Weekly Summary

Economics of Climate Change

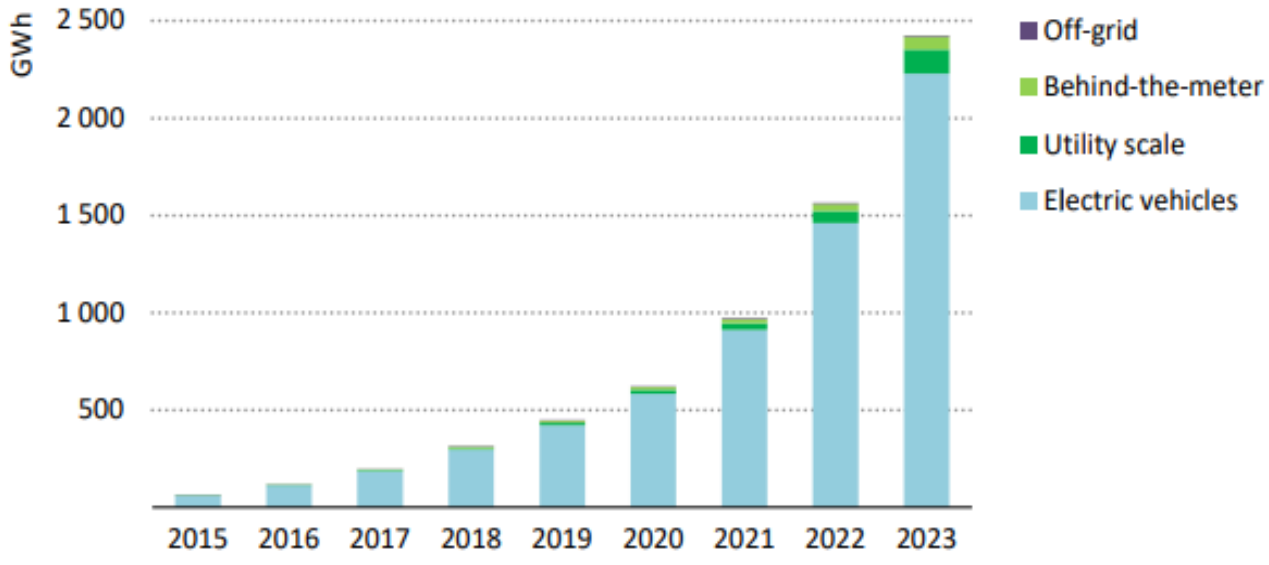
May 17, 2024

Batteries will be vital to enabling the green transition

Batteries will be pivotal in steering the global energy system towards net zero emissions. Achieving this will necessitate tripling renewable energy capacity, doubling the rate of energy efficiency improvements, and transitioning away from fossil fuels. Effective regulatory frameworks and incentives for international cooperation will determine the achievement of the goal.

Batteries are becoming increasingly relevant, especially in transport and power sectors.[1] Batteries are an important part of the global energy system that will play a critical role guaranteeing a secure and affordable energy transition. In the transport sector, they are the essential component of electric vehicles (EVs) and, in the power sector, they are becoming increasingly important in utility-scale and behind-the-meter applications, as their costs fall and as the share of solar and wind energy sources rises (see **Figure 1**).

