Lithium-Ion batteries: increased adoption, overlooked risks

QBE

Overview

Lithium-Ion (Li-Ion) batteries power everything from smartphones and laptops to electric vehicles (EVs) and renewable energy storage systems. Their high energy density, long cycle life and decreasing cost have fuelled widespread adoption across various industries around the world.

However, the growing use of these batteries comes with risk implications – for both consumers and businesses. What are these risks? And how are they likely to impact the insurance sector in the coming years?

Use cases and adoption trends

Li-Ion batteries are an omnipresent feature of modern technology because they perform better than other battery technologies. Their high energy density allows them to store more energy per unit of weight, making them ideal for portable devices.

Li-Ion batteries can be charged and discharged many more times than other types of batteries before their performance degrades. This durability makes them a long-term cost-effective choice for both consumer electronics and larger applications such as EVs and energy storage systems.

The lower self-discharge rate of Li-Ion batteries means they lose less charge when not in use, further enhancing their efficiency and reliability.

On top of that, these batteries can also be produced in various shapes and sizes, offering flexibility in design and engineering for manufacturers across different industries.

> In 2023, over a billion smartphones were sold globally, virtually all powered by Li-Ion batteries

Consumer electronics

Li-Ion batteries are the preferred choice of manufacturers in consumer electronics, powering an increasing number of devices around the world. In 2023, over a billion smartphones were sold globally, virtually all powered by Li-Ion batteries. Other day-to-day Li-Ion powered electronics include laptops, tablets, smartwatches, digital cameras, portable speakers, e-readers, gaming consoles, wireless headphones, and portable medical equipment.

Sales of Li-Ion-powered electronics globally in 2023

1.2bn	242m	135m	70m
smartphones	laptops	tablets	speakers

Electric vehicles (EVs)

The growing adoption of Li-Ion batteries in EVs is one of the most significant trends shaping the future of transportation. A virtuous combination of decarbonisation policies by multiple governments and substantial investments in battery innovation and manufacturing capacity has driven growth across different markets – a trend that will likely only intensify in the coming years.

> Global sales of EVs reached over 14m units in 2023, a 35% increase from 2022

In 2023, global sales of EVs reached over 14m units, a 35% increase from 2022 (when sales were up by 55% from 2021), according to the International Energy Agency (IEA). While China leads EV sales, momentum is also notable in Europe. In Germany and the UK, for example, electric models represented 24% of car sales in 2023. A similar scenario is also being seen in the US, while the rest of the world is catching up on the trend.

Total EV sales, 2021-24

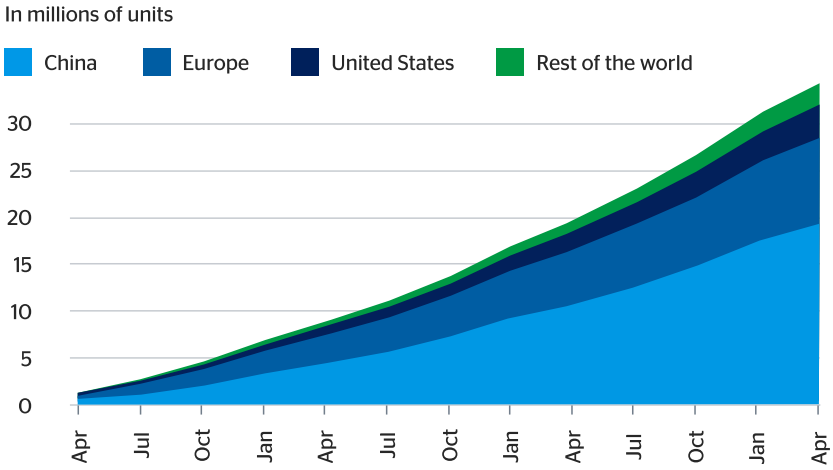

Chart: Control Risks • Source: IEA

Renewable energy storage

Li-Ion batteries can store renewable energy, which helps stabilise grids and enhance the efficiency of renewable power systems such as solar or wind. The US Energy Information Administration (EIA) reported that battery storage capacity in the United States almost quadrupled to 20.7 GW in 2024 (from 5.5 GW in 2021) and that Li-Ion technology features in most US utility-scale battery energy storage systems.

Similarly, Europe is also witnessing a rapid expansion of battery storage projects, which are mainly driven by the European Green Deal – the EU's flagship climate policy framework - and its associated goal to achieve climate neutrality by 2050. Total installations in Europe - including European Union (EU) and non-EU countries - totalled approximately 10.1GW. This was more than double the 4.5GW recorded across Europe for 2022, as Europe continues to pursue an ambitious target of 95 GW by 2050.

Overlooked risks?

