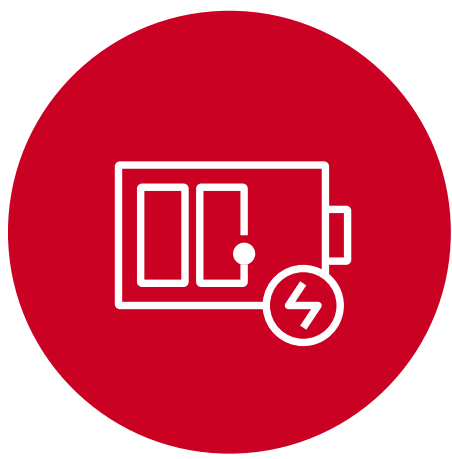


# Managing critical challenges in battery energy storage systems

How battery innovators can address complexities to advance energy storage adoption

Battery energy storage systems (BESS) play a crucial role in integrating more renewable energy, enhancing grid reliability and electrifying transportation. The International Energy Agency (IEA) estimates that a sixfold increase in BESS deployment is needed by 2030 to support the energy transition. While BESS offers significant potential to reduce emissions, promote reliability, and integrate into many new products and applications, they also introduce new complexities.



## Safety concerns

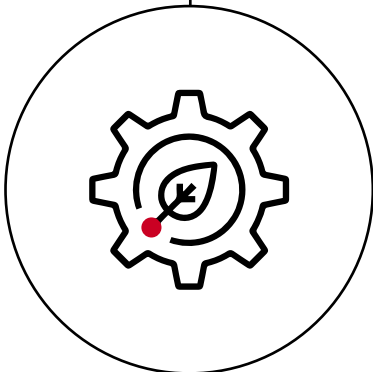
- ⚠ **Improper handling**
- ⚠ **Manufacturing defects**
- ⚠ **Operational faults**

can lead to overheating, fires or explosions, posing significant risks to users and the environment. To mitigate these risks, advanced detection systems, new firefighting strategies and better community preparedness are essential for safer, more sustainable BESS deployment.



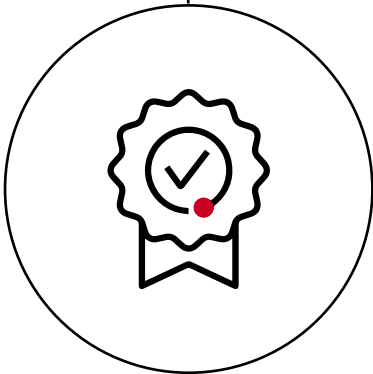
## Performance under extreme conditions

The diversity of battery designs can impact their function, especially when connected to larger systems. Rigorous testing across different dimensions of performance and foreseeable adverse conditions helps manufacturers and OEMs bring safer components and systems that perform as designed, specified and advertised to market.



## Compliance and regulations

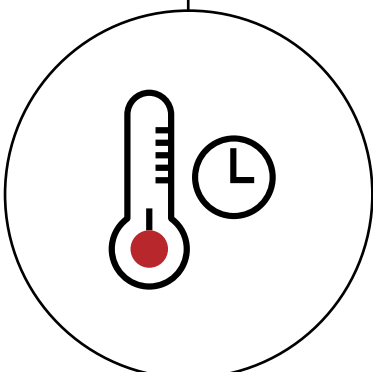
Rapid innovation often outpaces published standards, leading to gaps in safety. Staying ahead of the curve on changes to standards, codes, and regulations is critical for all stakeholders in the energy storage landscape.



## Degradation

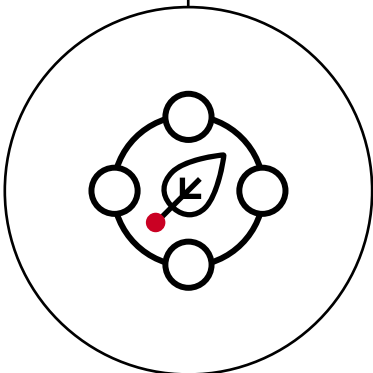
- ⚠ **Temperature**
- ⚠ **Usage patterns**
- ⚠ **Manufacturing quality**

Factors like temperature, usage patterns and manufacturing quality influence battery degradation. Optimizing charging practices, temperature management and battery maintenance could mitigate risks to quality and performance.



## Environmental impact

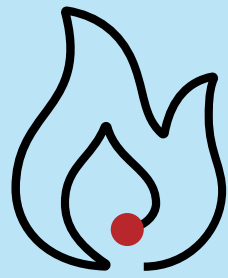
Lithium-ion batteries introduce complex environmental challenges across their lifecycle. Improper handling can lead to environmental contamination and safety risks posed by hazardous materials. Promoting more sustainable end-of-life management can help address these concerns and doing so in initial testing and design stages can help turn challenges into a source of competitive advantage.



