Surging Clean Energy Growth Requires Innovation in Fire Protection

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Surge in clean energy demand

The U.S. is experiencing an ongoing surge in clean energy implementation, from industrial facilities to vehicles to homes. The tech sector is rushing to build more data centers in the expectation of increased demand for AI services, and is seeking clean energy to power them. For example, Meta (Facebook) and Amazon each announced a new contract in June 2025 to procure approximately 1 GW of solar and wind energy. This growth in both data centers and renewable energy production has been accompanied by the implementation of lithium-ion battery energy storage systems (BESS) for backup power and for integrating renewable energy with the power grid. At the same time, electric vehicles (EVs), and electric bikes (e-bikes), and homes equipped with photovoltaic solar panels (PVs), are rapidly becoming popular with the general public.

These various clean energy innovations deliver great benefits in terms of reducing greenhouse gas emissions, but care must be taken to ensure their safe operation. Although the incidence is low, fires can result from equipment failures and accidents. Most fire departments are relatively inexperienced at dealing with energy-related fire hazards, and require new guidance and tools. Leading firefighting experts are rising to this challenge to develop new standards and best practices, and test emerging tools.

Washington CORE prepared this article based upon interviews with several of these experts.

"Thermal Runaway" in Lithium-Ion Batteries

Out of the various potential fire hazards that can occur with clean energy generation and storage, it is lithium-ion batteries that have drawn the most attention due to their wide adoption across vehicles and BESS for building backup power and renewable energy storage. Lithium-ion batteries can pose a particular challenge for firefighters due to the phenomenon of thermal runaway, when the failure of an internal cell in a single battery can start a chain reaction across other cells. These fires generate an extreme and uncontrollable level of heat that does not respond to most current firefighting tools. Burning batteries also release toxic chemicals in the air that are harmful for firefighters and nearby residents.

Photo of January 2025 fire at Moss Landing, CA BESS Facility

Source : LA Times

In January 2025, a large fire broke out at the Moss Landing BESS facility south of San Francisco. It took four days to extinguish the fire, and more than 1,200 residents had to be temporarily evacuated. Nearby residents reported skin, eye, and respiratory symptoms from the fire's gases, and a soil survey of the fire site found concentrations of heavy metals such as cobalt and copper that were 100 to 1,000 times higher than normal. The accident prompted the California state government to establish strict safety standards for the installation of BESS to reassure the public about their safe operation.

EVs and E-bikes

As of 2024, there were approximately 4 million EVs on U.S. roads, and according to National Transportation Safety Board (NTSB) data, on average only 25 fires occur for each 100,000 vehicles sold, making them a much lower risk for fire than internal combustion engine vehicles (i.e., gasoline-powered vehicles). However, when an EV fire does occur, it can be more difficult to control and extinguish due to thermal runaway.

Fire caused by e-bike batteries in New York City
Source: NY Times

According to Sean DeCrane, Director of Health and Safety for the International Association of Fire Fighters (IAFF), while there is a need for more innovation in specialized firefighting methods and tools to combat EV fires, the basic firefighting techniques and use of water should not be forgotten. Some fire departments have begun to adopt tools such as "water lances" that fire high-pressure streams of water to cut into the vehicle and apply water directly to the burning battery, and fire blankets that are thrown over the vehicle to smother the fire.

However, these tools are very expensive, and they have not demonstrated a high success rate in tests by independent product testing labs. According to UL (Underwriters Laboratory)'s Fire Safety Research Institute's current EV test project, the use of fire blankets to cover burning EVs may actually increase safety risks for firefighters, because explosive gases from the fire accumulate underneath them. FSRI and others are continually evaluating new tools to see what solutions would be most effective. DeCrane believes it is critically important for new tools, equipment and materials to be thoroughly tested through independent laboratories to validate their performance claims before using them in the field. He explained, "We have too many products that promise way too much with no real proof they are effective or safe."

The rising adoption of e-bikes and other micromobility modes in urban areas in the U.S. requires attention to their safety as well. In 2021, e-bikes outsold EVs in the U.S. by 800,000 to 652,000. New York City experienced a number of fires related to e-bikes in the early 2020s. This was due largely to the rapid growth of app-based food delivery services such as Uber Eats, whose delivery workers often use cheap e-bikes to quickly get around the crowded city. In 2022-2023, 20 people died due to e-bike battery fires, four of them due to a blaze at an e-bike repair shop. New York City passed a "Right to Repair" law in 2022 that grants consumers the right to repair and improve the electronic equipment they have purchased. Taking advantage of the opportunity, businesses sprung up to modify cheap, low-quality e-bikes to be more powerful, which resulted in more frequent cases of unsafe battery use and greater risk of fires.

