October 2023
By Felipe Diniz and Lucas Santiago

Battery Industry

Overview and sector perspectives

With strong technological progess in the last decade and a significant demand growth coupled with emphasis on sustainability, the global battery industry has been undergoing transformation – this article offers an insight into the key trends and opportunities shaping this industry. By 2030, the battery market is expected to expand by 3.5 times, predominantyl driven by lithium-ion models, with a compound annual growth rate (CAGR) of 19%. Readers will gain insights into the battery technologies driving this evolution and their applications across various sectors.

Electric mobility and stationary storage segments hold substantial market potential, with a projected global revenue of over USD 600 billion in the coming years. Several investments have already been made in Brazilian companies to create value based on this growing mark.

Don't miss the opportunity to establish your presence in this dynamic and fast-growing sector, where innovation and sustainability are the keys to success. Explore how Mirow & Co. can be your partner in this exciting journey through the battery industry.

Battery Industry Overview

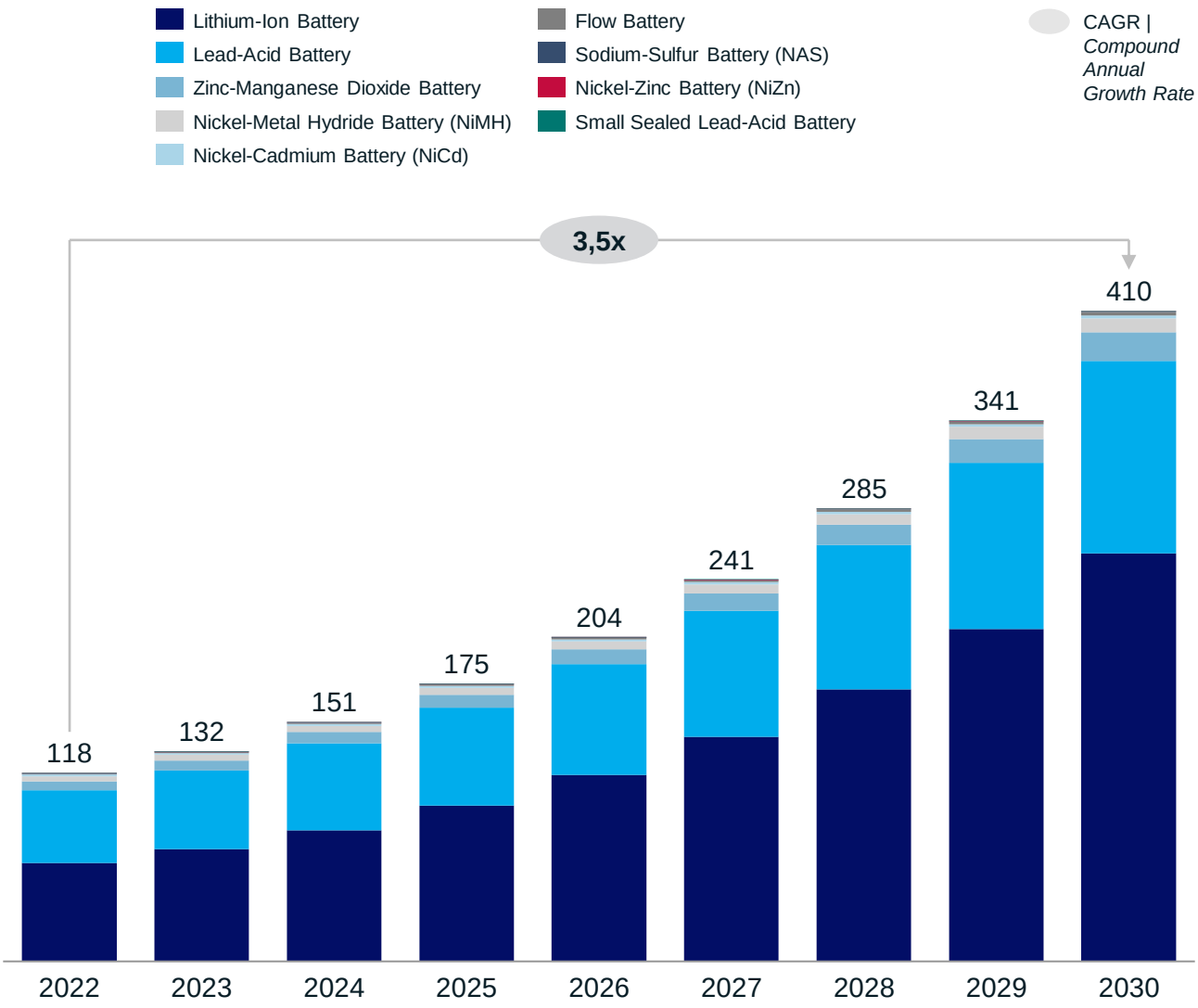
The battery industry is undergoing significant transformation, driven by technological advancements, growing demand, and environmental concerns.

