

Powering consumer
adoption of new
technology

Empowering Trust[®]



Lithium-ion (li-ion) batteries are the most used battery technology for a growing range of product categories. Learn how to minimize risks while reaping the rewards.

During the past 30 years, consumer electronics have become significantly more complex — and ever-present. One of the reasons behind the rise of consumer electronics is advances in portable power, such as the 1991 introduction of lithium-ion batteries.

Li-ion batteries have reduced their physical size while becoming more powerful over the past decades. As a result, the latest products for the consumer market now feature evolving capabilities and connectivity that can integrate the tinier lithium cells and electronic circuitry.

Let's explore how this versatile technology has proven transformative for consumers — and how li-ion batteries will continue to impact daily life.



Portability and versatility — Consumers rely on devices for more activities than ever. From e-bikes to tablets, health-centric wearables to e-cigarettes, these battery-powered devices are in pockets, packs and purses around the world. A quick charge may keep a device powered up and cord-free for a few hours, days, weeks or months, depending on use.

Advances in li-ion capabilities have made batteries popular in more substantial devices, such as residential solar systems and even airplanes. Even traditional products are more feature-rich, including consumer and commercial robots with automatic sensors to detect human movement and interaction, electric mowers with onboard geofencing or interactive toys for curious pets.



Performance — Advances in battery design have helped overcome limitations and enable enhanced dependability. Today's li-ion batteries feature increased energy density, fitting more power in a smaller footprint.



Sustainability — The science around climate change requires us to take direct action to lessen our environmental impact. When it comes to energy choices, the increased power of li-ion batteries makes it not only possible but practical and affordable to go off the grid. A roof's worth of solar panels and lightweight and stackable li-ion batteries can provide power for single-family homes in many areas.

In addition, the use of cobalt is being reduced from many of the newer li-ion chemistry formulations. Cobalt has often been cited as a conflict mineral and new efforts are underway to more responsibly and sustainably obtain cobalt as well as reduce the dependency of it in the latest battery chemistry formulations.

City planners, transportation advocates and consumers are all becoming more interested in how transportation can improve sustainability, including personal mobility solutions, electric and hybrid vehicles and more robust public transport solutions. All of these methods of transit can be supported through li-ion power, and European countries, such as Germany and Ireland, plan to roll out li-ion-powered electric trains, according to Railway Age. [Deloitte](#) estimated that more than 300 million e-bikes may be in use by 2023, and by 2028 the e-scooter market will experience a compound annual growth rate (CAGR) of 7.6%, according to [Research and Markets](#).

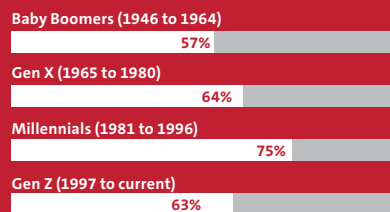


In 2020, the li-ion battery market was \$50 billion (USD). By 2025, the market is predicted to reach \$100 billion (USD).

Source: [Market Study Report](#), May 2020

Green facts

Consumers are willing to pay more for environmentally sustainable products. Here's how it breaks down by generation:



Sources: [GreenPrint](#), [Pew Research](#)

Emerging consumer trends empowered by li-ion technology for everyday home or work use



Entertainment and work

Virtual work/school technology, home/office equipment, gaming, augmented reality (AR), virtual reality (VR), mixed reality (MR)



Health and wellness

Fitness trackers, hearing aids, toothbrushes, smart clothing/wearables, personal grooming equipment, Bluetooth® headphones



Home and garden

Service robots, robot mowers/vacuums, hobby drones, security systems



Micromobility

e-Bikes, e-scooters, hoverboards



Proactively address consumer concerns

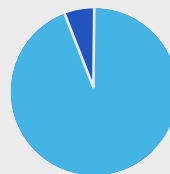
Because of the rising universality of products with li-ion batteries on board, manufacturers must ensure that their battery-operated products can meet the expectations of today's discerning consumers for performance but, more importantly, for safety.

