EV and Energy Transition

Articulate the need for the fire service to lead and inform the discussion on the fire safety of lithium-ion batteries and other alternative energy sources within our communities, at all levels of government, and with industry partners.

Issue

The fire service must lead the discussion of safety surrounding lithium-ion (LI) batteries and other alternative energy sources. As lithium-ion battery powered products grow increasingly prevalent, the fire service's trusted voice and unique insight can engage all stakeholders in understanding the associated risks and work to ensure policy decisions consider the safety of our people and communities.

While LI batteries are an attractive option to power our many modern needs, fire risk increases when they are damaged or used, stored, or charged incorrectly. Combined with what we know of their complex fire risk, their ubiquitous presence requires the fire service to turn research and data into operational considerations quickly.

LI batteries and emerging alternatives constitute a significant component of the drive to reduce emissions worldwide. They are part of a complex global ecosystem of multinational agreements and organizations, geopolitical security questions, and finite natural resources. While a daunting task, the fire service has a central and critical role in ensuring policy decisions address fire safety risks.

Impact Areas

Complex Operational Challenges

Firefighters need to consider the presence of LI batteries in all operations, including the risk of faster flashover rates and increased temperatures. The stored energy in a LI battery presents the risk of thermal runaway, which can occur when damaged cells experience uncontrolled increases in temperature and pressure[1]. Current research shows that LI batteries present four hazard scenarios for firefighters: flammable gas release, flaming, vented deflagrations, and explosions.[2]

In addition, LI batteries present response challenges that are outside of the norm. While LI batteries are engineered to be safe, the nature of these devices is that they may continue to hold a charge after being damaged, even if fully submerged in water. This phenomenon is known as stranded energy[3]. However, firefighters are often operating around damaged equipment, and must always consider the risk that engineered safety systems and elements are no longer functioning as intended. Also, fires associated with alternative energy sources can require personnel and water resources far exceeding normal expectations, stressing a department's ability to maintain resources for all emergencies.

Community Safety

While our communities are generally aware of risks associated with their ordinarily benign devices, it is important for the fire service to adopt fire safety messaging regarding LI batteries and alternative energy sources to share with the public about their unique risks. In particular, messaging on these devices' safe usage, storage, and charging is needed.

As policy decisions are made regarding what is allowed to be sold on the U.S. market, the fire service must play a role in

What are lithium-ion batteries?

Lithium-ion batteries are a type of rechargeable battery that contains lithium-ion cells, which are composed of an anode, cathode, separator, and electrolyte. This ordinarily stable electrochemical system provides stored electrical energy, but mechanical, electrical and thermal abuses and manufacturing defects can destabilize the system can cause thermal runaway. Thermal runaway typically occurs when an abuse initiates a short circuit inside a cell. The thermal runaway process can produce extremely high temperatures in a chain of chemical reactions, often rapidly, and this can induce thermal runaway to propagate to adjacent cells in a battery pack. In addition to heat, LI cells produce flammable gases during thermal runaway, which is what drives LI fire and explosion hazards.

Where are lithium-ion batteries found?

Nearly everywhere. These batteries power everyday items such as cell phones and computers. They are found in small to large transportation options, including e-bikes, e-scooters, and electric vehicles. LI battery energy storage systems are increasingly prevalent at outdoor installations supporting utility operations and should be expected to be installed outside commercial structures and within residences.

Resources

The Science of Fire and Explosion Hazards from Lithium-Ion Batteries. UL/Fire Safety Research Institute (FSRI). https://fsri.org/lithium-ion-battery-guide.

US Fire Administration: Lithium-ion batteries (fema.gov)

Global EV Outlook 2023: https://www.iea.org/reports/global-ev-outlook-2023

discussing the safety of these items, with a specific focus on the components directly affecting the fire safety of U.S. communities.

Need for Research

Research is being conducted to better understand the hazards associated with LI batteries and means for mitigation. However, more research is needed.

To the extent possible, the fire service must continue to mitigate exposure to toxic chemicals that fires involving LI batteries can release. Ongoing research is needed to understand the new and complex hazards LI batteries can present, and to provide firefighters with data and information to inform operational procedures.

As an emerging technology, there are additional research questions that the fire service can take the lead in addressing with its community partners. For example, how do charging stations fit safely within current zoning and code ordinances? There is an existing roadway infrastructure built for gasoline distribution — how do these two systems work together safely?

While LI batteries are an emerging technology, the reality is that the industry is already seeking alternatives. New technologies will likely seek to increase energy density, allowing a smaller battery footprint with increased capacity. It is critical for the fire service to understand the risks of these new technologies.

More Information

[1] Safety Risks to Emergency Responders from Lithium-Ion Battery Fires in Electric Vehicles. National Transportation Safety Board. November 2020.

[2] The Science of Fire and Explosion Hazards from Lithium-Ion Batteries. UL/Fire Safety Research Institute (FSRI). https://fsri.org/lithium-ion-battery-guide.

[3] Safety Risks to Emergency Responders from Lithium-Ion Battery Fires in Electric Vehicles. National Transportation Safety Board. November 2020.