CEC Exhibit-10

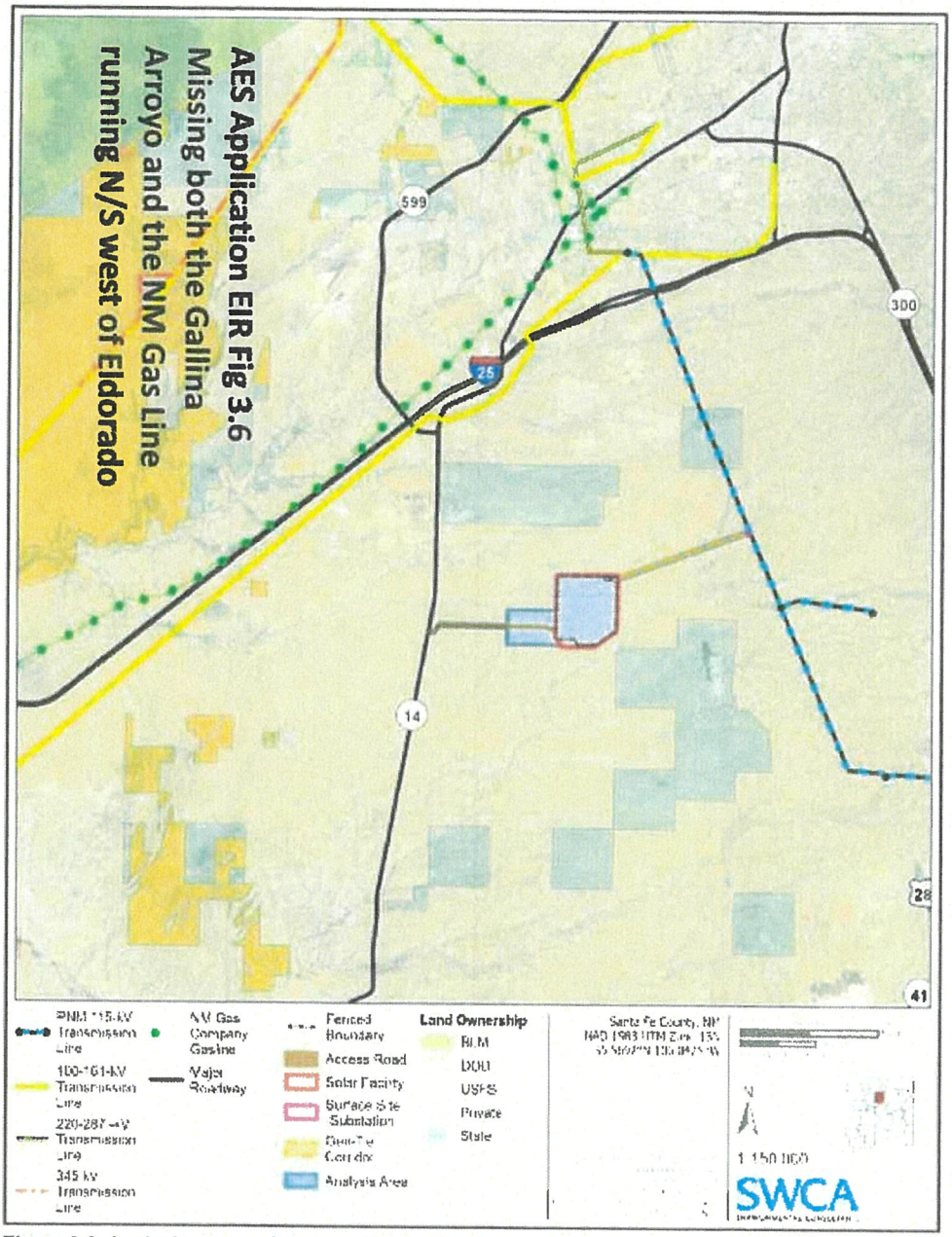
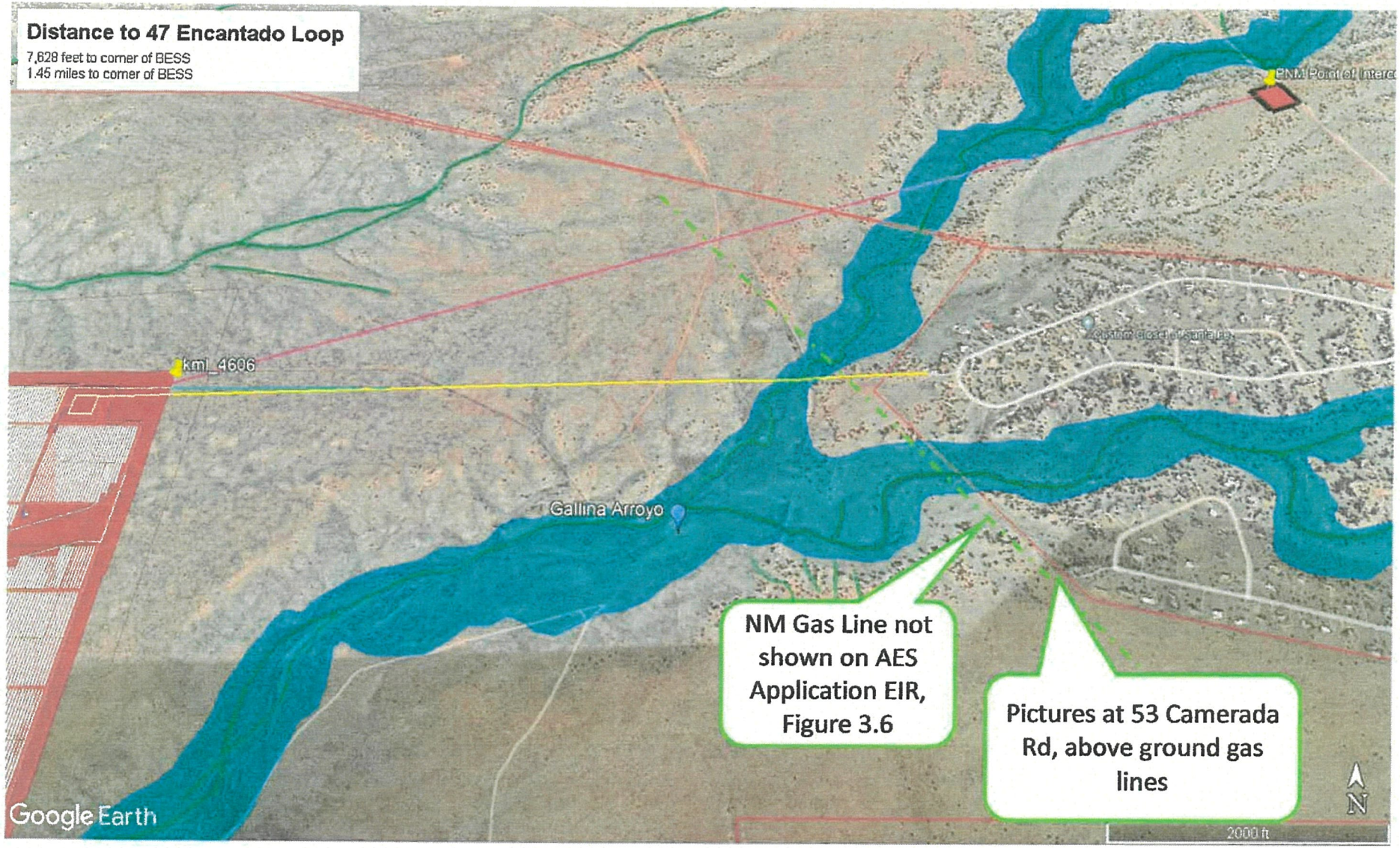
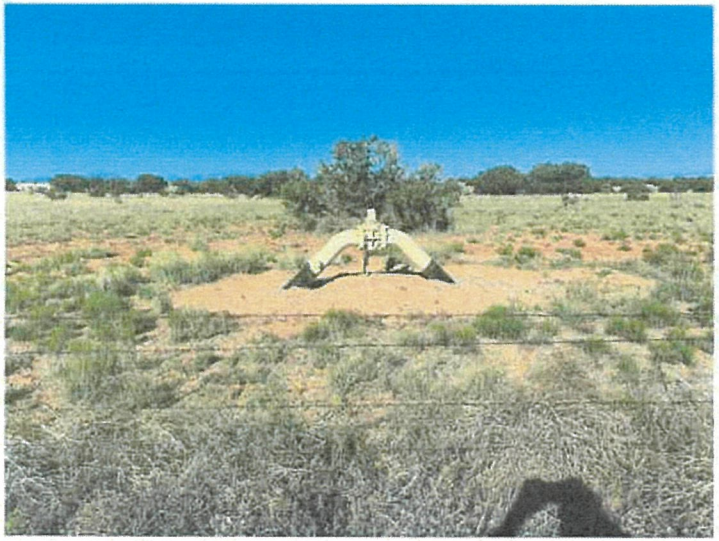
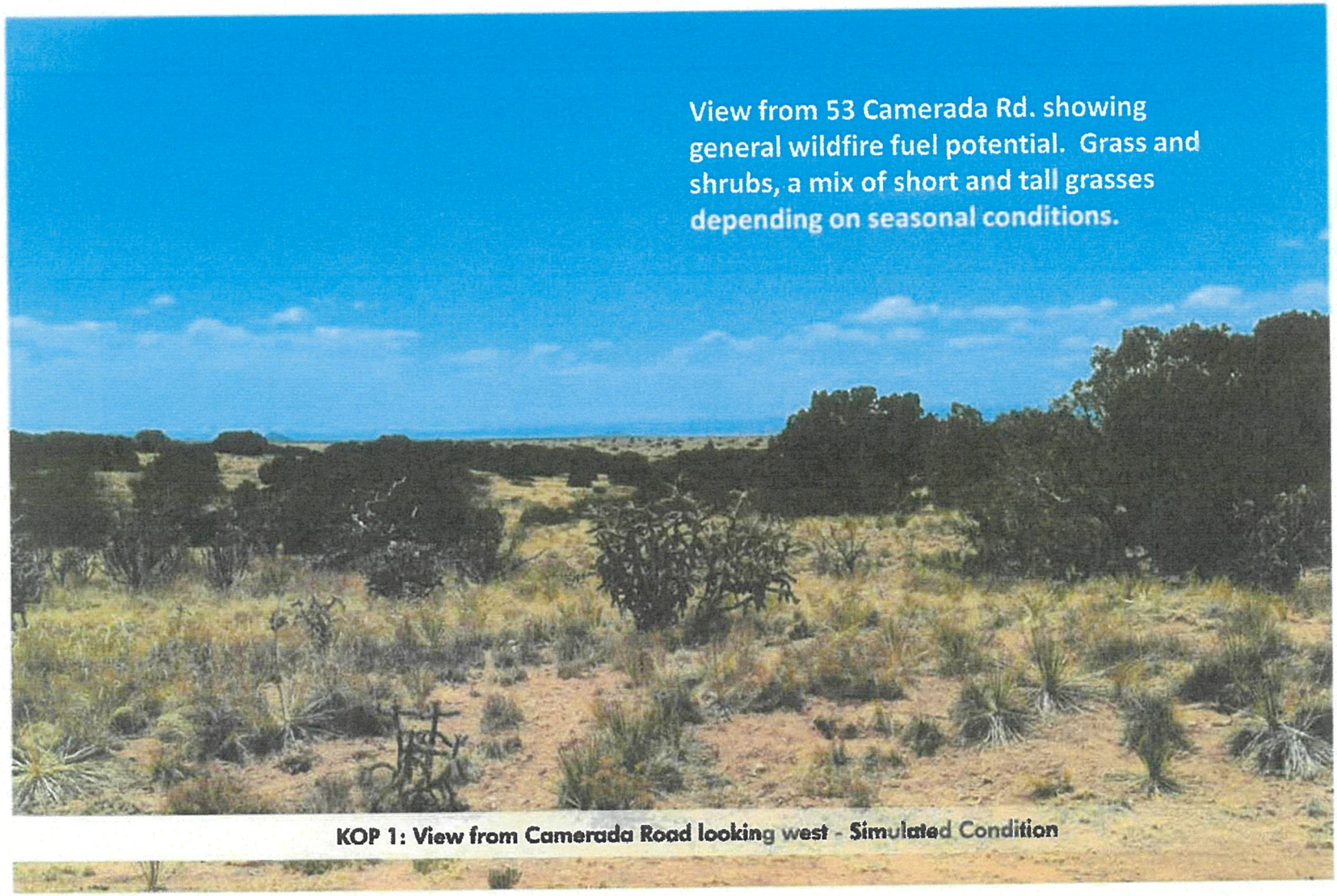