Recent advancements in battery chemistry and design have significantly enhanced the safety profile of Li-Ion batteries. However, considerable risks persist, with management implications becoming more complex and important as adoption and use cases continue to increase. Monitoring and understanding battery health over the life-cycle is a crucial aspect of risk reduction. Taking pre-emptive action when a battery sustains damage greatly reduces the potential for dangerous incidents.

Thermal runaway and fire hazards

One of the most critical risks is thermal runaway, a condition where a battery cell overheats and causes a chain reaction leading to fire or explosion. This phenomenon occurs when the internal temperature of a battery cell rises uncontrollably due to internal short circuits, overcharging, excessive discharge or physical damage. The heat generated during this process can cause the electrolyte within the battery to break down, releasing flammable gases. These gases can ignite, leading to fires or explosions that can spread rapidly and are difficult to extinguish. In addition, thermal runaway cannot be reversed once it has begun.

> Increasing incidents have led the London Fire Brigade to publicly characterise e-bikes as 'London's fastest growing fire risk'

For example, in New York City, 92 Li-Ion-based fires injured 64 people and killed nine in 2023, nearly equal the combined fatalities for 2021 and 2022, according to data by the International Association of Fire and Rescue Services (CTIF).

In Europe, countries such as the UK, Germany, France and Spain have each reported dozens of fire cases associated with Li-Ion batteries. According to data collated by QBE, UK fire services recorded 270 fires linked to electric bikes in 2023, up from 158 in 2022. Increasing incidents have led the London Fire Brigade to publicly characterise e-bikes as "London's fastest growing fire risk". Fires involving e-bikes and e-scooters have caused deaths to riders but have also caused significant disruption to by-passers when the emergency response to the incidents required evacuation of densely populated areas.

Risks in aviation

The US Federal Aviation Administration (FAA) and the European Aviation Safety Agency (EASA) have also reported a growing number of accidents involving Li-Ion batteries in air transportation, with a total of 55 cases reported in the US alone in 2022. Cases typically involve batteries in devices such as laptops, smartphones, e-cigarettes and portable power banks, which can overheat, ignite or explode, leading to fires that can be difficult to extinguish. The increasing frequency of such incidents has prompted aviation authorities worldwide to tighten regulations on the transport of Li-Ion batteries and enhance safety protocols to mitigate the associated risks.

> Batteries that have been used or are 'returned' to a business operating rental schemes are much more likely to suffer faults leading to thermal runaway

Manufacturing defects and design flaws

Safety risks stemming from manufacturing defects and design flaws are multifaceted and potentially significant. Manufacturing defects, such as contamination of the cell components or improper assembly, can lead to internal short circuits. These defects may cause the battery to overheat, ignite, or even explode.

For instance, microscopic metal particles left inside the battery during the manufacturing process can penetrate the separator, causing a short circuit. In a high-profile case involving a tablet model that was widely sold in recent years, manufacturing defects led to widespread battery fires and explosions, resulting in a number of injuries and a costly global recall for the manufacturer.

Design flaws also contribute to safety risks, particularly when batteries are integrated into devices without adequate thermal management or protective features. Poor design can exacerbate the risk of thermal runaway. For example, inadequate space for thermal expansion, lack of sufficient cooling mechanisms or insufficient protective circuitry can all contribute to failures. In addition, batteries that have been used or are 'returned' to a business operating rental schemes are much more likely to suffer faults leading to thermal runaway. These risks are heightened in applications with larger batteries, such as EVs and large-scale energy storage systems, where the elevated energy density can amplify the consequences of design flaws.

Geopolitical competition

Overreliance on Li-Ion batteries may also pose operational risks for businesses. Lithium and cobalt are critical components of Li-Ion batteries, leaving supply chains vulnerable to delays or shortages. With China a dominant player for extraction and processing, geopolitical competition will combine with growing global demand to likely cause occasional disruptions in the coming years.

This will also have some safety implications. As countries and multinationals will likely rush to introduce new solutions in the market around clean energy technology (including batteries), there is a risk that the associated, growing political pressure might impact regulatory processes – ultimately compromising the robustness of safety protocols.

In fact, the rapid evolution of Li-Ion battery technology has almost outpaced regulatory frameworks in recent years, leading to some degree of uncertainty for businesses. In the US, the Department of Transportation (DOT) and the FAA have established guidelines for the safe transport of Li-Ion batteries, but these regulations require continuous updates to address new risks.

The EU, in its turn, introduced a regulatory framework in 2023, to address challenges across the entire battery lifecycle, from production to disposal. Its focus on safety and sustainability will likely set the agenda for other regions, as the significant adoption of Li-Ion batteries raises concerns regarding waste management.

