to spur this industry's growth. These developments are already affecting:

- Investments in energy generation
- Utility demand management programs
- Battery manufacturers' production and investment decisions

As batteries offer potential solutions to the challenges of legacy electric grids, it's important to use market forecasting and intelligence to make sound planning decisions.

Sam Jaffe, vice president of Battery Storage Solutions at E Source, explained in our webinar Battery market forecast to 2030 that the presence of a Li-ion battery changes not just the essence of the product it's added to but the entire market for it. Jaffe says that customer-sited solar plus storage and a battery's ability to balance to balance generation with sophisticated load control will be disruptive forces on the current utility model.

Learn about E Source battery storage solutions

Contact us to learn more about E Source Battery Next. With Battery Next, we offer a data-focused solution for tracking the battery energy storage market and anticipating where it will go.

What opportunities do battery energy storage systems offer the grid?

Our forecasting suggests considerable growth in utility- and customer-owned battery energy storage systems by 2030. The potential benefits these systems offer include:

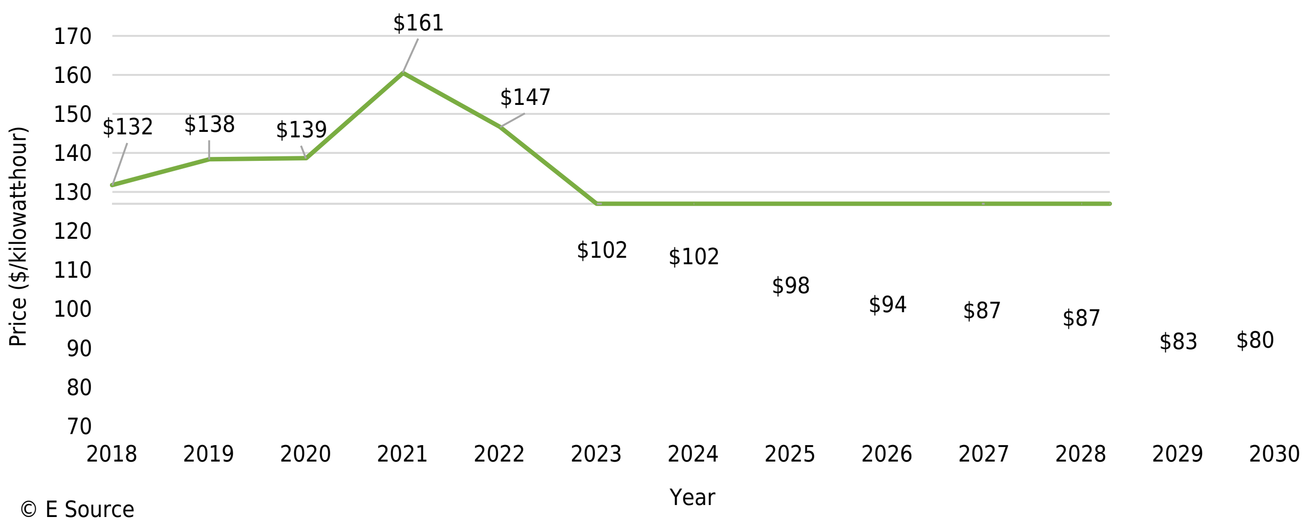
- Increased use of renewable energy
- Savings on utility customers' bills and demand-charge management
- Power services such as frequency regulation, which ensures the balance of electricity supply and demand, and spinning reserve, the extra generating capacity that's available by increasing the power output of generators connected to the power system
- Lower carbon intensity of electricity
- Distributed, low-carbon backup power when paired with renewable generation
- Deferred grid upgrades for areas nearing peak capacity

What are the main drivers of growth in batteries?

Growth in the battery industry is a function of price. As the scale of production increases, prices come down. **Figure 1** forecasts the decrease in price of an automotive cell over the next decade. The price per kWh moved from $132 per kWh in 2018 to a high of $161 in 2021. But from 2022 to 2030 the price will decline to an estimated $80 per kWh. Factors like material supply and charge-discharge strategies will have an influence on market growth.

Figure 1: Expected battery price per kWh from 2022 to 2030

We expect a change in trajectory in 2022 and a continued decline through 2030. An important milestone for battery and EV manufacturers comes around 2025, when the price per kWh falls below $100. This price is crucial for EVs because it represents price parity with gasoline vehicles. The cost of EVs is still the biggest barrier to adoption.



Recycled lithium

Recycled Li-ion cells are less expensive than newly manufactured cells, and they'll begin to substantially affect the supply chain around 2027. We expect reused Li-ion to represent 11% of the supply chain by 2030.