Figure 3.6. Analysis area and surrounding land uses.


Distance to 47 Encantado Loop
7,628 feet to corner of BESS
1.45 miles to corner of BESS
kml_4606
Gallina Arroyo
NM Gas Line not shown on AES Application EIR, Figure 3.6
Pictures at 53 Camerada Rd, above ground gas lines
Google Earth
2000 ft
N



NM Gas Line not shown on AES Application EIR, Figure 3.6



KOP 1: View from Camerada Road looking west - Simulated Condition


Search Google Maps
Restaurants
Hotels
Things to do
Museums
Transit
Pharmacies
ATMs
47 Encantada Loop
NM Gas Line
53 Camerada Rd.
Eldorado Community Improvement
Exit 1
Exit 2
Exit 3
El Dorado Supermarket
Eldorado at Santa Fe
Only possible evacuation routes out of Eldorado
Santa Fe Dressage
Google
Layers

CEC Exhibit-11

How PFAS is Affecting the Fire Suppression Industry

February 9, 2023

The hot topic in the fire suppression industry, as well as several others, is the shift away from PFAS chemicals. In particular, the use of PFAS chemicals in special hazards fire suppression systems will no longer be an option. 3M, a major multinational chemical manufacturer, announced that it would stop producing Novec 1230 by the end of 2025. Novec 1230 is a popular "clean agent" fire suppression chemical, often used in mission-critical facilities where water damage by water sprinkler systems would create catastrophic problems. With an extreme amount of litigation (3,287 lawsuits between January 2020 and December. 2021, according to Bloomberg Law), 3M announced the discontinuation of all products that include these chemicals. However, this move has the industry wondering – what comes next?