The battery market is on the rise, with projected growth of 3.5 times by 2030. Lithium-ion technology leads this growth, with a compound annual growth rate (CAGR) of 19%. The most prominent types of batteries are lithium-ion and lead-acid, which together represent more than 90% of the market during this period.

EXHIBIT 1

Market size segmented by Battery type

USD billion, 2022 – 2030



Market size segmented by battery type
Source: Statista, Mirow & Co.

This industry offers various technological options, each playing different and important roles in the market:

- Lithium-Ion (Li-Ion): Leads global growth and is ideal for applications requiring high energy density and lightness, such as in cell phones and laptops;
- Lead-Acid: More economical for high-power applications, found in energy backup systems, hospital equipment, and emergency lighting;
- Nickel-Cadmium (NiCd): Used in two-way radios, biomedical equipment, and professional video cameras;
- Nickel-Metal Hydride (NiMH): Has higher energy density compared to NiCd, applied in hybrid cars due to lower cost compared to lithium-ion.

AMONG THE MAIN TECHNOLOGIES, LITHIUM-ION IS THE ONE THAT PRESENTS THE BEST CHARACTERISTICS IN DIFFERENT DIMENSIONS, SUCH AS LOW MEMORY EFFECT, HIGH VOLTAGE SUPPORT, LOW TOXICITY, AND HIGH ENERGY DENSITY, AMONG OTHERS

EXHIBIT 2

Battery with the best characteristics

Feature met
Feature partially met
Feature not met

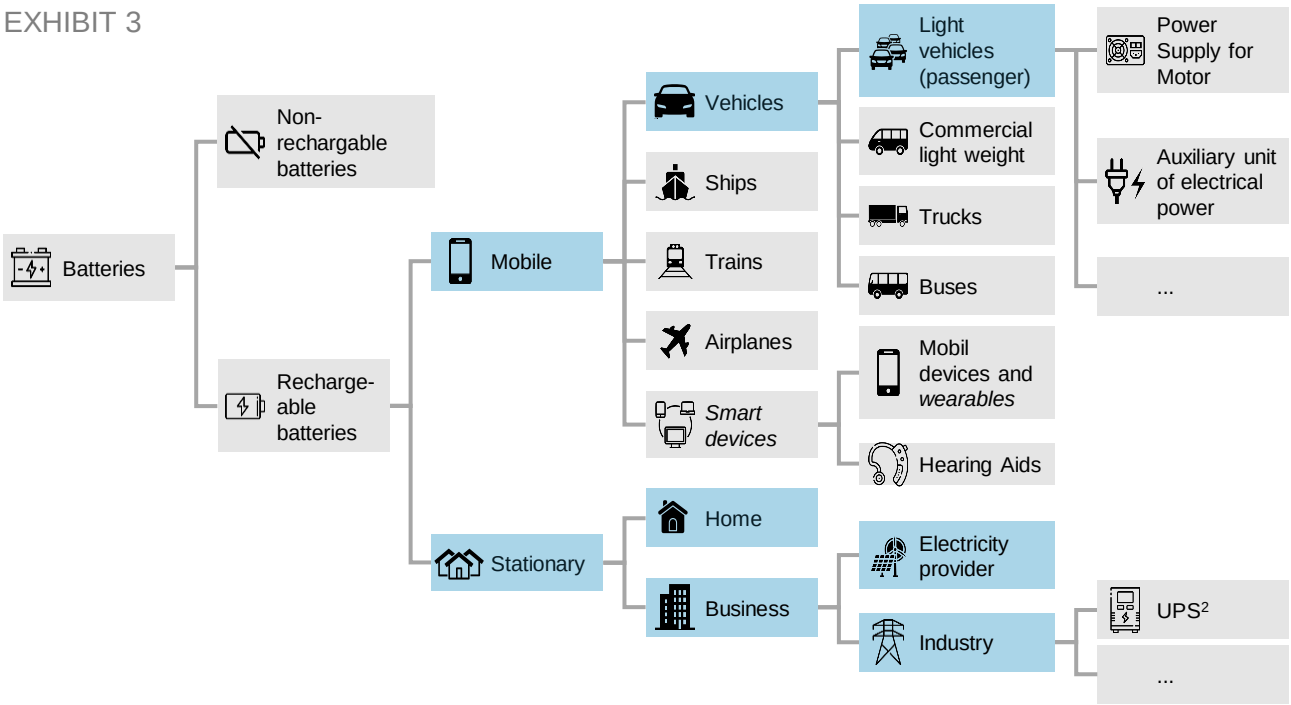
	Battery Characteristics	Lithium-Ion	Lead-Acid	Ni-Cd	Ni-MH
Chemical	Low memory effect	✓	✓	✗	✓
	High voltage support	✓	✓	✗	✗
	Low self-discharge rate	✓	✓	✗	✗
	Low toxicity	✓	✗	✗	✓
	Overcharge tolerance	✗	✓	✓	✗
	Low flammability	✗	✗	✓	✓
	Short charging time	✓	✗	✓	✓
Physical	High energy density	✓	✗	✗	✓
	High weightlessness	✓	✗	✓	✓
	Long life cycle	✓	✗	✓	✗
Mechanic	Thermal runaway resistance	✓	✗	✓	✓
	High temperature resistance	✗	✗	✓	✗
	Maintenance-free	✓	✗	✗	✗