### Fire Safety

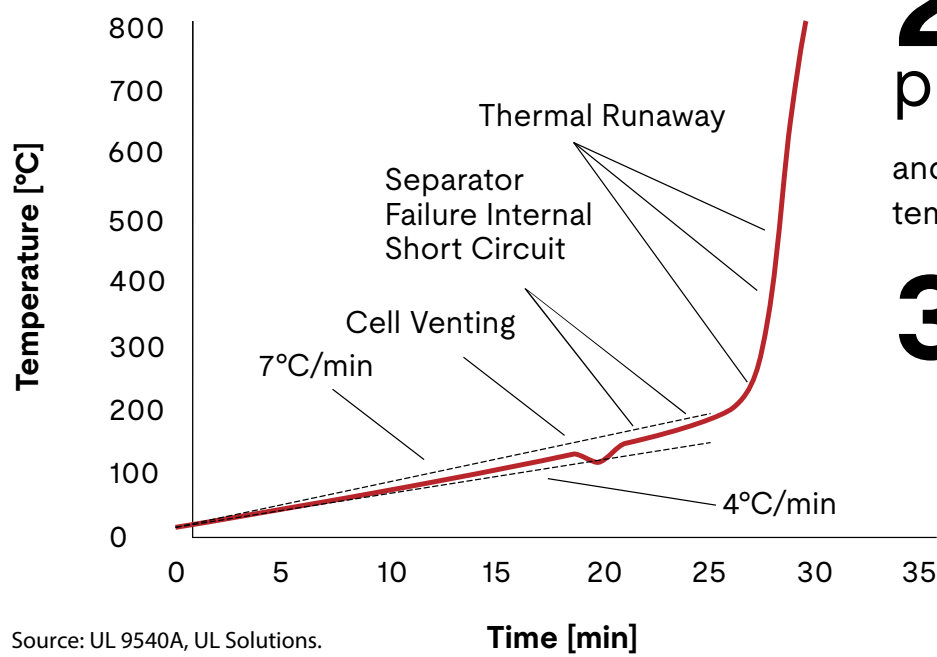
Over the past 30 years, UL Solutions has identified that fire-related incidents have resulted in nearly:

**500** fatalities  
**4,000** injuries  
from battery failures



### Performance under extreme conditions

Lithium-ion cells can reach thermal runaway when temperatures rise uncontrollably at a rate greater than



**20°C** per minute  
and when maximum temperatures exceed  
**300°C**

### Compliance and regulations

Laws to enhance the safety of products with lithium-ion batteries are being developed and passed worldwide, including state legislation in New York, the U.S. federal Setting Consumer Standards for Lithium-Ion Batteries Act and the European Commission's updated EU Battery Regulation.

### Degradation

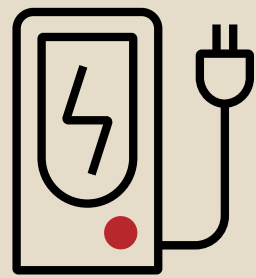
Various battery lifespans can range from 500-20,000 cycles.

EV batteries could have

**1,000-2,000** cycles

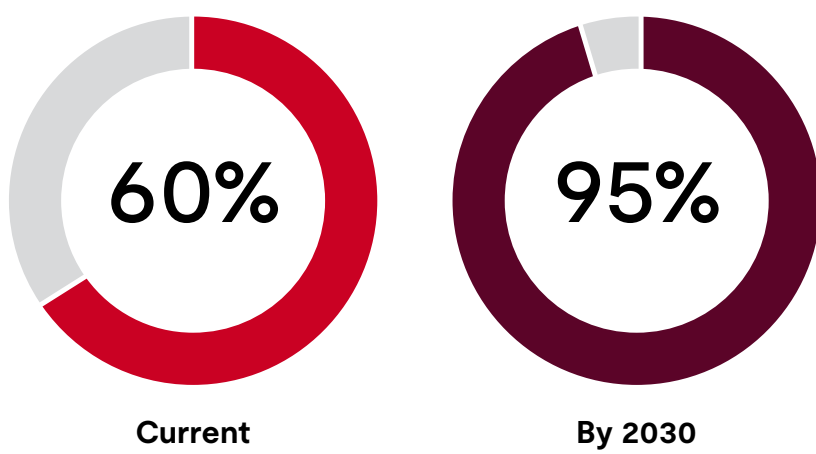
while smartphone batteries typically feature

**500-1,000** cycles



### Environmental impact

Nearly 60% of lithium is mined for battery applications and projected to reach 95% by 2030. This mining entails significant environmental impacts.



## Supporting leaders in battery energy storage

With more than 130 years of expertise in safety, testing and certification, UL Solutions helps stakeholders ranging from manufacturers and OEMs to developers and project operators navigate the complexity of the battery energy storage landscape as it evolves. We offer the following services and advantages, as well as many others:

### Battery safety and performance

Competitive benchmarking, charge/discharge and overcharge tests as well as performance condition testing for component and system manufacturers and integrators.

### Environmental impact

Resources and certifications, such as UL 1974, the Standard for Evaluation for Repurposing Batteries, that promote sustainable sourcing, recycled content validation and recycling validations.

### Staying ahead of the curve

We routinely participate on standards panels and in working groups to stay ahead of the curve on evolutions to standards, codes and regulations that may impact testing and compliance.

Together, we can advance safety, quality and performance in battery energy storage in service of the energy transition. Connect with us today.