The discontinuation of 3M Novec 1230 as a special hazard fire suppression agent due to PFAS brings more struggles to the special hazard fire suppression industry.

What is PFAS?

What is PFAS?

PFAS stands for Perfluoroalkyl and Polyfluoroalkyl Substances. As explained by the National Institute of Environmental Health Sciences (NIEHS), PFAS molecules have a chain of linked carbon and fluorine atoms. These create very strong carbon-fluorine bonds that take a long time to degrade. Due to this, they're commonly referred to as "forever chemicals." PFAS chemicals have been associated with a wide variety of serious health issues, including cancer.

The fact that these chemicals fail to degrade for an unknown amount of time, agencies such as NIEHS are concerned about the potential for damage to human health due to issues such as bioaccumulation and long-term exposure to PFAS. These concerns have led to widespread restrictions and bans on PFAS chemicals.

How is This Affecting the Fire Suppression Industry?

Special hazard fire suppression systems have been affected by new legislation aimed at restricting and banning the use of PFAS. In fact, many very effective special hazard fire suppression "clean agents" have met their end due to environmental and health concerns. The manufacture of Halon 1301, one of the earliest and most effective clean agents, was banned in 1994 because it was classified as an ozone-depleting chemical. The manufacturing of FM200, the most popular Halon replacement, began a phase-out in 2022 for being identified as a global warming agent. And in 2025 the production of Novec 1230 will be discontinued by 3M. Finally, AFFF firefighting foams have been severely restricted or outright banned in most areas. This has created a challenge to the fire protection industry as they

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ultimately, the special hazard fire suppression industry is facing another major setback as they continue to search for a clean agent that is effective and easy to use. The agent also needs to be safe for use around humans without having a significant negative impact on the environment.

Only time will tell what is next for special hazard suppression agents as the fire suppression industry continues its research and development into appropriate alternatives.

Fire Protection Services from Fireline

Whether you need smoke detectors, fire extinguishers, or an automatic sprinkler system installed at your commercial property, Fireline has you covered. We have been protecting

people and property from fire damage since 1947—and our experience shows in our excellent work! We are known for our superb customer service, our expertise, and our reliability. For more information on how we can help your residential or commercial property, visit us online or give us a call at (800) 553-3405. We are in Baltimore, MD, with a second office in Leesburg, VA. For more fire safety tips, be sure to follow us on Facebook, Twitter, and LinkedIn.

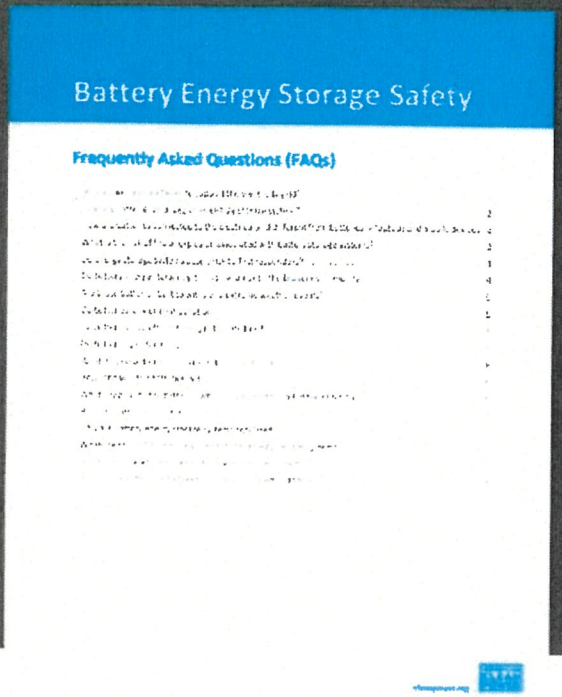
Categories: Fire Suppression Systems | **Tags:** fire suppression, fire suppression industry, fire suppression systems, PFAS, and special hazard fire suppression

This entry was posted on Thursday, February 9th, 2023 at 11:16 am. Both comments and pings are currently closed.

CEC Exhibit-12

Energy Storage: Safety FAQs

Download



Energy storage is a resilience enabling and reliability enhancing technology. Across the country, states are choosing energy storage as the best and most cost-effective way to improve grid resilience and reliability.

ACP has compiled a comprehensive list of Battery Energy Storage Safety FAQs for your convenience.

Read ACP's FAQ document to learn more in detail.

Fact sheets

(PDF download)

Share:

The basics of battery energy storage safety

+ **Why do we need batteries to support the electricity grid?**
+ **How are batteries arranged in an energy storage system?**
+ **How are batteries connected to the electrical grid different from batteries in laptops and mobile devices?**
+ **What is the risk of fire or explosion associated with battery storage systems?**
+ **Do energy storage systems pose a risk to first responders?**

+ **Do battery energy storage systems pose a risk to the broader community?**

+ **Are these batteries built to withstand extreme weather events?**

- **Do batteries leak or emit pollution?**

  In normal operation, energy storage facilities do not release pollutants to the air or waterways. Like all energy technologies, batteries can present chemistry-specific hazards under fault conditions. Batteries with free-flowing electrolytes could leak or spill chemicals, so these systems are normally equipped with spill containment. Batteries with aqueous electrolytes may emit small quantities of hydrogen gas in normal operation and larger amounts under fault conditions, but these emissions are handled by ventilation systems and are not considered polluting. As discussed previously, all batteries release toxic substances in a fire, and if water is used for firefighting, it can create contaminated runoff – another reason for manufacturers' recommendations to allow fires to burn themselves out.

+ **Do batteries give off electromagnetic radiation?**

+ **Do batteries produce noise?**

+ **What do grid batteries look like? Is there light pollution?**

+ **How long will grid batteries last?**

+ **What happens to the batteries when they reach the end of their lifetime?**

+ **How are batteries monitored?**

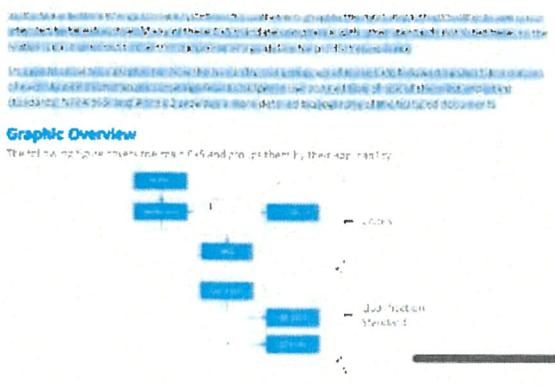
+ **How are battery energy storage systems regulated?**

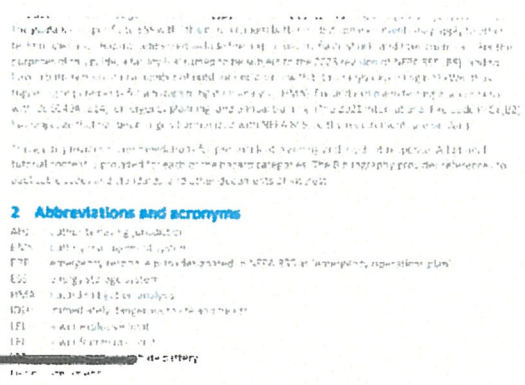
+ **What are the certification requirements for energy storage systems?**

+ **What are some key parameters for energy storage systems?**

+ **What is the difference between AC and DC coupled systems?**

You may also be interested in:





CEC Exhibit-13

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The Key Bridge Collapse Reshaping Infrastructure Insurance

SEARCH

Lithium-Ion Batteries – What are the Risks?