In July 2020, Consumer Reports conducted a study demonstrating that today's buyers have expectations around safety that manufacturers are not meeting:

- 96% of American consumers believe that products they purchased require adherence to mandatory safety standards. The real number? Just 70 of 15,000 — **fewer than 1%** — of product categories overseen by the Consumer Product Safety Commission (CPSC) must comply with a mandatory safety standard.
- 97% of American consumers expect that manufacturers test products before they enter the market.

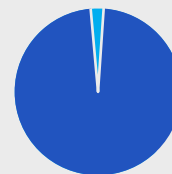
Product Testing

BELIEF



96% of Americans believe products they buy for their home must adhere to a required safety standard.

REALITY



<1% of product categories overseen by the CPSC must comply with a mandatory safety standard.



In 2020, the CPSC had reported more than 25,000 incidents involving li-ion battery-operated products since 2012. To protect the public from the risk of injury, the CPSC issued more than 70 product recalls representing in excess of 7 million units of various battery and end products.

Source: U.S. Consumer Product Safety Commission, [“Updated Status Report on High Energy Density Batteries Project.”](#)

March 31, 2020.

- Safety — high-profile incidents involving fires or explosions leading to product recalls may linger in the memory of some consumers, making buyers hesitant to purchase a battery-operated product. Yet consumers still want more powerful batteries in smaller packages and lower prices.
- Thermal runaway is commonly the culprit behind these problems. This reaction is caused by uncontrolled overheating within the battery cell and must be carefully managed through product design, electronic circuitry, critical safety software and clean manufacturing. Manufacturers should further commit to their brand promise and protect consumers from known li-ion dangers by utilizing independent and impartial third-party evaluation, testing and certification.
- Products contain more li-ion power than ever before and are being rushed to a market that does not mandate third-party certification. Hasty development and lack of oversight can translate directly into product faults, fires and even injuries.
- Product life cycle — we know that consumers are interested in sustainability. Li-ion batteries feature sustainability claims because these products can be charged hundreds or thousands of times, minimizing waste. But there are few recycling programs. The United States Department of Energy estimated that fewer than 5% of li-ion batteries are recycled. The methods for sourcing and countries of origin for lithium and other components, such as cobalt, may result in additional consumer questions.
- Manufacturers must be careful not to make erroneous claims about the sustainable nature of their products. Unsubstantiated claims may alienate or anger consumers and damage brand credibility, while truthful claims can reinforce perceptions and educate consumers.

“For consumer applications, incidents caused by li-ion batteries have been increasing steadily for the past 10 years. The abundance of lithium cells within household appliances, consumer electronics, medical devices, electric vehicles, and many other surprising applications is a cause for concern for public safety. UL believes one of the easiest and best safeguards for the public is to require a third party to certify the conformance of any product to the applicable product safety standard. Product safety standards are written by a community of experts in the aim to improve public safety and are one of the tools we have to help ensure safe lithium-ion battery-operated products.”

Crystal Vanderpan, principal engineer director, UL's Consumer and Medical Technology



Comprehensive battery safety program designed for battery and battery-operated product manufacturers

As portable electronic devices proliferate, the efficiency, reliability and safety of battery cells and battery-operated products become even more critical. UL offers a wide array of services to give manufacturers peace of mind and buyers and consumers increased confidence in their products.

Battery safety testing and certification

UL provides many related services essential to the safety of battery-operated products. We start with the materials and can evaluate lithium-ion cell battery separators to UL 2591, the Outline of Investigation for Battery Cell Separators.

For cellular-enabled products, UL is a CTIA Authorized Test Laboratory for battery safety, offering manufacturers and suppliers a flexible and cost-effective way to gain industry recognition. CTIA certification demonstrates that mobile battery products comply with IEEE 1725 (rechargeable batteries for cellular telephones) or IEEE 1625 (rechargeable batteries for portable computing).

In-house EMC compatibility

UL also offers electromagnetic compatibility (EMC) services, providing a customized package to optimize testing capabilities. This enables manufacturers to identify and resolve EMC problems as early as possible.

Stand by sustainability

UL's Environmental Claim Validation (ECV) provides manufacturers with credibility for their environmental sustainability claims, such as battery recycling programs. UL's publicly available sustainable product database, UL SPOT, features validated products.