Figure 1. **LITHIUM-ION BATTERY VOLUMES IN USE BY TYPE OF APPLICATION, 2015-2023**



Source: BBVA Research from IEA report

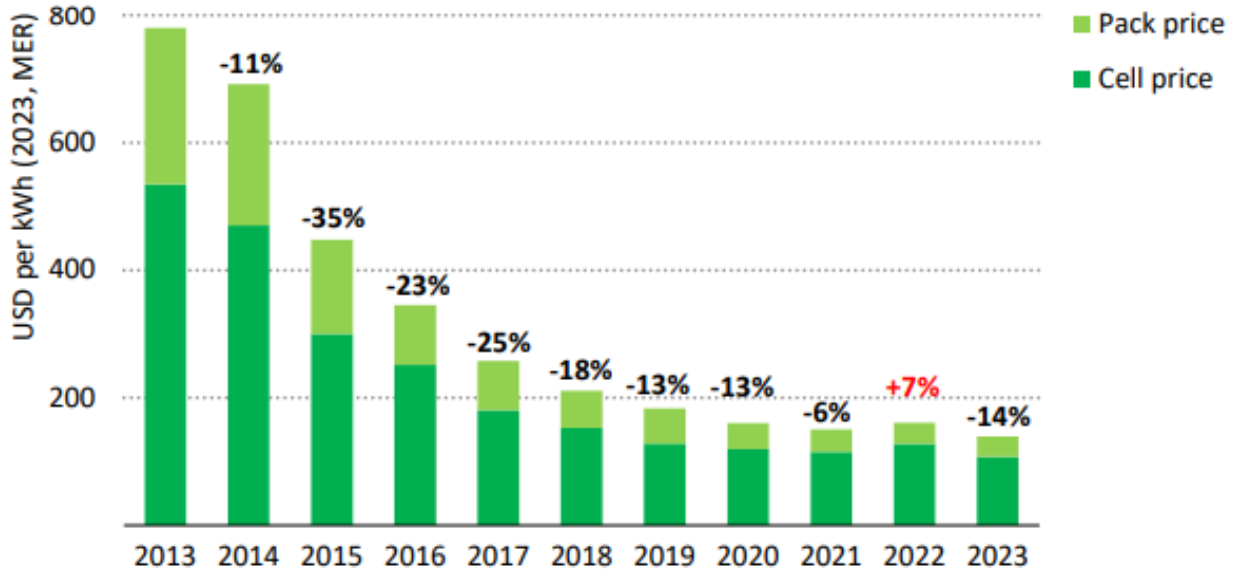
In 2023, the global market battery storage emerged as the fastest growing energy technology, more than doubling its deployment. This increase was evident across several sectors including utility-scale battery projects, behind-the-meter batteries, mini-grids, and solar home systems for electricity access, adding a total of 42 GW of

1: IEA's Report on Batteries and Secure Energy Transitions

battery storage capacity globally. Additionally, electric vehicle (EV) battery deployment increased by 40% last year, with 14 million new electric cars, accounting for the majority of batteries used in the energy sector.

Lithium-ion batteries dominate battery use due to recent cost reductions and performance improvements. Over the last decade, lithium-ion batteries emerged as the superior choice, boasting a greater than 80% reduction in prices[2] (see **Figure 2**), thanks to continued progress in R&D, economies of scale and technological innovation. They also achieved significantly higher energy densities compared to lead-acid batteries, allowing them to be arranged in lighter and more compact battery packs. **Lithium-ion batteries dominate both EV and storage applications**, and chemistries can be adapted to mineral availability and price.[3]