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Article

Battery power is set to gradually replace diesel-fueled generators on many U.K. train routes as the rail industry seeks to cut greenhouse gas emissions and reduce toxic pollutants. Some locomotive manufacturers are reportedly trialing lithium-ion batteries, but there are concerns that this technology could pose unique fire safety challenges. The potential environmental impact of such an event is also a significant consideration that should be factored into the equation.

Over the last 20 years, the environmental insurance industry has seen a change in the severity of contamination incidents, as well as a transition over causation and the options for waste disposal. While the U.K.'s legally binding target is to achieve net zero emissions by 2050, it is essential to also take into account the risks associated with the new technologies that will help reach this goal and how any failures might impact the environment.

Environmental Remediation

The commercial U.K. environmental remediation industry is well established, with standard guidelines for investigating and assessing contaminated land and water. During the 1990s, advances in remediation technologies drove more sustainable 'in-situ' techniques. This saw a transition from a traditional "dig and dump" approach in removing contaminated soil to using new solutions, such as chemical or biological treatments, soil stabilization to encapsulate contamination, or soil removal and cleansing prior to reuse on-site.

Within the insurance sector, the majority of contamination incidents involve loss of fuel, primarily heating oil, to the ground. The claims resolution process is well understood. It involves collecting samples to assess the extent of contamination, delivering the remediation works and then collecting additional samples for validation to ensure concentration levels are below those that would cause a risk to any receptors – whether that be humans, buildings or the wider environment.

The applicability of in-situ remediation techniques is often limited by other driving factors, such as timescale, when the customer wants to return to the property as soon as possible, for example. Cost, including the provision of alternative accommodation or premises, will also impact the remediation option that's applied.

Despite the development of new technologies aimed at providing greener solutions, there are emerging environmental risks associated with them. When failures occur, they can challenge existing environmental remediation practices and often prove costly and time-consuming to put right.

Thermal Runaway

Lithium-ion batteries have become widely used globally, and the U.K. is no exception. They are used in everything from e-scooters and mobile phones to power tools and electric vehicles (EVs). Within the domestic environment, many different devices have the same type of charging sockets, and the wrong charger, which isn't correctly rated for that particular item, can sometimes be used. Using an incorrect charger and poor battery management may lead to the device charging too quickly, which can cause overheating issues and potential thermal runaway.

On a larger scale, high numbers of EVs are often stored in one place, on transport ships, in car parks and bus depots, for example. Failure and thermal runaway of an EV battery can be explosive, and jets of flames might be emitted several meters from each side of the car. In modern car parks, with tight parking spaces, this can easily lead to the propagation of the fire to adjacent vehicles.

Battery recycling centers are another example of areas where multiple batteries stored in close proximity to each other present a similar risk. In February this year, a French warehouse storing 900 tonnes of old lithium-ion batteries caught fire following an explosion. Thick black smoke billowed around the local town of Viviez in Aveyron, and local authorities ordered residents to stay indoors and keep windows shut. Over 70 firefighters worked to put out the blaze, which had spread to nearby storage units.

According to Sedgwick's claims data, lithium-ion battery fires have increased by 81% this year compared to 2023, and the total cost of settled claims is up 140%. This trend is leading to a change in the type of environmental claims we manage in the insurance sector.

Read This Next

Lithium-Ion Batteries – What are the Risks?

New Jersey Wildfire Is Tied to Arson as Firefighters Make Gains

How the Key Bridge Collapse Continues Reshaping Infrastructure Insurance

Marsh Sues Aon, Ex-Team Leader Over Exit of 20 Construction Surety Employees

US Regulator Takes Initial Steps to Boost Self-Driving Cars

It's worth mentioning at this point that lithium-ion batteries also pose an issue for traditional fire suppression procedures. When a lithium-ion battery enters thermal runaway, it causes a rapidly accelerating chemical reaction, releasing large amounts of flammable gases. Trying to extinguish the fire with water is unlikely to be successful, although it could help stop the spread to other buildings.

Metal Contamination

In these types of fire incidents, high concentrations of lithium-ion and other base metals (including iron and manganese) are released and spread. Where many batteries are stored in one location, the concentrations of resulting heavy metal contamination can be very high. If surface water or groundwater becomes contaminated, a specialist resin is required to remove the metals from the water, which, in a large-scale incident, will often have to be imported from Europe. This treatment is costly and can take months, in some cases years, to resolve.

In terms of soil contamination, concentrations can also be very high, often at levels only generally seen at industrial sites. This limits the options for soil treatment, and if the concentration levels are greater than U.K. landfills can accept, it dramatically reduces the possibilities for soil disposal. Given these constraints, we must consider less sustainable approaches, such as exporting the polluted material overseas.

Understanding the Risk

Of course, battery technologies continue to evolve, and it's reported that their potential has yet to be reached. A recent Statista report (1) projects that between 2022 and 2030, the global demand for lithium-ion batteries will increase seven-fold, but their safety regularly comes under question.

While a recently published study found that EVs suffer 25 fires per 100,000 sold, compared to 1,530 fires in petrol or diesel vehicles, concerns remain around the storage of multiple batteries in one place. By 2035, it's estimated that 150,000 tonnes of lithium-ion batteries will reach their end of life annually, so it's crucial to appreciate the potential risk of operating any large-scale recycling facilities.

However, our understanding of the risk and the required level of insurance cover for such activities is improving, and new EV fire suppression systems can help prevent fires, reduce damage and minimise the risk of propagation. Particular care and appropriate precautionary measures should be taken if that facility is also located in an environmentally sensitive area—close to a river system or on an aquifer used for public groundwater abstraction and supply. Fast responses to these types of incidents will limit the spread of highly contaminated water, helping avoid significant environmental damage and reducing the potential third-party exposure and costs involved.

If the U.K. rail industry decides to adopt battery power across its entire network, no doubt the potential environmental risks will be assessed against the distinct benefits this form of clean energy can deliver.

Kyle is head of environmental consultancy, EFI Global, Sedgwick.

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CEC Exhibit-14

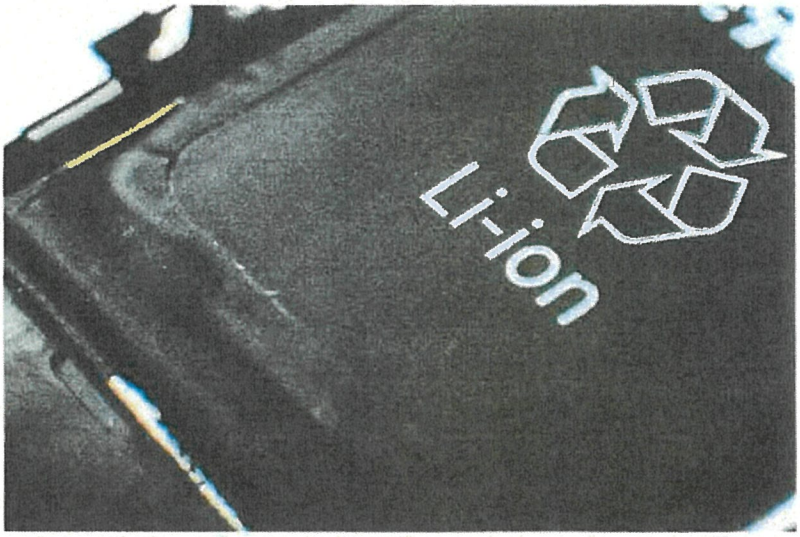
Lithium-ion batteries

This article is more than 8 months old

'Forever chemicals' used in lithium ion batteries threaten environment, research finds

A subclass of PFAS has been found near manufacturing plants and landfills, and in remote regions of the world

Tom Perkins



The subclass of PFAS known as bis-FASI has been found in remote regions, suggesting this is more easily through the atmosphere. Photograph: Ercan Ersoy/Anadolu Agency via Getty Images

Toxic PFAS "forever chemicals" used in lithium ion batteries essential to the clean energy transition present a dangerous source of chemical pollution that new research finds threatens the environment and human health as the nascent industry scales up.