Source: Interview with experts, IMP, *desk research*, Mirow & Co

Battery Market

The market is divided between rechargeable and non-rechargeable batteries, with applications in mobile and stationary batteries. Applications in light vehicles and stationary storage for residences and businesses have seen significant growth among rechargeable batteries.

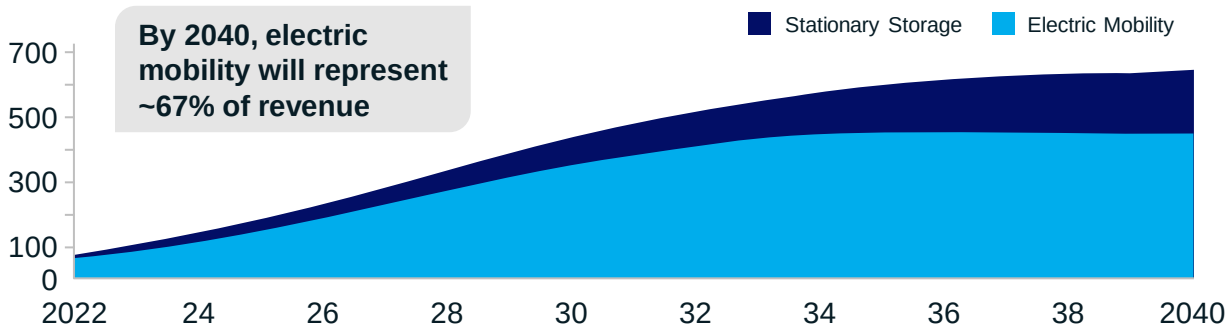
EXHIBIT 3



Battery market structure by segment of operation
1. Vans e pick-up trucks 2. *Uninterruptible power supply*
Source: Mirow & Co.

Electric mobility and stationary storage have the potential to generate over USD 600 billion in revenue in the coming years. Between 2022 and 2040, the largest share of this revenue will come from electric mobility batteries, followed by stationary storage. Additionally, the accelerated market growth is expected to result in reduced battery manufacturing costs.

