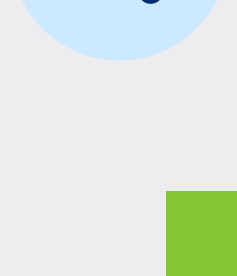


RISKY BUSINESS

What You Need To Know About...

LITHIUM-ION BATTERIES



Lithium-ion (Li-ion) batteries continue to increase in popularity as more devices and equipment utilize them for power. Because of the unique properties of lithium, **these batteries have a high energy density, minimal memory loss and low loss of charge when not in use.**

HOW LI-ION BATTERIES WORK:

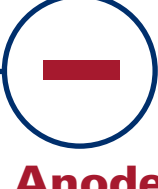
Batteries convert chemical energy to electrical energy and can consist of one or more cells.

Each cell contains one positive electrode (cathode) and one negative electrode (anode), with a separator in between.



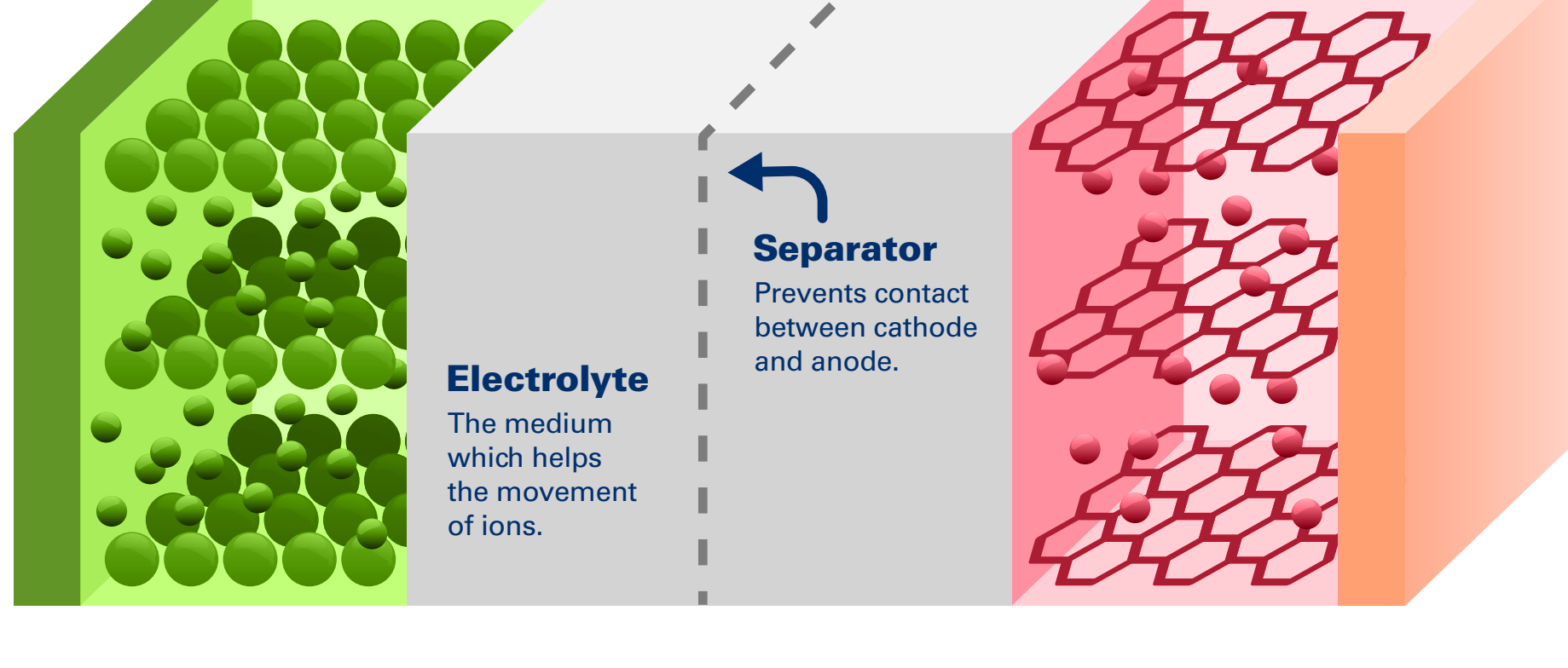
Cathode

As the source of lithium ions, determines the capacity and the average voltage of a battery.



Anode

Stores and releases lithium ions from the cathode, allowing currents to pass through an external circuit.



Cathode ← Anode

Li-ion batteries generate power during discharge by the lithium ions moving from the anode to the cathode.

Cathode → Anode

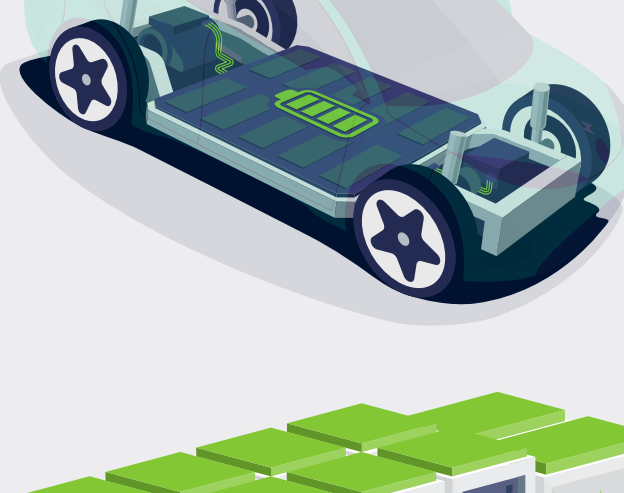
This process is reversed when batteries are charging. Typically, the separator sits inside of an electrolyte bath that is an ignitable liquid.¹

COMMON USES:

1 Small Electronic Devices



2 Electric Vehicle Cell Pack



3 Large Energy Storage Systems



HAZARDS OF LI-ION BATTERIES:

Lithium is a highly reactive metal and can present a fire risk. This risk increases when lithium batteries include other ignitable chemicals.