The multipronged, peer-reviewed study zeroed in on a little-researched and unregulated subclass of PFAS called bis-FASI that are used in lithium ion batteries.

Researchers found alarming levels of the chemicals in the environment near manufacturing plants, noted their presence in remote areas around the world, found they appear to be toxic to living organisms, and discovered that waste from batteries disposed of in landfills was a major pollution source.

The nation faces "two critical challenges - to minimize aquatic pollution and increase our use of clean and sustainable energy, and both are worthy causes", said Jennifer Guelfo, a Texas Tech University researcher and study co-author.

"But there's a bit of tug-of-war between the two, and this study highlights that we have an opportunity now as we scale up this energy infrastructure to do a better job of incorporating environmental risk assessments," she added.

PFAS are a class of about 16,000 human-made compounds most often used to make products resistant to water, stains and heat. They are called "forever chemicals" because they do not naturally break down and have been found to accumulate in humans. The chemicals are linked to cancer, birth defects, liver disease, thyroid disease, plummeting sperm counts and a range of other serious health problems.

Public health advocates are increasingly sounding the alarm over the need to find alternatives to the toxic chemicals for clean energy technology, such as

batteries and wind turbines, as the transition progresses.

The paper notes that few end-of-life standards for PFAS battery waste exist, and the vast majority ends up in municipal dumps where it can leach into waterways, accumulate locally or be transported long distances.

It looked at the presence of the chemicals in historical leachate samples and found none in those from prior to the mid-1990s, when the chemical class was commercialized.

The study noted previous research that bis-FASI can be reused, though as little as 5% of lithium batteries are recycled. That could yield a projected 8m tons of battery waste by 2040 if battery recycling is not dramatically scaled up with demand.

"This says that we should be taking a closer look at this class of PFAS," Guelfo said.

Since very little toxicological data on bis-FASI exists, the study also checked for effects on invertebrates and zebrafish. It found effects at low exposure levels, which suggests toxicity in line with other PFAS compounds known to be dangerous.

Researchers also sampled water, soil and air around a 3M plant in Minnesota and other large facilities known to make the chemicals. The soil and water levels were concerning, Guelfo said, and detection of the chemicals in snow suggests the chemicals easily move through the atmosphere.

That may help explain why the chemicals have been found in Chinese seawater and other remote areas not close to production plants.

While the most commonly used PFAS definitions globally include bis-FASI, one division of the EPA does not consider it to belong to the chemical class, so it was not included on a list of compounds to be monitored in US water. The EPA has drawn criticism for using a narrow definition of PFAS that public health advocates say has excluded some chemicals at the industry's behest.

However, the new research, taken with previous evidence, shows bis-FASI are persistent, mobile and toxic like most other PFAS, noted Lee Ferguson, a Duke University researcher and co-author.

"That classification combined with the huge ramp-up in clean energy storage that we're seeing should at least ring some alarm bells," he said.

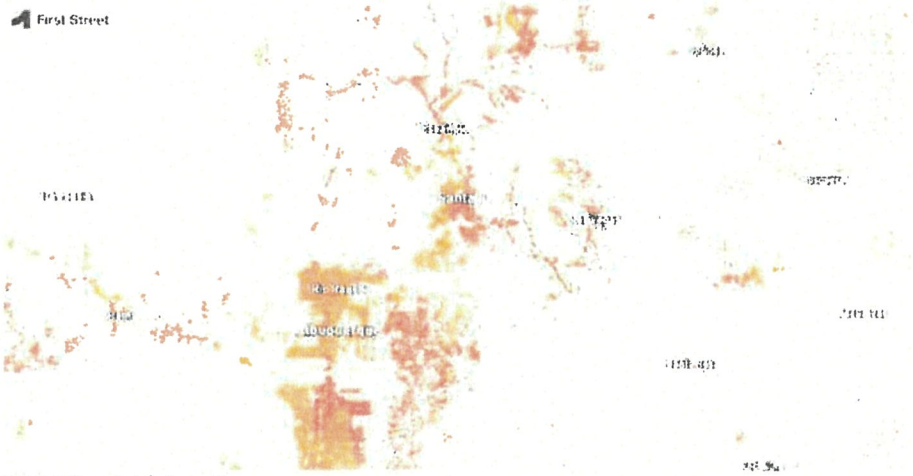
CEC Exhibit-15

Does Santa Fe County have Wildfire Risk?

Major FIRE FACTOR

There are **79,102 properties** properties in **Santa Fe County** that have some risk of being affected by wildfire over the next 30 years. This represents **100%** of all properties in Santa Fe County.

In addition to damaging properties, wildfire can also cut off access to utilities, emergency services, impact evacuation routes, and may impact the overall economic well-being of an area. Overall, **Santa Fe County** has a **major risk of wildfire** over the next 30 years. This is based on the level of risk the properties face rather than the proportion of properties with risk.



Residential: Major Risk
78,914 out of 78,907 homes at risk

Infrastructure: Moderate Risk
298 out of 298 facilities at risk

Commercial: Major Risk
5,992 out of 5,992 properties at risk

Social: Major Risk
517 out of 530 facilities at risk

Find the Wildfire Risk for Any Property

Discover its current and future risk from wildfire, wildfire history, damage estimates and understand steps you can take to reduce risk.

Want More Data?

First Street

First Street™ is the leading provider of climate risk data. First Street data is licensed by leading government agencies, banks, and corporations. To put our data to work for your organization, contact our sales team.

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Wildfire Protection Measures for Santa Fe County

Flood Factor Fire Factor Air Factor Heat Factor

Wildfire Protection Measures for Santa Fe County

Although wildfire risk can never be completely eliminated, communities that adapt to higher standards can limit damage and lower rebuilding costs. Learn more about solutions.

Known controlled burns

0
Known controlled burns

0
Properties near controlled burns

Find the Wildfire Risk for Any Property

Discover its current and future risk from wildfire, wildfire history, damage estimates and understand steps you can take to reduce risk.

Understanding Vulnerability Factors in Wildfire-Prone Areas

Understanding how wildfires begin and spread in your area can help you better protect your community from nearby risks and damage. The below image illustrates key factors that make an area vulnerable to wildfire.

1. Vegetation and fuel sources

The type of fuels sourcing a fire can have an impact on how intense it can get and how quickly it can spread. While dry grass can catch fire and spread quickly with high winds, extremely intense fires tend to build more in dry dense vegetation areas where treetop canopies can cast embers miles away.

