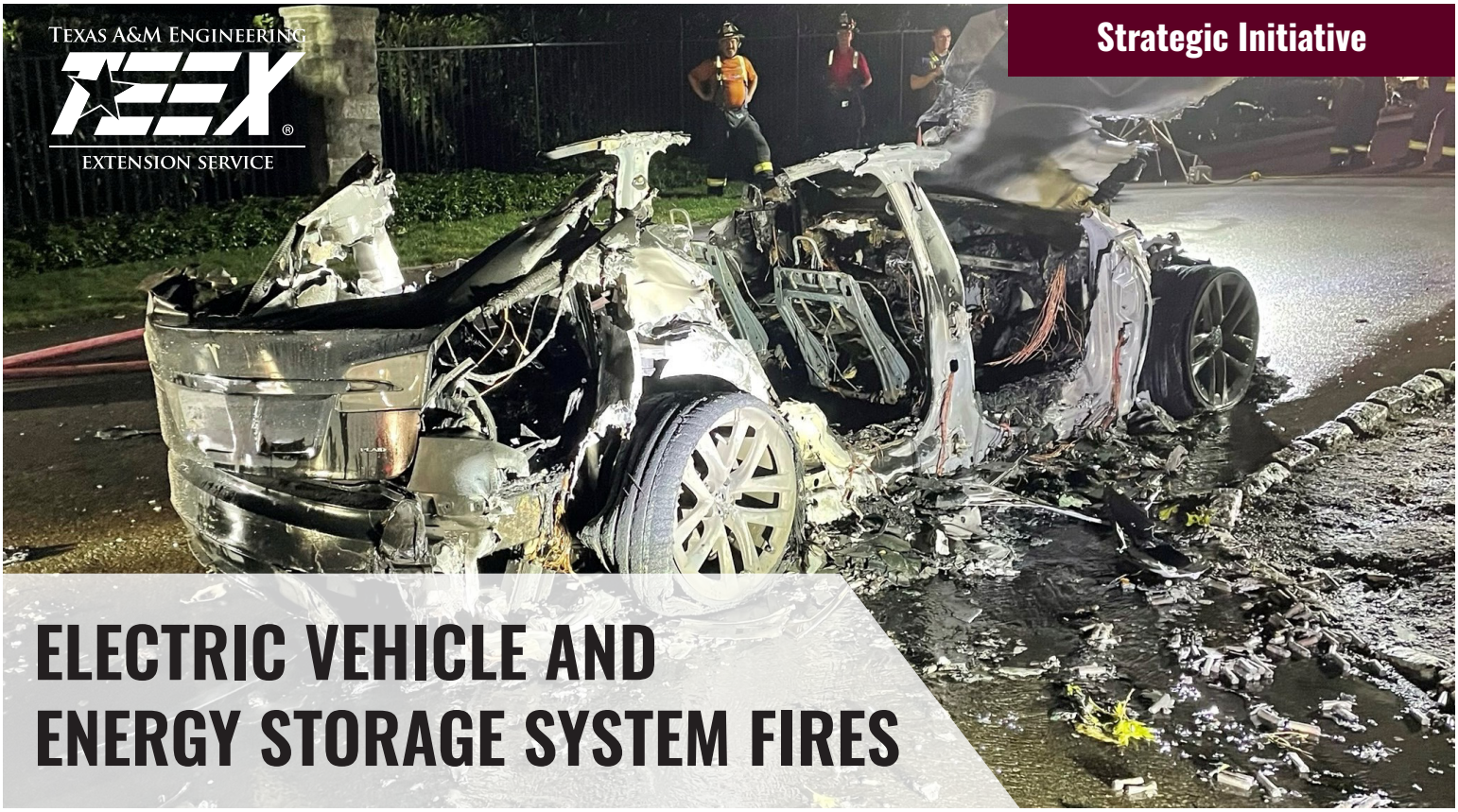


ELECTRIC VEHICLE AND ENERGY STORAGE SYSTEM FIRES

Photo provided courtesy of Gladwyne Volunteer Fire Company, Gladwyne PA.