Figure 2. **PRICES FOR LITHIUM-ION BATTERIES, 2013-2023**

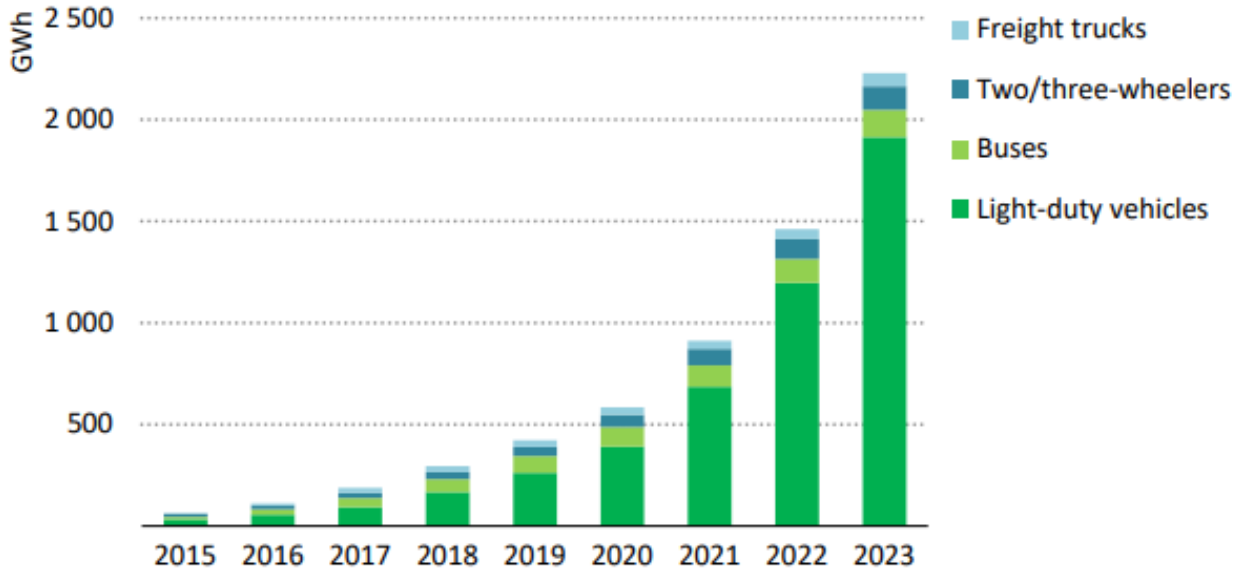


Source: BBVA Research from IEA report

EV battery volumes quadrupled over the past three years, mostly in passenger cars.[4] In 2023, EVs accounted for over 90% of battery use in the energy sector, with annual volumes hitting a record of more than 750 GWh (see **Figure 3**). This surge is mainly due to both **more robust support policies and lower obstacles** related to the larger batteries and power needs required for electrifying heavy-duty or long-distance transport. Electromobility is also progressing in other areas, particularly with the electrification of two/three-wheelers and city buses, especially in emerging markets and developing economies.

2: Lithium-ion battery prices (including cell and pack costs) have declined from around USD 800 per kilowatt-hour (kWh) in 2013 to less than USD 140 kWh in 2023.
3: This adaptability is evidenced by the market share of lithium iron phosphate (LFP) batteries, which surged to 40% of EV sales and 80% of new battery storage in 2023.
4: Nearly one-in-five new cars sold are electric. Both bigger cars and range concerns have driven an increase in the average size of EV battery packs in recent years.

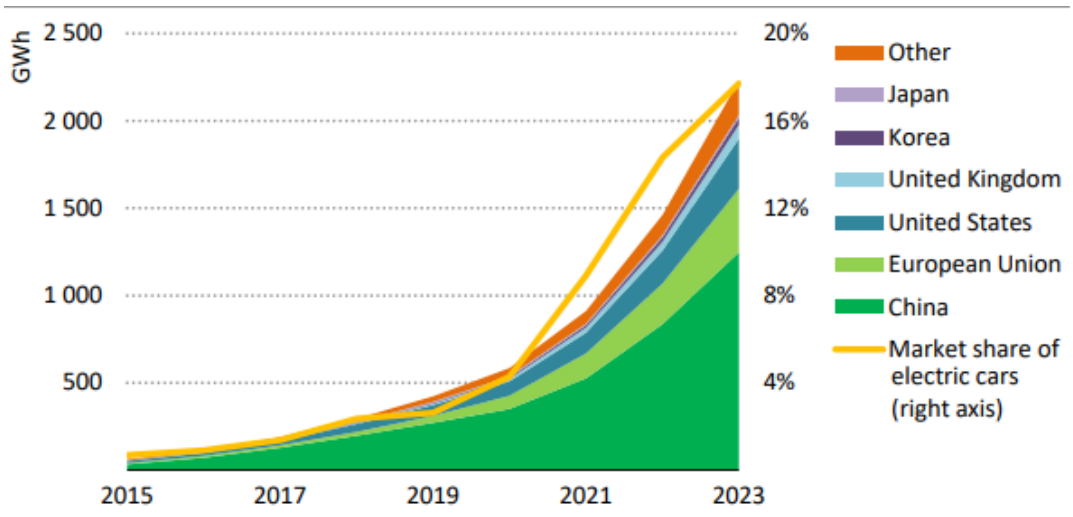
Figure 3. **EV BATTERY VOLUMES IN USE BY VEHICLE TYPE, 2015-2023 (*)**