Subsequently, city officials mandated that all e-bikes sold or rented in the city must be certified in accordance with UL safety standards and initiated a trade-in program to take unsafe e-bikes off the streets. The city also developed an approved battery exchange station to reduce the risks associated with battery storage in the home. The overall result was a quick and dramatic drop in the number of e-bike related fires.

Sean DeCrane

Director of Health and Safety, International Association of Fire Fighters (IAFF), and previously the Director of Industry Relations for Building Safety Security Technology at UL (Underwriters Laboratories)

Roof-mounted solar panels and rapid shutdown safety systems

Fire caused by solar panels on a residential roof in Lago Vista, Texas
Source: Austin American Statesman

It is important to remember that clean energy equipment can also be found on ordinary homes in the form of PV panels. In April 2024, a house fire in Lago Vista, Texas, was caused by roof-mounted PV panels. The U.S. Department of Energy (DOE) notes that this type of PV spontaneous combustion is extremely infrequent despite the 1.8 million PV Panels installed in the U.S., but that precautions should be taken in case there are any component defects or installation errors. DOE noted that the National Electric Code (NEC) was already updated in 2014 to require the inclusion of a "rapid shutdown" feature in PV panel arrays that can instantaneously cut the power to the panels in the event of a fire.

Additionally, in 2018, at the urging of IAFF, a rapid shutdown requirement was also included in the International Building Code (IBC), the model for building codes throughout the U.S. As emphasized by DeCrane, the rapid shutdown feature makes it far safer for responding firefighters to approach the panels to put out the fire.

Wind Turbines

Chris Greene
Captain (ret.) and Emergency Response Team Supervisor/Energy Hazard Response Training Officer, Seattle Fire Department, Seattle, WA

In comparison to EVs and PV panels, former Seattle Fire Department Captain Chris Greene said that fire safety considerations related to wind turbines have received relatively little attention so far, though there are currently over 80,000 turbines operating in the U.S. The incidence of fires related to wind turbines is very low to date, but when a fire does occur it can pose a major challenge for fire response. Wind turbines are mounted on top of very tall towers, and are often located in remote areas, making them difficult to access and extinguish. The vast majority of wind turbine fires are caused by lightning strikes and/or electrical or mechanical malfunctions in the turbine itself. The remaining roughly 10% of fire incidents are caused by battery fires at the BESSs that are used to store the energy collected from wind power installations.

Fire suppression equipment supplier Firetrace International reports that due to the great difficulty of physically accessing turbine fires to extinguish them, currently the most common firefighter response is to wait for the fire to burn out by itself, which can result in extensive damage to both the turbine and the surrounding land. Since turbine operators often pay landowners to place turbines on their property, this poses a liability risk for them.

Fire-damaged turbine and field in Iowa

Source : The Gazette

In April 2025, a farmer in Iowa filed a lawsuit for negligence against Chicago-based Acciona Windpower, which operates two wind turbines on his farm. The lawsuit claims that Acciona's turbines caused "three fires in one year," which contaminated more than 200 acres of the surrounding farmland and caused the farmer to lose customers.

Strengthening firefighter preparedness

Given the rapid spread of lithium-ion batteries and renewable power generation infrastructure, and the need to better prepare for any potential fire hazards, in 2014 Greene began developing an Energy Response Team (ERT) at the Seattle Fire Department to handle energy-related fires. Seattle's ERT became the first such team in the nation that is wholly prepared for energy hazards with specialized training and equipment. In recent years, the ERT has become the leading model that other fire departments have sought to emulate.

New Guidelines for Firefighter Response

To help prepare firefighters to address various fire incidents related to modern energy systems such as BESS, solar panels, and EVs, the IAFF released its Energy Hazard Guide in June 2025. Guided by the expertise of DeCrane and Greene, the guide provides firefighters with recommendations for energy fire hazard indicators, response considerations, and personal protective equipment (PPE). The IAFF hopes that the guide will be widely used in the U.S. to improve response capabilities in the field.

The introduction of renewable energy is an indispensable measure to combat climate change. At the same time, it is vital to strengthen firefighter response capabilities to ensure that the new energy infrastructure can continue to be safely operated and expanded. Continuous efforts are required to develop innovative and effective fire response methodologies and tools.