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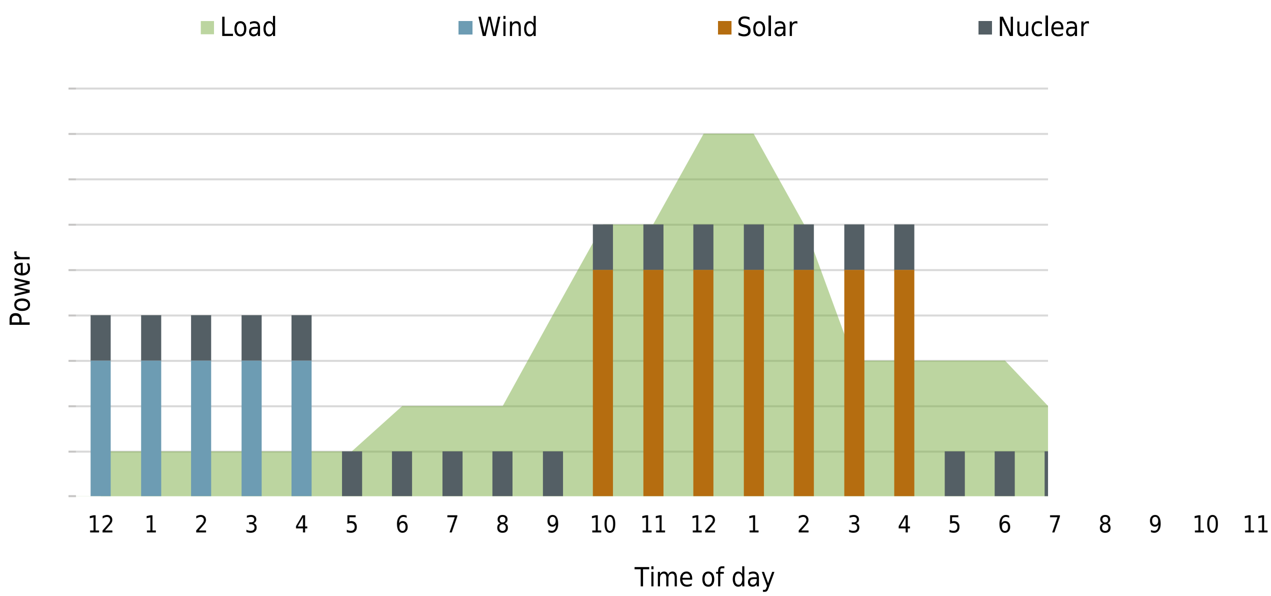
Double dipping

The idea of batteries cycling twice per day (or double dipping) will affect efficiencies and the overall number of batteries installed on the grid. **Figure 2** shows excess renewables generation during two distinct times of the day: overnight during wind overproduction and midday during solar overproduction. Meanwhile, there is an excess of demand during the early morning hours and in the evening. At these times, batteries can discharge. A battery that has four hours of energy capacity can charge and discharge twice, providing eight hours of discharged energy when it's needed most. This won't affect the cycle life of the battery because the actual charging regime will be relatively gentle.

Figure 2: Double dipping the grid

The green shaded area shows where a battery can charge twice in the same day. The impact on the grid operator is large: only half the battery installations are needed compared to charging and discharging once per day. This cuts costs in half.



Note: Assumes a generation mix of 60% solar, 25% wind, and 15% nuclear. © E Source

What’s the battery growth forecast to 2030?

We’re in the beginning stages of integrating batteries at various capacities onto the grid. Globally in 2021, the grid had 30 gigawatt-hours (GWh) of battery storage installed. We expect that number to grow to 400 GWh by 2030. This has many implications for utilities, battery storage investors, and large commercial energy users:

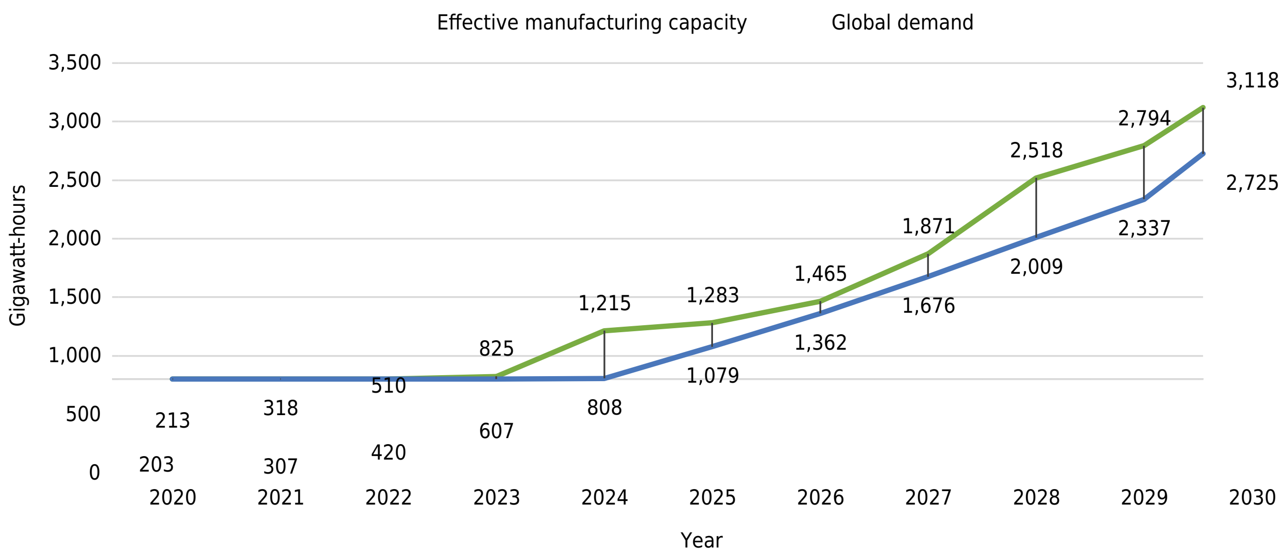
- Utilities will see an increase in battery installations in their territories. Some will be utility-deployed batteries, but most will come from independent power producers, home and building owners, and operators of virtual power plants, such as Tesla and Sunrun. How that buildout is structured will decide the level of utility ownership and control over distributed energy generation and aggregated distributed energy resources (DERs).
- An electricity grid dominated by independent power producers will see greater volatility in pricing and less utility participation. Utility-owned batteries will require huge capital expenditure but will allow the utility to retain ownership and operation of DERs like battery storage.
- To build the terawatt-hours’ worth of battery installations to keep up with demand, investors need to spend hundreds of billions of dollars. Allocating that capital wisely will be an important job for investors in battery technology over the coming decade.
- Customer-owned battery storage can take advantage of the peak and off-peak hours to cut the user’s monthly bill. As we discuss in our report [Capture the benefits of commercial battery storage](), commercial and industrial customers in markets with high demand charges can see substantial savings