2. Possible ignition sources

Fire Factor® takes into account electric transmission lines, areas prone to lightning, and historic data for determining where human-caused fires are more likely.

3. Topography and weather

Topography refers to the surface features of land. It includes the mountains, hills, creeks

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3. Topography and weather

Topography refers to the surface features of land. It includes the mountains, hills, creeks, and other bumps. After a fire begins, the topography of the land and the weather work together to determine how far and fast fires spread. Fires generally climb uphill and more intense winds can spread a fire more quickly and carry embers further.

See solutions to help reduce susceptibility to wildfire here.

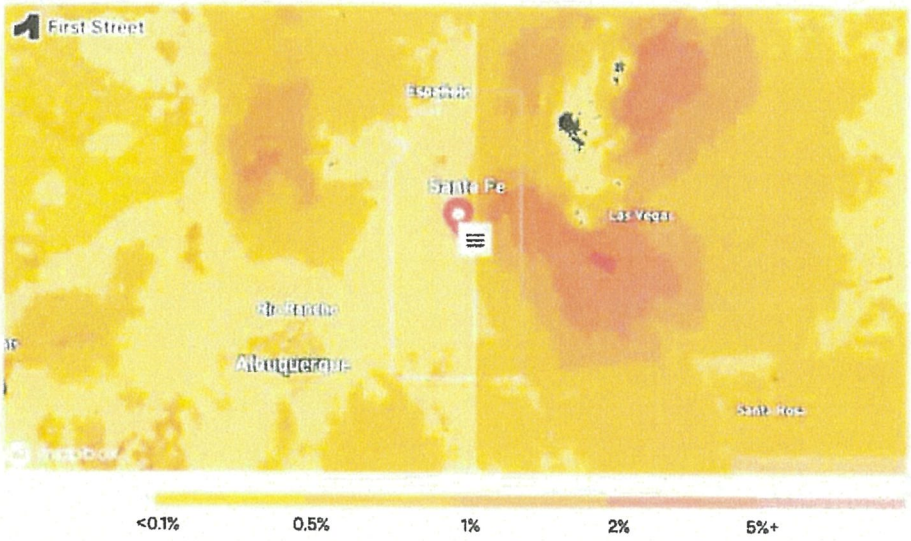
Identifying the Sources of Wildfire Risk in Santa Fe County

In **Santa Fe County** there are **79,102 properties** that have wildfire risk over the next 30 years.

Drag the slider on the map below to see how wildfire risk probability in Santa Fe County will change between this year and 30 years from now.

% likelihood of wildfire

This year



Properties at risk

79,070	79,102
Today	In 30 years

Historical Wildfire Events in Santa Fe County

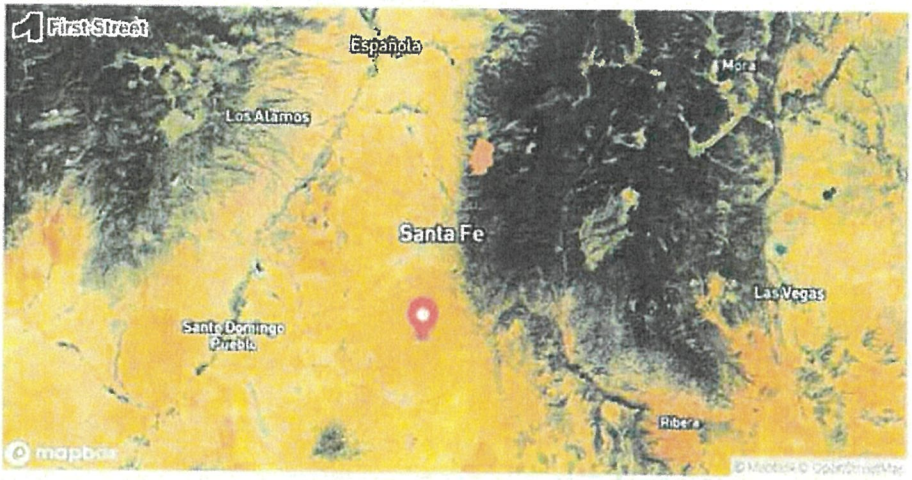
Historical Wildfire Events in Santa Fe County

There have been **5** wildfires recorded near **Santa Fe County** between 1984 and 2021. In **August, 2020**, **1** buildings in **Santa Fe County** were impacted by **a wildfire**. This fire covered **17 square miles**.

Spotlight: MEDIO, August 2020

Properties impacted in **Santa Fe County:** | **5**

Square miles covered by fire: | **17** square miles



Burn area

Find the Wildfire Risk for Any Property

Discover its current and future risk from wildfire, wildfire history, damage estimates and understand steps you can take to reduce risk.

Want More Data?

First Street

First Street™ is the leading provider of climate risk data. First Street data is licensed by leading government agencies, banks, and corporations. To put our data to work for your organization, contact our sales team.

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Exploring the Changing Nature of Wildfire Risks

Wildfire risks are changing because of the environment. A changing environment means higher temperatures and drier conditions, creating conditions which are prime for wildfires to spread.

Learn more about the environmental factors increasing wildfire risk here.

Air Temperatures

Precipitation Change

Decreasing Humidity

CEC Exhibit-16

Journal of Energy Chemistry
Volume 92, May 2024, Pages 422-439

A holistic approach to improving safety for battery energy storage systems

James Close [a b], Jonathan E. Barnard [a], Y.M. John Chew [a], Semali Perera [a]

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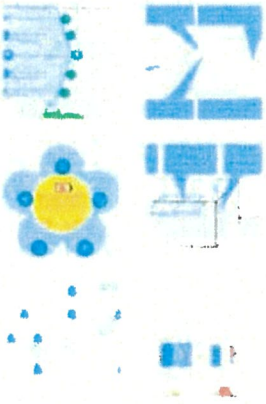
Abstract

The integration of battery energy storage systems (BESS) throughout our energy chain poses concerns regarding safety, especially since batteries have high energy density and numerous BESS failure events have occurred. Wider spread adoption will only increase the prevalence of these failure events unless there is a step change in the management and design of BESS. To understand the causes of failure, the main challenges of BESS safety are summarised. BESS consequences and failure events are discussed, including specific focus on the chain of events causing thermal runaway, and a case study of a BESS explosion in Surprise Arizona is analysed. Based on the technology and past events, a paradigm shift is required to improve BESS safety. In this review, a holistic approach is proposed. This combines currently adopted approaches including battery cell testing, lumped cell mathematical modelling, and calorimetry, alongside additional measures taken to ensure BESS safety including the requirement for computational fluid dynamics and kinetic modelling, assessment of installation level testing of the full BESS system and not simply a single cell battery test, hazard and layers of protection analysis, gas chromatography, and composition testing. The holistic approach proposed in this study aims to address challenges of BESS safety and form the basis of a paradigm shift in the safety management and design of these systems.



2. BESS consequences and failures

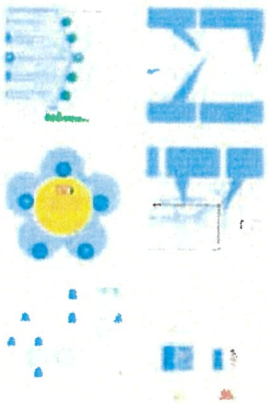
The consequences and failure causes will be assessed in this section to highlight the challenges associated with BESS safety and how these failure modes will aid in forming a holistic approach. BESS consequences can fall into two main categories.