UL can evaluate battery products, such as lithium-ion battery cells and packs, chargers and adapters, and battery-operated end products, to key international, national and regional standards and certification schemes, including:

- [UL 810A, the Standard for Electrochemical Capacitors](#)
- [UL 1642, the Standard for Lithium Batteries](#)
- [UL 1973, the Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail \(LER\) Applications](#)
- [UL 2054, the Standard for Household and Commercial Batteries](#)
- [UL 2580, the Standard for Batteries for Use In Electric Vehicles](#)
- [UL 2271, the Standard for Standard for Batteries for Use In Light Electric Vehicle \(LEV\) Applications](#)
- [IATA/UN DOT/UN 38.3 T1-5, T6, T8 or IEC/EN 62281, lithium cells and packs](#)
- [IEC/EN/UL 60086-1/-2, the Standard for Safety for Primary Batteries](#)
- [IEC/EN/UL 60086-4, the Standard for Safety for Primary Batteries - Part 4: Safety Of Lithium Batteries](#)
- [IEC/EN 60086-5, primary, aqueous electrolyte cells](#)
- [IEC/EN/UL 62133-1:2017, the Standard for Secondary Cells and Batteries Containing Alkaline or Other Non-Acid Electrolytes - Safety Requirements for Portable Sealed Secondary Cells, and for Batteries Made from Them, for Use in Portable Applications - Part 1: Nickel Systems](#)
- [IEC/EN/UL 62133-2:2017, the Standard for Secondary Cells and Batteries Containing Alkaline or Other Non-Acid Electrolytes - Safety Requirements for Portable Sealed Secondary Cells, and for Batteries Made from Them, for Use in Portable Applications - Part 2: Lithium Systems](#)
- [IEC/EN/UL 62368-1, the Standard for Audio/Video, Information and Communication Technology Equipment - Part 1: Safety Requirements](#)
- [IEC/EN 62619, Safety requirements for lithium-ion cells, modules, and packs intend to stationary storage](#)
- [IEC/EN 62620, Performance requirements for lithium-ion cells, modules, and packs intend to stationary storage](#)
- [IEEE1625/1725, CTIA](#)
- [BMSI, CNS 15364 99/102 Taiwan](#)
- [JIS C 8715-2, Stationary — Japan](#)
- [GB31241-2014, China CQC Mark for battery which intend to portable electronic devices](#)

Why UL?

At UL, we're constantly looking at how technology will impact safety to stay on pace with market developments and work closely with consumer advocacy, trade associations and user groups to shape standards designed to identify and mitigate risk.

We offer a comprehensive battery safety program for manufacturers that can help reduce the likelihood of safety issues:



Recognized expertise –UL offers more than 40 years of experience in battery evaluation and testing. By demonstrating compliance to applicable standards, thousands of products have earned UL certification, a key driver of brand reputation and public trust.



Supplier selection – Success often rests on the caliber of partners involved in a project. The UL Prospector® and UL Product iQ® databases help manufacturers identify suppliers that fit their needs by properties, applications, safety data, performance characteristics and more.



System approach to safety – We take a systems approach to safety and analyze ancillary products consumers depend on, such as replacement batteries and chargers.



Failure analysis and audits – Some of the best information about product safety comes when we push products to the limit and identify areas of vulnerability, using methods such as simulation, physical testing and fault tree analysis.



Continual education – We offer self-paced training to research and development, compliance, factory, assembly, maintenance, transportation and shipment workers across the entire li-ion battery value chain, as well as informative webinars that help navigate the regulatory landscape.

Count on the Mark

Consumers deserve to trust that the products they've chosen are safe, but all too often, it's impossible to know.

That's why many consumers look to third-party testing and certification, such as the UL Mark. We have also developed specialized Listing and Classification Marks that convey specific significance for consumer products and the batteries that power them.

Retailers also value the UL brand, with 66% of U.S. retailers expressing a preference for the UL Mark over other testing, inspection and certification (TIC) marks, according to a recent U.S. Value Chain Study.

The devices that power our modern world demand a holistic approach to safety that helps protect consumer health, property and data. At UL, we help manufacturers identify risks that may impact product safety, time to market and brand reputation.

Get started with UL's battery safety testing and certification program. To learn more, visit www.UL.com/batt or contact us at UL.com/contact-us



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