and shorter payback times for their battery assets.

Our forecast predicts Li-ion manufacturing capacity to stay above global demand through 2030. **Figure 3** shows our forecast model of manufacturing capacity. We assume a healthy dose of skepticism in our model based on thousands of data points. We expect a sixfold increase in manufacturing capacity between now and 2030, an increase from 510 GWh manufactured today to over 3,100 GWh by 2030.

Figure 3: Battery supply and demand through 2030

The capacity to manufacture Li-ion will fluctuate but stays above forecasted demand throughout the decade.



A growth trajectory of global Li-ion consumption shows a sixfold increase by 2030

We tracked 30 battery markets in major regions and found that in 2022 the world will consume or demand 420 GWh of Li-ion batteries for all applications. By 2030 that will rise to 2,722 GWh. Stationary battery storage isn't likely to account for more than 15% of all battery energy capacity. Understanding the trends and dynamics of other battery markets, ranging from power tools to e-scooters to automobiles, will allow stationary storage battery consumers like utilities and independent power producers to hedge against unanticipated pricing and supply shocks in the future.

What are the potential bottlenecks for the battery and energy storage markets?

The battery and energy storage markets are challenged by problems with:

- Snarled supply chains and high inflation
- Stationary energy storage technology
- Operating margins and barriers to entry for new companies
- EV charging infrastructure and load requirements

Snarled supply chains and high inflation

Of all the commodities that go into the battery supply chain, lithium is the most critical possible bottleneck. To meet anticipated demand, lithium producers will need to build new extraction and processing facilities and strongly consider geographic constraints. Other battery materials with critical constraints will involve nickel, cobalt, and copper foil.

Inflation will also affect supply-chain constraints. In 2021, most material inputs had increased in price. Even industrial commodities like PVDF (polyvinylidene fluoride, a polymer binder used during the manufacturing process) and phosphoric acid (used in some battery formulas) had seen price increases of 30%–50%. Lithium has seen the highest price spikes. Spot pricing for lithium carbonate, the most-used form of lithium feedstock for batteries, increased by 400% in the past 18 months.

Stationary energy storage technology

When a stationary battery sits unused, it's not earning money for you. Batteries need to be charged or discharged as often as possible to earn revenue. To keep up, the industry will need to develop higher-quality batteries and more-advanced technologies.

An EV battery cell is different, as it's temperature regulated, safely enclosed, and sitting 90% of the time. Even with these differences, we expect the $100-per-kWh pricing to occur around the same time for stationary storage and EVs (in 2025). Effective energy storage programs can help you and the customer make the most of batteries.

Operating margins and barriers to entry for new companies

Increasing scale in battery manufacturing is the only way to produce a decent margin. Operating margins are small and barriers to entry are large, which cause oligopolies. Today, a few companies in China make most of the batteries. Even as manufacturing ability increases in Europe and the US and Canada, we'll continue to see just a handful of companies dominating the market.

EV charging infrastructure and load requirements

As we electrify transportation, vehicle charging becomes a challenge. A light-duty EV can pull 15 kW on Level 2 chargers. Fast-charging commercial trucks draw as much as 1 megawatt (MW). Newly built commercial charging stations draw as much as 100 MW at full capacity. Many large battery packs charged at the same time can severely strain the grid. As a result, utilities need to carefully design charging stations. We offer some solutions in the report Building your EV charger asset management plan.