> Operational impacts: Batteries that fail during operation can result in the system to be out of service. Operational failures can result in loss of a BESS to provide electricity for example.
>
> Environmental and safety impacts: Pertains to potential property damage, safety, and environmental consequences, including severe consequences such as thermal runaway, which can lead to fires, explosions, and the release of toxic gases [7], [22], [23], [24], [25].

A major consequence is a BESS fire or explosion, fires resulting from BESS failures can pose serious safety risks to nearby personnel, communities, and emergency responders. The release of toxic fumes and hazardous materials during a battery fire can further exacerbate health and safety concerns. Fires and the release of toxic pollutants can have adverse effects on the environment, including soil, air, and water contamination.

BESS can fail in numerous ways; a brief overview of potential failures that can lead to BESS fires is provided in the fault tree analysis (FTA) diagram in Fig. 4 [26]. Some BESS failures presented in Fig. 4 should be more carefully considered during a hazard analysis than others (highlighted in Fig. 4). Incorrect installation practices highlighted in Fig. 4 should be carefully considered; one of the key findings of the month long investigation into the BESS fires by Korea's Ministry of Trade, Industry and Energy found that poor installation was a contributing factor to the fire incidents occurring in South Korea within the years 2017 to 2019 due to potential spark and short circuit generations creating a source of heat or ignition [12], [26], [27], [28]. Incorrect practices can result in mechanical damage to components and cells, faulty wiring and improper ventilation, leading to overheating of the system and abuse of the cells within the system [26], [28].

Cited by (11)



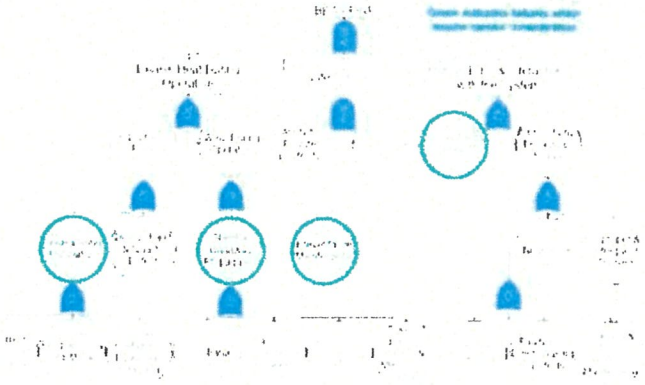


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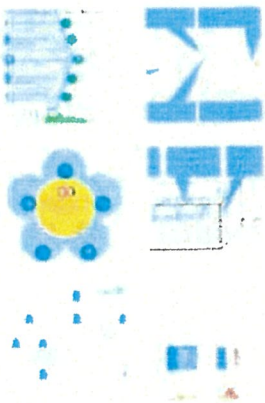
Fig. 4. An example of a fault tree analysis (FTA) for a BESS Fire [adapted image] [26].

External fires, failure to apply firewalls, adequate spacing between equipment, minimal consideration for the operating environment, and adverse weather conditions were other factors highlighted in the investigation conducted by Korea's Ministry of Trade, Industry and Energy; these environmental issues are highlighted in Fig. 4 [6], [8], [26], [27], [28]. Large temperature swings and high humidity damaged the insulation between the cells and module ground, resulting in short circuits [12], [26], [27], [28]. In the chemical process industry, the external environment is considered during the placement or design of a chemical facility or, in this case, a BESS; these external factors are included in facility siting studies for the installation and design phase and are considered in the holistic approach.

Improper maintenance, programming and testing of the BMS and thermal management systems can lead to battery abuses and overheating of the BESS. These factors are considered under the incorrect installation, thermal runaway propagation and preventative maintenance categories in Fig. 4 [6], [8], [27]. The BMS is crucial for monitoring and managing the health of individual battery cells. Failures in the BMS can lead to inadequate monitoring, overcharging, or overdischarging of cells, increasing the risk of fire or cell thermal runaway due to lack of temperature, charging and discharging control [6], [8], [27]. Failures in the cooling strategy could also lead to system overheating, leading to thermal runaway, as shown in Fig. 4 [6], [30]. Failure of the cooling system and BMS could be categorised



Failure of the cooling system and BMS could be categorised as a design fault. However, failures of the control systems could be due to design changes and systems that needed to be modified to accommodate system changes such as cell type, capacity, and size but were not.

Preventative maintenance is a broad category and covers failures such as cell, auxiliary and control systems maintenance, testing and replacement. One factor is the maintenance of the cell systems when defects occur, the cell is worn during operation, or when manufacturing defects are present in cells before operation [12], [26], [27], [28]. During Korea's Ministry of Trade, Industry and Energy committee investigation into the numerous BESS fires in South Korea, plate folding, cutting defects and electrode coating defects were identified and could potentially lead to internal short circuits and thermal runaway [12], [26], [27], [28]. Through cell cycle tests, the committee concluded that cell defects are not the direct cause of the BESS fires; defects coupled with other factors could lead to a situation where failures and defects could lead to perfect conditions for fires and explosions [12], [26], [27], [28].

Other factors, such as training, design faults, and negligence, can also cause BESS failures. These factors are only sometimes considered during a BESS hazard analysis. However, this does not mean they are not necessary to consider and depend on the stage of the system's life cycle when the analysis is conducted.

Although training issues can be perceived as optional throughout the analysis, they may need to be given more attention during a hazard analysis because, most of the time, when an analysis takes place, it might be considered beyond the scope of the study. Depending on stages in the system development, such asduring the operation stage, first response or performing an analysis on a recent incident, it may be a priority to consider human factors.

Design reviews, testing and faults can still occur and are a category of failures that can contribute to BESS fires. They may not be singled out for consideration as significant flaws in a hazard analysis, as they can occasionally be assumed to be identified and addressed during the design phase. The testing data and design documentation to specific standards such as NFPA 855 on a cell, module and container basis should be assessed in parallel with the other factors in the

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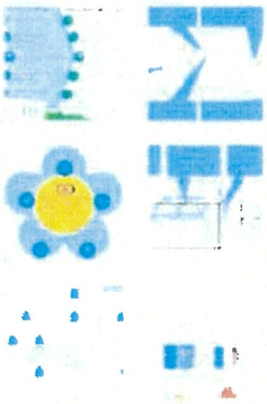

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Tables (4)

Table 1

Table 2

Table 3

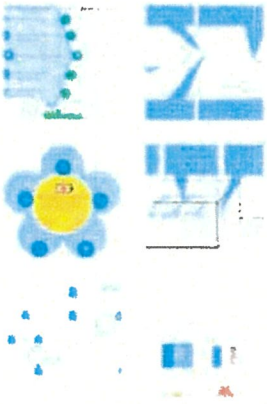
Table 4

hazards like gases produced during thermal runaway and thermal propagation. Hence, standardising pass/fail criteria, best practices, and test setup is a challenge. A battery passport scheme is being attempted to trace, standardise, audit, and compare battery data [64], [65].