THE ISSUE

The prevalence of Lithium-Ion (Li-ion) batteries in battery electric vehicles (BEV), micromobility devices, such as scooters and e-bikes, and battery energy storage systems (BESS) continue to increase. The intense heat, high-voltage cables and toxic emissions make BEV and BESS fires challenging for first responders because no extinguishing agent is fully effective on these fires. The Texas A&M Engineering Extension Service (TEEX) provides training and best practices for responding to these emergencies, which are constantly changing as new technologies and battery chemistry continue to evolve.

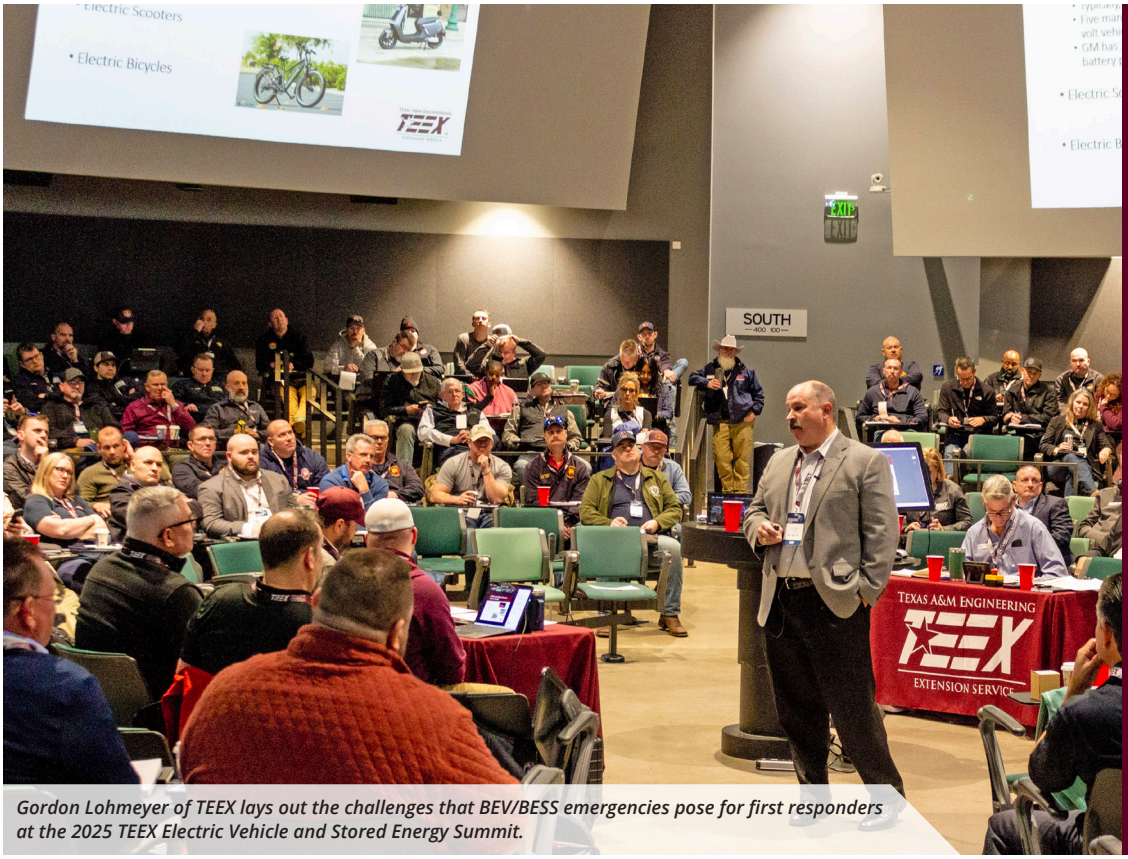
Unique hazards of Li-ion battery fires:

- ***Thermal runaway:*** Thermal runaway can occur due to overcharging, overheating, physical damage or manufacturing defects and could result in extremely high temperatures, fire, toxic gas or explosive shrapnel.
- ***Fire:*** Fire risks increase due to damage or defects or during charging or discharging. In addition to being difficult to extinguish, reignition is a threat after the event.
- ***Electrical shock:*** BEVs rely on high-voltage electrical systems that pose an electrical shock risk to occupants and first responders in an emergency.
- ***Chemical exposure:*** Li-ion batteries contain toxic chemicals and heavy metals that may harm first responders, the public and the environment.
- ***Structural failure:*** Li-ion batteries can burn at temperatures up to 2,200 degrees Fahrenheit and can cause concrete and metal fatigue, which could lead to significant damage to exposed critical infrastructure such as overpasses or parking garages.

TRAINING AND RESOURCES

TEEX is working with industry and research partners, national laboratories, federal agencies and EV manufacturers to conduct testing and develop training and practical solutions for lithium-ion battery fires. TEEX has developed two no-cost courses for first responders: *Electric Vehicle Safety for the First Responder* (online, 2.5 hours) and *Electric Vehicle Lithium-Ion Battery Awareness* (face-to-face, 4 hours).

TEEX hosts an annual Electric Vehicle and Stored Energy Summit where industry experts, first responders and community leaders discuss challenges, best practices and knowledge gaps related to BEV/BESS fires. The results of these summits help communities standardize response procedures and obtain the training needed to mitigate these emergencies. Information and training resources are located at https://teex.org/ev-ess-current-practices/.



Gordon Lohmeyer of TEEX lays out the challenges that BEV/BESS emergencies pose for first responders at the 2025 TEEX Electric Vehicle and Stored Energy Summit.

SCAN TO LEARN MORE

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RESEARCH RESULTS

In 2024, TEEX, along with its research partners, conducted a series of tests to determine the contamination produced by Li-Ion batteries and its impact on first responders and their personal protective equipment (PPE). Researchers also measured the effectiveness of different PPE cleaning methods.

During testing, at the Southwest Research Institute in San Antonio, TX, researchers subjected Li-ion batteries to thermal runaway by overcharging, causing them to catch fire. First responder bunker gear (all three layers), apparatus fabric (traditional and clean-cab fabric) and self-contained breathing apparatus straps were exposed to the Li-ion battery fire byproducts.

The tests concluded that Li-ion battery fires release highly toxic gases and ultrafine metallic particles that well exceed the U.S. Environmental Protection Agency and Occupational Safety and Health Administration's permissible exposure limits.

The National Fire Protection Association 1851 standard for water-based cleaning removed about 99 percent of the metallic particles in the contaminated gear, and the liquid CO2 cleaning method removed almost all of the metallic particles. After water-based cleaning, 21-92% of the semi-volatile organic compounds remained in the gear. Liquid CO2 cleaning removed most of the sVOC compounds to near non-detectible levels. However, several heavy metals remained in the gear regardless of cleaning method. To review the report and view a summary video, visit https://teex.org/ev-ess-current-practices/.

FUTURE FOCUS

As the BEV/BESS emergency landscape evolves, TEEX has identified future topics to address:

- Train and educate first responders, dispatchers and officials about BEV/BESS fires and risks as Li-ion batteries evolve and present new environmental hazards.
- Implement a public outreach campaign to educate the public about safe use, hazards and preventive actions regarding BEVs and Li-ion batteries.
- Seek funding for additional research to perform testing and contamination analysis on larger Li-ion batteries, such as 400- and 800-volt Li-ion vehicle batteries and BESS.
- Raise community awareness of Li-ion battery hazards, such as BESS, solar farms, battery recharging locations, warehouses, manufacturing sites, recycling centers, large transport areas, and salvage yards.