Insurance risk implications

As Li-Ion battery technology continues to evolve, consumers and businesses need to be aware of emerging risks. Proactivity pays off in risk management, so those that properly anticipate both technological and regulatory trends will likely be able to best mitigate the associated threats. Businesses should work with the relevant stakeholders to mitigate disruption risks through robust supply chain management and compliance strategies. Ultimately, the successful integration of Li-Ion batteries into the global economy will require a collaborative effort between manufacturers, regulators, insurers, and end-users to ensure safety, reliability, and sustainability.

> Businesses should mitigate disruption risks through robust supply chain management and compliance strategies

Consumers and businesses must account for the possibility of large-scale incidents arising from Li-Ion-related accidents, which can occur in diverse settings, including business facilities, residences, during transportation, and in public spaces. On 23 June, an explosion of Li-Ion batteries in a waste recycling plant near Glasgow caused a massive fire, disrupting local businesses and residents for an extended period.

If a Li-Ion device malfunctions while charging at home, it could harm occupants and cause damage, leading to personal injury and property damage. If an EV catches fire while being shipped, the blaze will propagate to the other vehicles on board, endangering the crew and leading to major logistical disruptions. If a battery fails in a crowded space like a shopping mall or an airport, this could spark panic, injuries, damage, and disruption. The resulting liability could involve multiple parties, including manufacturers and venue operators.

The risks are complex and multifaceted, requiring a comprehensive approach to risk management. By staying informed about technological advancements and regulatory changes, insurers, consumers and businesses can better protect themselves from the potential hazards associated with Li-Ion batteries.

EVs in the spotlight

The increasing adoption of EVs adds another dimension to the consumer risk profile. Incidents involving EVs not only pose significant safety risks to the vehicle users but also to other people and property. EV batteries are also driving average claims costs higher due to the need to replace batteries involved in accidents. A battery can account for more than a third of a vehicle's value and safety measures installed by certain manufacturers require batteries to be replaced in the event of an accident even if no damage has been sustained. Insurers need to continuously update their risk assessment models and coverage policies to keep pace with the evolving landscape of Li-Ion technology.

Companies that manufacture, distribute and use of Li-Ion batteries are exposed to a range of associated risks. Manufacturers must ensure stringent quality control and compliance with evolving safety standards to prevent defects that could lead to battery malfunctions. Product recalls, legal liabilities and reputational damage can have huge financial implications. Insurers must evaluate these risks carefully, considering not only the direct costs associated with potential claims but also the broader impact on the company's market position and operational continuity. This requires a comprehensive understanding of the technological and regulatory landscape, as well as close monitoring of emerging trends and incident data.

Finally, insurers and businesses must stay on top of ongoing and incoming regulatory changes across different jurisdictions and work together to ensure compliance, thereby reducing the likelihood of costly claims and improving the effectiveness of risk management strategies.

The ongoing energy transition is currently one of the most dynamic investment spaces worldwide. The batteries sector, which is a key aspect of this, will certainly evolve in the coming years. Geopolitical landscape and market incentives, among other factors, will drive innovation, along with the risks associated with batteries – and fast.

Insurers should monitor closely changes to materials, manufacturing technology, regulation and consumer preferences. Innovation can be charged with potential, provided we understand and mitigate the associated risks.

Annex – key references

"Apple overtakes Samsung as world's biggest phonemaker", bbc.co.uk
"PC Shipments Drop Below 250 Million in 2023", statista.com
"Global tablet market ends tough 2023 with 11% decline in Q4", canalys.com
"QBE issues plea as fires linked to lithium-ion batteries rise", insurancetimes.co.uk
"Lithium-ion battery fire fatalities in 2023 will likely surpass last 2 years combined", fireresCue.com
"Europe reached 4.5GW of battery storage installed in 2022; could hit 95GW by 2050", energy-storage.news
"Number of smartphones sold to end users worldwide from 2007 to 2023", statista.com
"Lithium battery fires", ctif.org
"Lithium Battery Incidents", faa.gov
"E-bikes London's fastest growing fire risk, says fire service", bbc.co.uk
UK fire services face 46% increase in fires linked to lithium-ion batteries, qbeeurope.com
Batteries are a fast-growing secondary electricity source for the grid, eia.gov
Europe installed 10GW of energy storage in 2023, EU policies to drive major growth this decade, energy-storage.news

About QBE

QBE helps businesses build resilience through risk management and insurance.

Our insurance solutions are designed to meet the different requirements of our customers and range from flexible e-trading solutions through to comprehensive, specialty programmes. Cover can include the standard suite of property, casualty and motor through to the specialist financial lines, marine and energy.

Depending on the size and complexity of their business needs, QBE customers can access a wide range of risk management services, self-assessment questionnaires and risk management toolkits which are focused on the key causes of incidents, generating action plans for improved outcomes, reducing risk and making claims less likely.

QBEeurope.com

This report has been developed for QBE by **Control Risks**

QBE European Operations
30 Fenchurch Street
London EC3M 3BD
+44 (0)20 7105 4000
QBEeurope.com

641209/2405