(*) Light-duty vehicles include passenger cars and light commercial vehicles. Freight trucks include medium and heavy freight trucks.
Source: BBVA Research from IEA report

China dominates the global EV battery market, but its share is gradually declining. In 2023, China accounted for around 55% of EV battery volumes in use, followed by the EU and the USA, which together represented 30% of the total (see **Figure 4**). However, China's dominance in the global battery market has gradually declined from 65% to around 55% over the past five years due to the increasing support mechanisms and regulations in other regions. The growing preference for electric sport utility vehicles (SUVs) and EVs with longer driving ranges in advanced economies is further boosting battery demand.

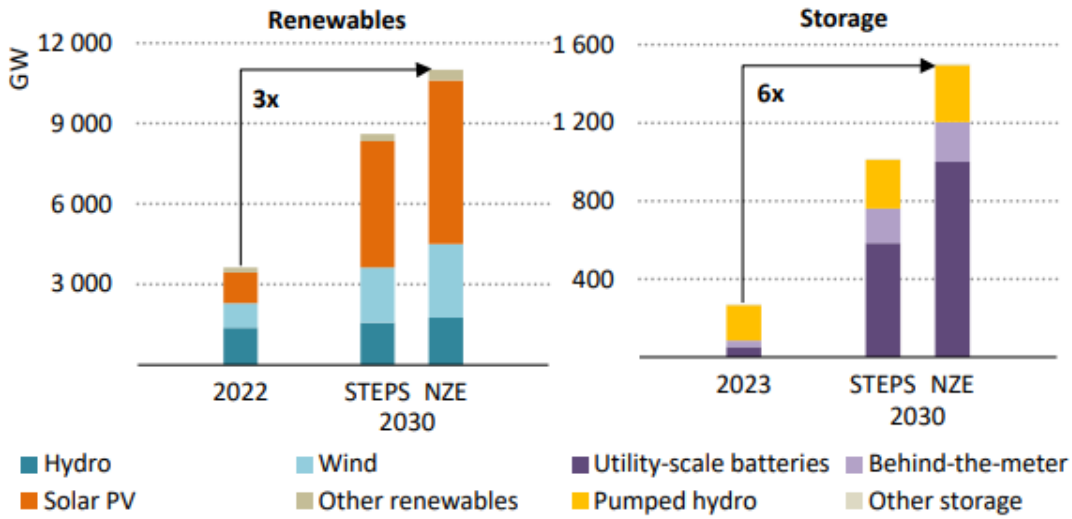
Figure 4. **EV BATTERY VOLUMES IN USE BY REGION AND MARKET SHARE OF ELECTRIC CARS IN SALES, 2015-2023**



Source: BBVA Research from IEA report

Battery deployment should increase six-fold by 2030 to meet COP28 goals. Batteries are pivotal to the transition away from fossil fuels, significantly enhancing energy efficiency through electrification and the increased utilization of renewable energy sources. To achieve a threefold increase in global renewable energy capacity by 2030 while ensuring electricity security, energy storage capacity must expand six-times (see **Figure 5**). The deployment of battery storage must sustain an average annual growth rate of 25% by 2030, necessitating coordinated efforts from policymakers and the industry. In the Net Zero Emissions (NZE) Scenario, batteries are projected to contribute to approximately 60% of the CO2 emissions reduction in the energy sector by 2030.[5]