EXHIBIT 4

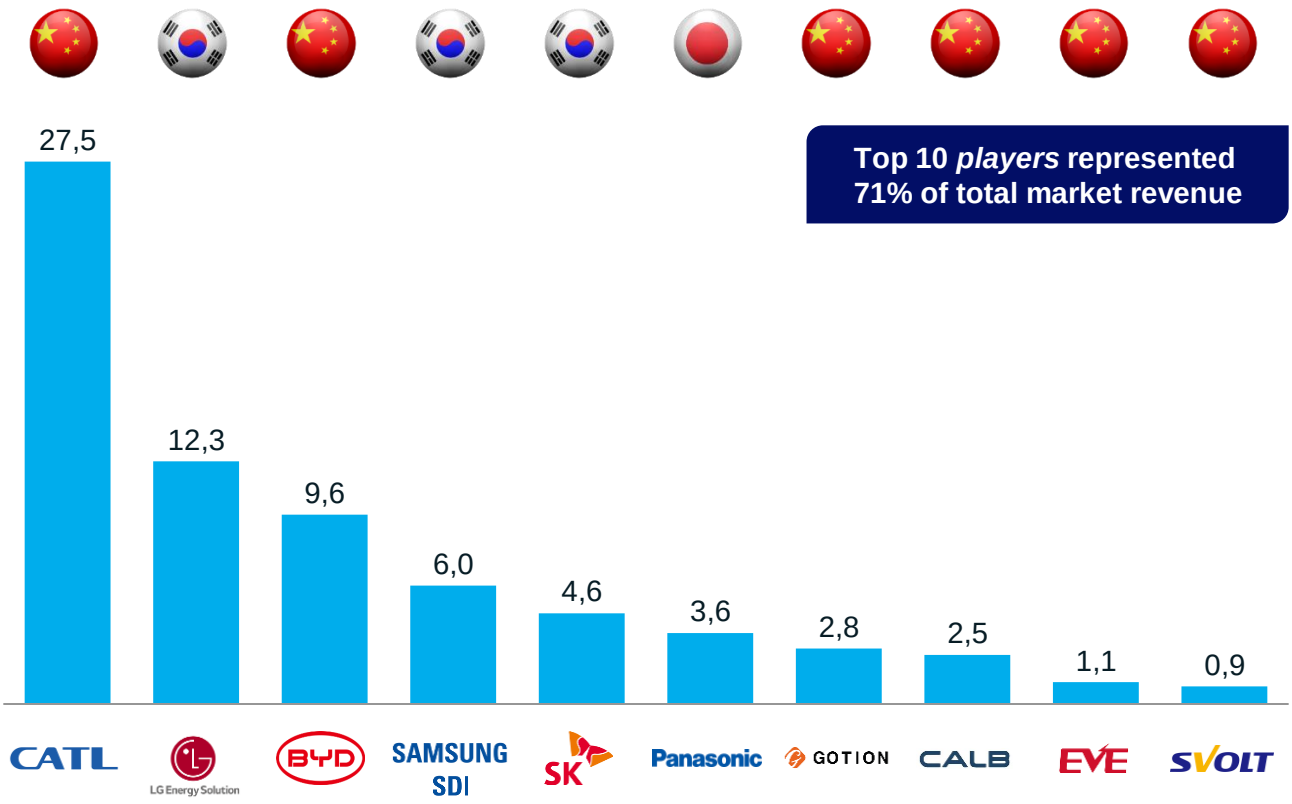


Evolution of global energy storage revenue by segment, USD billion, 2022 – 2040
Source: Lux Research, Mirow & Co.

Geographical Concentration And Investments In Brazil

Asia is currently the largest producer of batteries, with the top ten companies in the sector in 2022 representing 71% of total revenue. Among these companies, there are six Chinese players (CATL, BYD, Gotion, CALB, Eve, and Svolt), three South Korean (LG Energy Solution, Samsung SDI, and SK), and one Japanese (Panasonic).

EXHIBIT 5



Top 10 electric vehicle battery manufacturers in 2022 - Market share, % global revenue
Source: SNE Research, *desk research*, Mirow & Co

Moreover, Brazilian companies are identifying opportunities in the battery market and making significant investments, such as Weg, Suzano Ventures, BYD, and Bravo Motor Company, demonstrating the growth of this sector in the country

EXHIBIT 6

- **Investment of R$ 100 million until 2024 to expand lithium** battery pack production capacity in Brazil.
- Focus on the growth of electric mobility demand in the country, mainly for the bus and truck segment

- **Investment of USD 6.7 million in 2023 in the startup Allotrope Energy, specializing in the production of lithium-carbon batteries.**
- The focus of the investment will be on replacing metals and applying cellulose as a carbon source for batteries for vehicles with two and three wheels

- **Investment in 2022 of R$ 3 billion for the construction of 3 factories** in the state of Bahia
- Factories will be dedicated to the production of bus chassis, electric trucks, electric and hybrid passenger vehicles, as well as lithium and iron phosphate processing

- **Investment of R$ 25** billion to create a factory for electric cars and batteries in Minas Gerais with completion scheduled for 2025
- **Partnership with ABB** to provide innovative solutions for the construction of the production hub

- **Investment in 2022 of R$ 600 M in a new factory in Pernambuco**
- The factory will have a recycling capacity of 100 thousand tons of lead, and the material will be used in the production of new batteries

Source: Interviews with experts, Mirow & Co.