Physical Damage

Physical damage can come in the form of cracks or dents. These can occur during the manufacturing process, shipping or handling of the battery. Physical damage may not always be visible as it can be present inside of the enclosed battery. This type of damage can also lead to thermal runaway.



Thermal Runaway

A chemical reaction that occurs when more heat is created within the battery than is being dissipated. The heat will degrade the electrolyte inside of the battery causing it to fail and catch on fire. During thermal runaway, the electrolyte degrades into flammable gases, such as hydrogen, hydrocarbons and carbon dioxide.

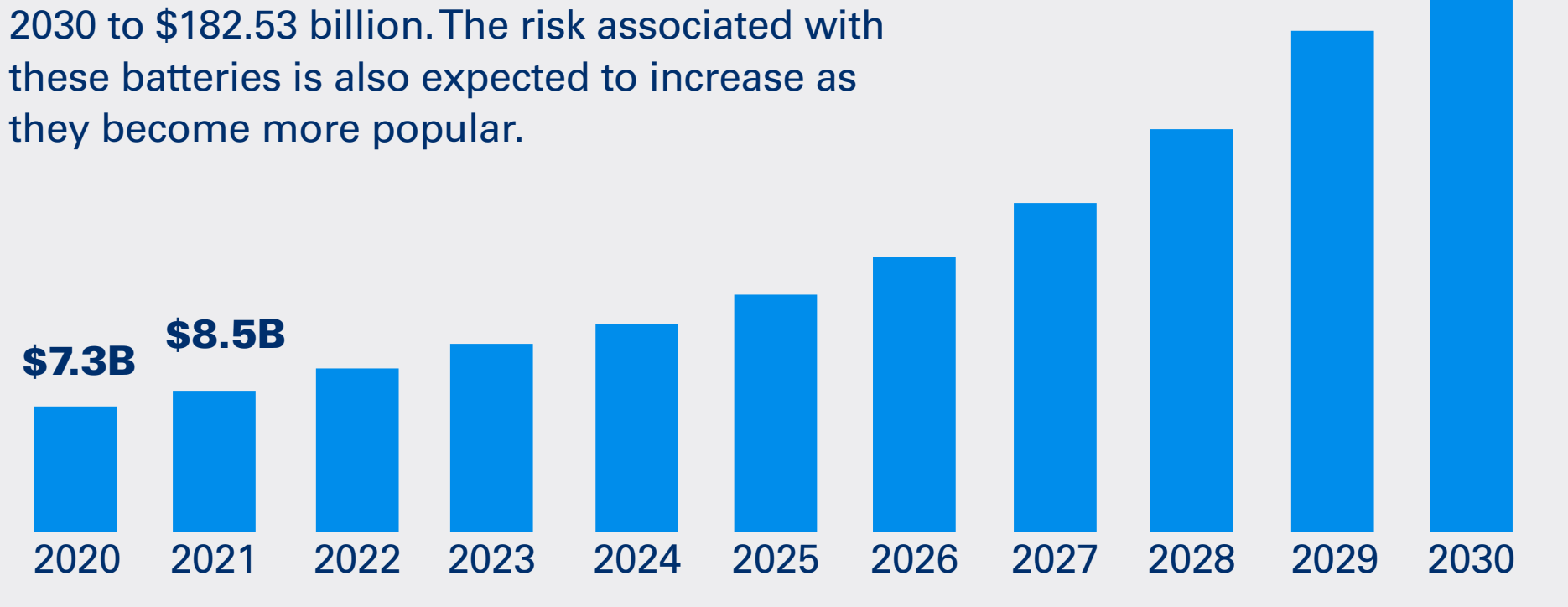
Electrical Abuse:

Common types of electrical abuse are overcharging and over-discharge. Electrical abuse can lead to thermal runaway.

EMERGING TRENDS:

U.S. Li-ion Battery Market Size²

The **U.S. market for Li-ion batteries is projected to steadily increase**, more than quadrupling by 2030 to \$182.53 billion. The risk associated with these batteries is also expected to increase as they become more popular.



MAINTENANCE TIPS:



Follow the manufacturers' guidelines

and instructions for batteries and the devices that use them.



If accessible, routinely inspect batteries and replace if damaged.

Common signs of battery damage include bulging, dents, corrosion and unusual heat or smell.



Properly dispose of or recycle batteries.

Batteries should not be thrown away with normal household trash.



Never expose batteries

to an environment that is outside of the manufacturers' recommendation.



Always keep batteries and the devices that use them within the manufacturers' recommended temperature range,

whether the temperature is from the environment or from use.



Always use original chargers

designed for the device. Incorrect or non-branded chargers could damage the battery and device.



Properly label packages

per the law when shipping batteries or the devices that use them.



Unplug devices

once they are fully charged; over-charging can damage the battery. Some devices have overcharge protection that will limit the charge on the device.



Keep devices out of direct sunlight.

Prolonged exposure to direct sunlight can cause the battery to overheat and it could explode or catch on fire.

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References

¹ Mikolajczak, C., M. Kahn, K. White, and R.T. Long. *Lithium-Ion Batteries Hazard and Use Assessment*. Exponent Failure Analysis Associates, Inc. Fire Protection Research Foundation. July 2011.

² <https://www.grandviewresearch.com/industry-analysis/lithium-ion-battery-market>