Figure 5. **GLOBAL INSTALLED RENEWABLE ENERGY AND ENERGY STORAGE CAPACITY[6]**



Notes: GW = gigawatts; PV = photovoltaics; STEPS = Stated Policies Scenario; NZE = Net Zero Emissions by 2050.
Scenario. Other renewables include bioenergy, geothermal, concentrating solar power and marine. Other storage includes compressed air energy storage, flywheel and thermal storage. Hydrogen electrolysers are not included.
Source: BBVA Research from IEA report

Expanding the global battery market generates new opportunities for diversifying supply chains. Batteries serve as a "master key" that can unlock significant industrial transformations and substantial economic benefits (see **Box 1**). The global automotive market, valued at USD 4 trillion, will increasingly rely on advanced battery technology for leadership. Furthermore, batteries bolster the deployment of wind and solar photovoltaic (PV) systems, which are poised to attract USD 6 trillion in investment in the NZE scenario from 2024 to 2030, by mitigating their intermittency and stabilizing the grid.

5: Close to 20% are directly linked to batteries in EVs and battery-enabled solar PV. Another 40% of emissions reductions are from electrification of end-uses and renewables that are indirectly facilitated by batteries.
6: It is based on the World Energy Outlook-2023 (WEO2023), which includes three scenarios that explore different pathways for the energy sector to 2050.

Box 1. Batteries, the “master key” of the energy system transition towards decarbonization

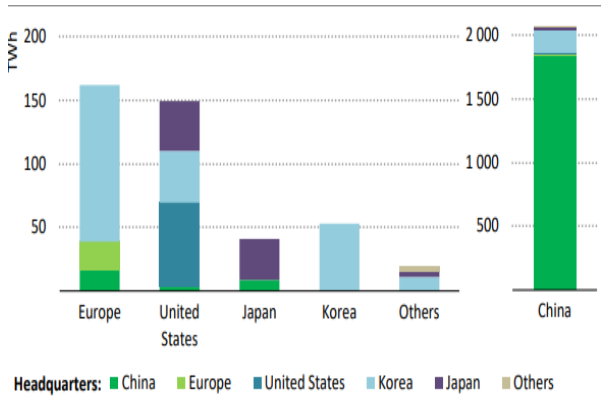
Batteries are indispensable for modern electricity grids, providing the flexibility, stability, and capacity needed to manage the dynamic and increasingly renewable-driven energy landscape. They help to meet peak demand, support grid services, and enable the integration of renewable energy sources, all of which are essential for a secure and efficient power system.

- **Ancillary Services**. Frequency regulation, voltage support, and operating reserves due to their rapid response capabilities.
- **Grid Stability and Flexibility**. Batteries support grid stability by providing inertia and short-circuit power, especially as the share of variable renewables like wind and solar increases and synchronous generation from conventional thermal power plants decreases.
- **Energy Shifting and Peak Load Management**. One of the primary applications of utility-scale batteries is energy shifting, where batteries store energy during periods of low demand or high renewable generation and discharge during peak demand periods. This helps to balance the grid and reduce reliance on peaking power plants, such as gas turbines. Batteries provide secure dispatchable capacity, contributing significantly to meeting peak demand and ensuring a stable electricity supply.
- **Congestion Management**. Batteries alleviate grid congestion by storing surplus power generated during times of high renewable production, thereby reducing curtailment and integration costs.
- **Distributed Energy Resources and Behind-the-Meter Storage**. Behind-the-meter batteries, installed at residential, commercial, and industrial locations, help manage local demand and reduce peak load on the grid. They can increase self-consumption of solar PV generation, reduce electricity bills through dynamic tariffs, and provide backup power during outages. When aggregated into virtual power plants (VPPs), these distributed batteries can also offer ancillary services and enhance overall grid flexibility.