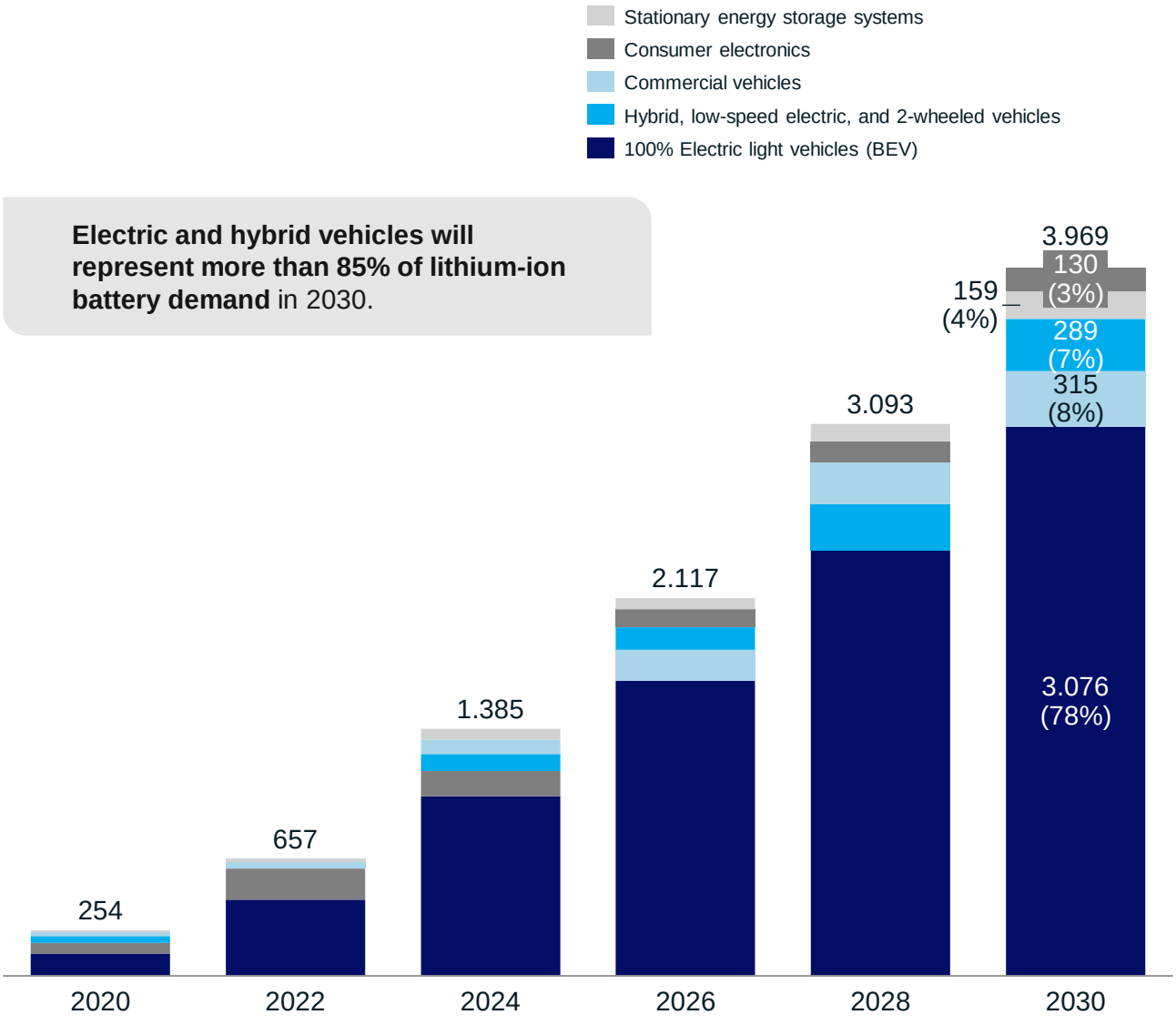
Opportunities In Electric Vehicle Batteries

By 2030, the sale of electric and hybrid vehicles will represent a significant portion of the automotive industry, reaching 30% of total vehicles sold in Brazil. This increase in sales implies substantial demand for batteries.

Moreover, over the last ten years, lithium-ion battery prices have seen a notable decline, reaching a reduction of 79%. The expectation is that this downward price trend will continue, reaching values below USD 100/kWh by 2026. Such a decline is due to factors such as increased efficiency in battery production, reduced production costs, and growing demand.

In parallel, with the growth in demand for electric and hybrid vehicles, a significant increase in demand for lithium-ion batteries is expected. This technology is the top choice for these applications due to its high energy density and reliable performance. Electric and hybrid vehicles will represent over 85% of the demand for lithium-ion batteries in 2030.

EXHIBIT 7



Global demand for lithium-ion batteries by application, GWh, 2020 – 2030
Source: Battery Monitor 2022 – The value chain in the field of tension between economy and ecology, Mirow & Co.

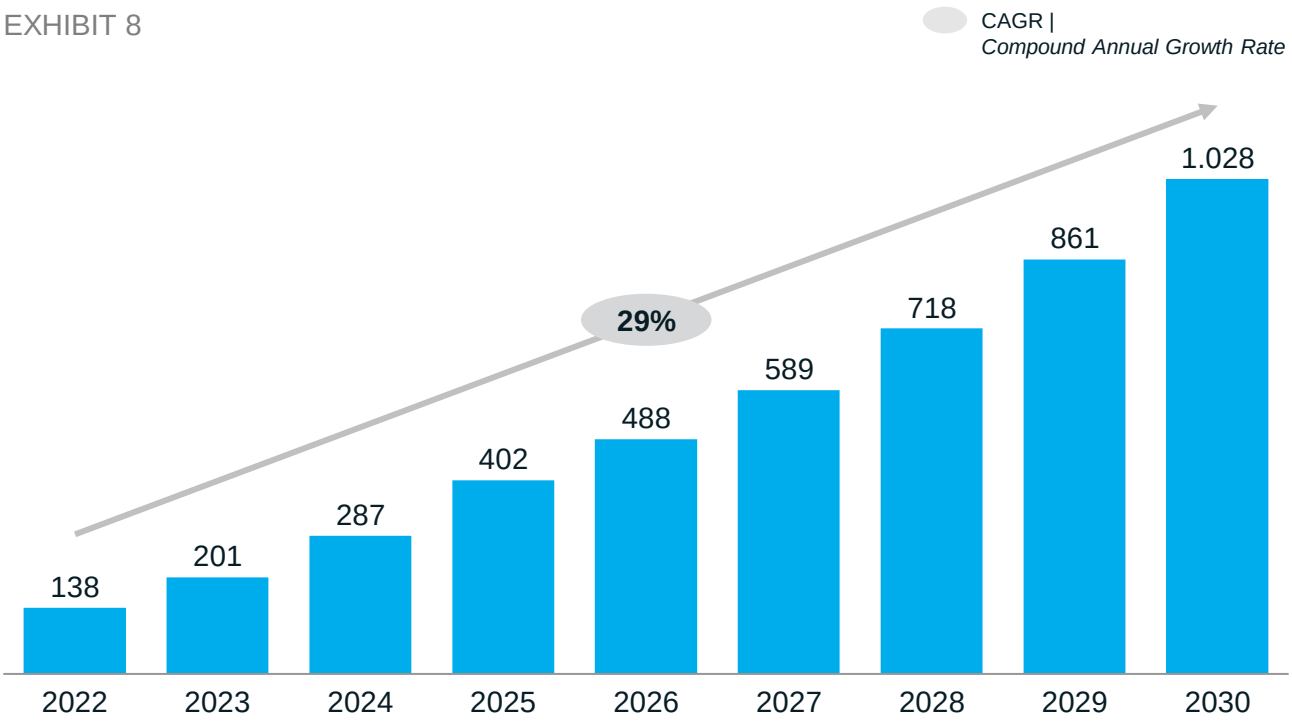
Opportunities in Energy Storage

Brazil is experiencing remarkable growth in renewable energy sources, with forecasts indicating that solar and wind energy will represent over 50% of the country's electricity matrix by 2050. This represents a significant transition from the use of hydroelectric power plants.