Support for Renewable Integration. By smoothing out the variability of wind and solar power, batteries enable higher penetration of renewables into the grid. They store excess generation during sunny or windy periods and discharge when renewable output is low, thus ensuring a continuous and reliable power supply. This capability is crucial for maintaining the balance between electricity supply and demand in systems with high shares of renewable energy.

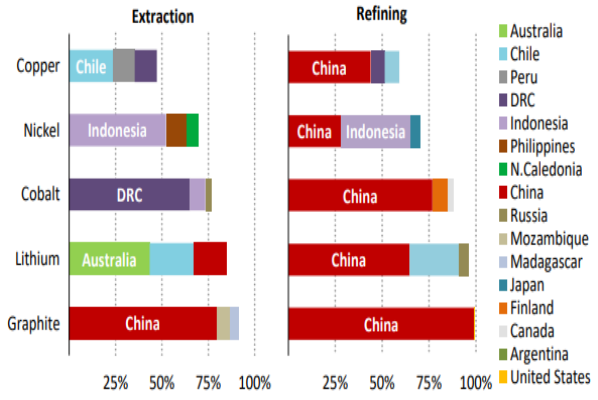
However, there are risks that could hinder batteries' contribution to energy transition. Costs must continue to decrease to facilitate further adoption across diverse sectors. While battery manufacturing capacity has more than tripled in the last three years, it remains concentrated in a few countries (see **Figure 6**), as does the extraction and processing of the critical minerals required (see **Figure 7**). Nonetheless, the development of new battery chemistries will help reduce dependence on a limited number of key ingredients, and advancements in recycling raw materials will eventually mitigate the need for new supplies of critical minerals.

Figure 6. **LITHIUM-ION BATTERY MANUFACTURING CAPACITY BY MANUFACTURERS' LOCATION, 2023**



Source: BBVA Research from IEA report

Figure 7. **SHARE OF THE TOP-THREE COUNTRIES IN EXTRACTION AND REFINING OF CRITICAL MINERALS FOR BATTERIES, 2023**



Source: BBVA Research from IEA report

Governments will play a key role in supporting the development of battery supply chains. To unlock the full potential of battery storage, policymakers and regulators must ensure that regulatory systems recognize the full value of the services it offers, facilitate market access, and establish price signals that accurately reflect its various contributions. Regulatory systems need to better align consumer and system benefits through cost-reflective variable electricity tariffs to capture the full benefits of behind-the-meter batteries. Where feasible, they should enable the aggregation of behind-the-meter batteries into virtual power plants that can provide services similar to utility-scale projects.

International cooperation will also be crucial. The growing demand for critical minerals for batteries highlights the need for secure, resilient, and sustainable supply chains. This involves developing diversified international networks and establishing environmental, social, and governance standards for mining and processing. Success is crucially dependent on international cooperation. Additionally, fostering innovation through research and development in battery chemistries and design, along with regulatory frameworks that promote battery recycling, is essential.

All in all, batteries are a relevant part of the global energy system, having a deep impact on two key sectors for the energy transition: transport and power. Reducing emissions and meeting the climate targets will hinge on whether the world can scale up batteries fast enough. National and international partners need to work together to support the development of battery supply chains that are safe, resilient and sustainable.

Highlights of the Week

- **Global | AI start-ups take aim at climate change**. Specialized applications can bring big benefits, but entrepreneurs also point to the technology's limitations.
- **Global | Why Washington's new tariffs on Chinese clean tech goods matter**. The US unleashes fresh tariffs of Chinese goods, sharply raising the levies on clean energy imports including solar parts and electric vehicles.
- **Europe | Europe After the EU elections: what should be Europe's energy and climate priorities for 2024-29?** A new Commission will be appointed to propose new priorities, a work agenda and thus open a new chapter in the EU energy and climate policy.

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