In light of this trend, stationary energy storage emerges as a significant opportunity. Growth rates of 29% are projected between 2022 and 2030, with the market segmented into three distinct arrangements: front-of-meter, behind-the-meter, and isolated systems.

The global energy storage market is expected to reach 1,028 GWh by 2030, with a growth rate of 29%, reflecting the increasing need for energy storage to support the expansion of renewable energies.

EXHIBIT 8



Global energy storage market expected to reach 1,028 GWh by 2030, with average annual growth of 29%

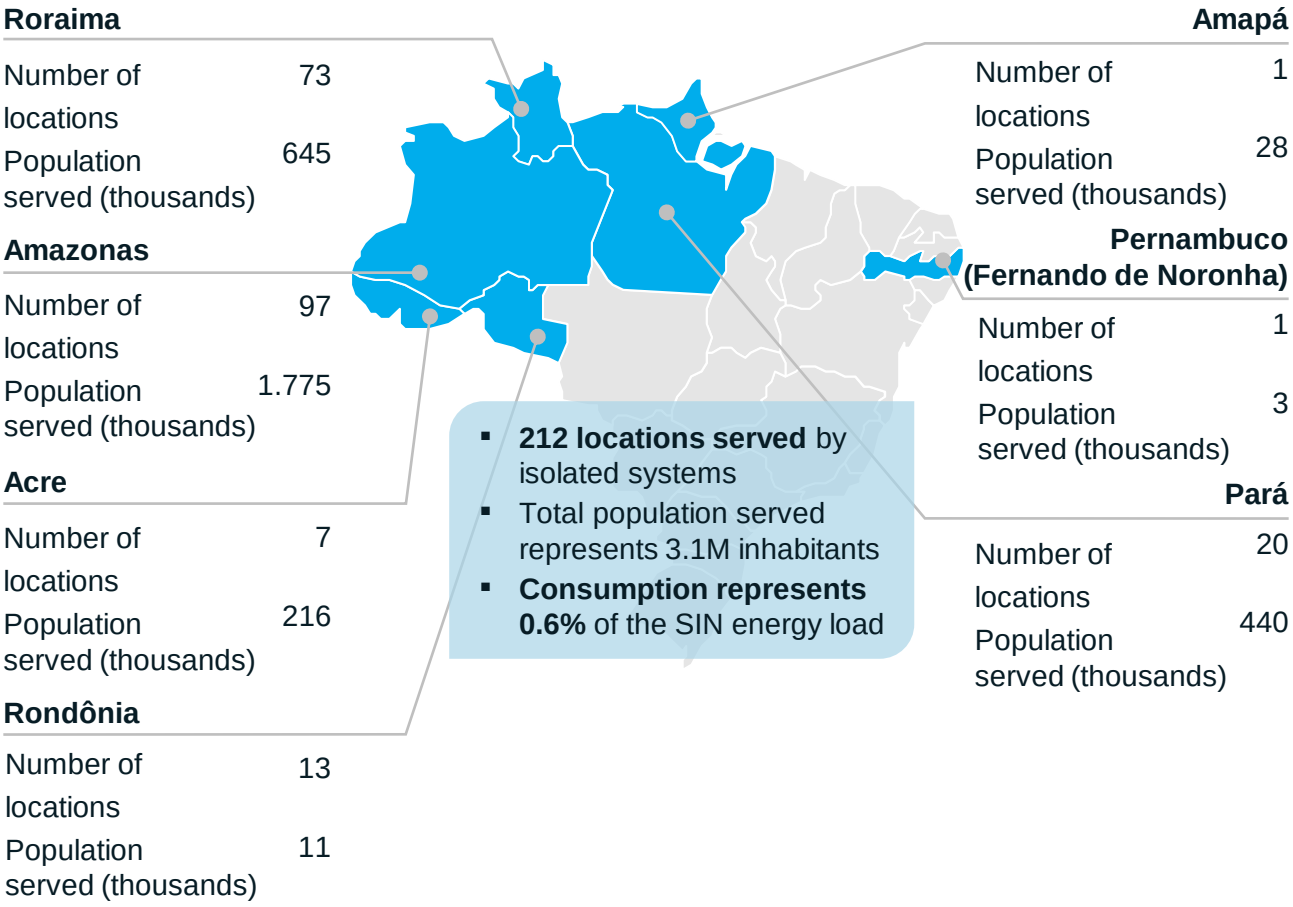
Evolution of the global stationary energy storage market, GWh, 2002 – 2030
Source: Bloomberg, desk research, Mirow & Co.

IN BRAZIL, SHORT-, MEDIUM-, AND LONG-TERM OPPORTUNITIES RANGE FROM REPLACING DIESEL GENERATORS IN ISOLATED SYSTEMS TO EXPANDING STORAGE SYSTEMS IN THE TRANSMISSION SCOPE. COMMERCIAL AND INDUSTRIAL SECTORS ARE THE FOCUS OF THESE OPPORTUNITIES, INCLUDING PROJECTS RELATED TO ELECTRIC MOBILITY AND RENEWABLE GENERATION

Key Role in Decarbonization

Despite its current low representation, storage systems will play a key role in decarbonizing the electric grid in the Amazon region. Currently, there are 212 locations served by isolated systems, with a total population of 3.1 million inhabitants and consumption equivalent to 0.6% of the National Interconnected System (SIN) energy load.

EXHIBIT 9



Geographical distribution of isolated systems in 2022
Source: Empresa de Pesquisa Energética (EPE), Mirow & Co.

How to Position Yourself in the Battery Market

To stand out in the battery market, it is essential to evaluate four main areas: market, technology, sustainability, and regulation.

EXHIBIT 10




Market	Technology	Sustainability	Regulation
▪ **Continuous growth**, driven mainly by increased demand for energy storage and the growing electrification of vehicles ▪ **Reduction in battery prices**, stemming from increased demand and new technologies in the market	▪ **Evolution of existing battery characteristics**, improving aspects such as lifespan and discharge time ▪ **New battery technologies offered** on the market, such as organic lithium batteries, flow batteries, silicon anode technologies, as well as new materials used in manufacturing	▪ **Increase in waste disposal requirements and search for less harmful materials** ▪ **Increased company investments in battery recycling** solutions ▪ **Increased demand for** batteries made with **sustainable materials**	▪ **Increase in** battery **safety standards requirements** ▪ **Increased government incentives for the use of sustainable energies will impact battery demand** for renewable energy storage and vehicle electrification

Battery sector expectations for the coming years in market, technology, sustainability, and regulation
Source: Empresa de Pesquisa Energética (EPE), Mirow & Co.

How can Mirow help your company explore opportunities in the battery sector?

Mirow & Co. offers a comprehensive approach to conducting projects in the battery industry, covering everything from market analysis and scenarios to the identification of emerging battery technologies, opportunity mapping, detailing of new business models, and implementation. This flexible approach allows projects to be customized and/or phased according to the specific needs of clients.

EXHIBIT 11

Market analysis and scenarios	Emerging battery techno-logies	Opportunity areas	Business models	Implemen-tation roadmap
▪ **Mapping the current structure, industry performance of the battery industry worldwide** (e.g., demand, value chain, key players, etc.) ▪ **Scenario creation for the battery market in the coming years** (e.g., main segments, market size, growth, etc.) ▪ **Conducting workshops** to discuss market scenarios and company strategy	▪ **Conducting interviews with experts** to identify industry trends and challenges ▪ **Synthesizing the main findings from interviews/ research** – Technologies – Applications – Maturity ▪ **Mapping the battery technology ecosystem** (e.g., centers, startups, companies, etc.)	▪ **Identification of opportunity areas** for the company in the sector ▪ **Assessment of business attractiveness and synergies** with the process of different opportunity areas ▪ **Conducting workshops with external** experts to discuss opportunity areas and evaluate potential possibilities	▪ **Detailing of prioritized opportunities:** – Initiatives – Involved Areas – Expected return – *Go-to-market* – Deadlines ▪ **Conducting workshops with leaders** for discussion and validation of the detailed strategy	▪ **Mapping of organizational implications:** – People – Structure – Processes/ tools ▪ **Development of implementation script:** – Actions – Deadlines – Monitoring Indicators – Responsible parties

The project can be customized and/or phased as needed

Source: Mirow & Co.

Want to learn more? Contact us:

Felipe Diniz

Partner

+55 (21) 99105-7396

felipe.diniz@
mirow.com.br

Lucas Santiago

Associate Partner – Operations and Supply Chain

+55 (11) 99203-5120

lucas.santiago@
mirow.com.br