A holistic battery safety approach involves using current codes and standards as guidelines and a basis for good engineering practice for design, testing, installation and operation of BESS units, some examples of codes and standards are presented in Table 2 to provide a starting framework in BESS safety [8], [13], [27], [29], [62], [66], [67], [68], [69], [70], [71], [72], [73], [74], [75], [76], [77], [78]. However, there are blind spots in standards which the battery industry has recognized such as the adaptation of UL 9540 to UL 9540A which includes more large scale and rigorous testing of the gas release, NFPA 855 also discusses the need for risk based approaches, if the local jurisdiction/organization has a description of a tolerable amount of risk but leaves it to the reader to determine an appropriate risk based approach [29], [61], [62].

Table 2. Examples of energy storage systems standards.

Category	Standard	Description	References
Energy storage system	UL 9540 and UL 9540A[a]	UL 9540 is a standard for safety of energy storage systems and equipment; UL 9540A is a method of evaluating thermal runaway in an energy storage systems (ESS); it provides additional requirements for BMS used in ESS.	[8], [13], [27], [62], [66]
	NFPA 855[a]	NFPA 855 applies to the design, construction, installation, commissioning, operation, maintenance, and decommissioning of ESS (including mobile and portable ESS installed in a stationary situation and the storage of lithium metal or lithium-ion batteries). NFPA 855 discusses thermal	[27], [29], [67]



4. A holistic approach to improving safety for BESS

There have been many thermal runaway incidents in energy storage systems. Although safety systems, equipment and procedures were put into place based on recent codes and standards, fires and explosions still occur. Heavy reliance on codes and cell testing can create installation safety gaps.

Similar to process safety in the chemical industry, a holistic approach to battery safety summarised in Fig. 10 should be considered to provide a combination of modelling, risk-based assessments, consequence modelling, design and testing solutions that are necessary to improve the understanding of credible hazard scenarios and the adequate safeguards that can be implemented to prevent failures and minimise consequences that can occur from low probability high-impact events.

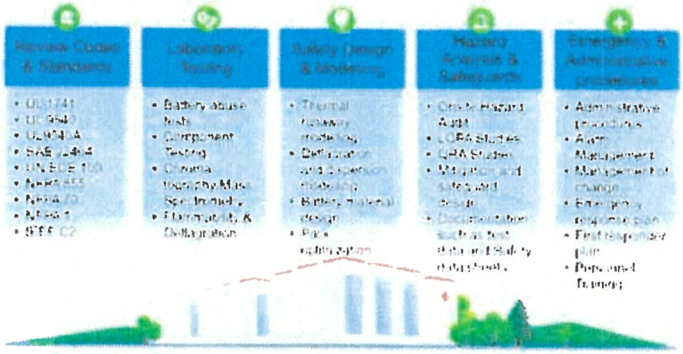


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Fig. 10. The overview of the holistic approach to battery safety.

4.1. Standards and regulation challenges

Despite rapid battery evolution, codes and standards development has lagged, though they are crucial for safety, reliability, and interoperability. However, they mainly focus on generating data and pass/fail criteria, making reliance on testing alone unadvisable. UL 9540A and other standards offer different tests but lack guidance on understanding energy storage system risks, designs, and mitigation.

Some regulations and standards struggle to keep up with evolving technologies and have overlooked critical inherent hazards like gases produced during thermal runaway and

CEC Exhibit-17

INVESTIGATIVE UNIT

Heavy metals found in dust miles from Moss Landing battery fire

By Jaxon Van Derbeken • Published March 25, 2025 • Updated 2 hours ago

New data collected by nearby residents after the Moss Landing battery fire and tested by a private lab shows heavy metals in surface dust miles from the scene -- at levels that one toxicologist calls "concerning."

"Something came out of that plant that's hurting people, and it's still happening," said Brian Roeder, a co-founder of the activist group Never Again Moss Landing who led the dust sampling effort.

In late January, volunteers took more than 100 dust samples around Prunedale, Castroville and other areas around the plant that caught fire on Jan. 16.

"There is reason to be concerned," Don Smith, an environmental toxicologist at UC Santa Cruz who specializes in heavy metals, said of the of the findings.

The dust residents collected using swab samples taken from flat, non-metallic surfaces reflects notably higher levels of nickel, cobalt and manganese, the three major components of lithium-ion batteries, Smith says.

All three elements have potential short-term and long-term health effects, including

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All three elements have potential short-term and long-term health effects, including respiratory inflammation, triggered when microscopic particles get trapped deep in the lungs, he says.

"Both manganese, and to a lesser extent, cobalt, are known to be neurotoxins. And nickel, of course, is recognized as a carcinogen," Smith said.

Smith advises Moss Landing area residents to wear masks as they safely remove dust regularly from their homes, and to be careful not to disturb the soil in their yards or flower beds.

Roeder says he and his wife had to move from their Prunedale home after she started having respiratory problems following the fire.

"We're not going back. We've abandoned our house at this time," he said.

Roeder said one of the first things the group decided to do was to test the dust in the areas around their homes – according to EPA protocols and instructions provided by a private lab he paid to analyze the results.

Although Smith says there's currently no regulatory guidance about safe levels in dust, he's worried that the swab sample results show levels notably higher than typical background levels, by as much as two to three times more concentrated.

Meanwhile, tests of the Elkhorn Slough ecological preserve done independently by local marine researchers also found elevated levels of the three battery metals in the soil east of the plant. The marine scientists even found charred pieces of batteries.

Roeder wants the state to do more testing beyond the limited efforts of marine researchers and residents themselves.

"There's not enough data," he said. "One of my questions is, why isn't data being collected that has to do with people's health?"

MONTEREY COUNTY

Moss Landing residents sue Vistra over battery facility fire

MONTEREY COUNTY

Moss Landing battery fire hit plant with older, vulnerable technology, expert says

The county's website cites some data collected by the state Department of Toxic Substance Control, which confirms some elevated soil levels in the immediate vicinity of the plant.

Weather Forecast

63° 56°

Partly Cloudy
0% Precip 63°

But the samples were not taken from the same Prunedale and Castroville areas where the residents did their dust sampling.

The county says the data collected to date has to be more fully analyzed before it develops a "proactive monitoring plan" to "detect and address any potential concerns."

The plant's owner, Texas-based Vistra, says "no hazardous conditions have been detected" in its own testing and air monitoring outside the plant.

"We want to emphasize again that Moss Landing is not only home to our facility, it's home to our employees and neighbors," the company said. "We are committed to doing everything we can to do right by our community and are working in concert with federal, state, and local agencies to ensure public health and safety."

But at least one popular business has become a casualty of the fire.

"I love what we've created here," said Kim Solano, owner of the Haute Enchilada Café, which has been operating for 25 years in the shadow of the Moss Landing plant.

Solano says her café was thriving until Jan. 16. Not long after the fire forced her to close, she reopened briefly. But a flareup prompted her to make a painful decision, she said.

"I decided to close because, one, there's not enough business, and two, the uncertainty of the plant in its current state," she said while sitting in her now empty establishment.

"We're just waiting for the answers," said Solano, who has suffered respiratory issues along with her husband. The couple recently filed a federal suit against Vistra.

Solano says she's angry the community has been forced to live in limbo. She expects the café will remain closed for the foreseeable future while authorities figure out the cause of the fire and make sure the plant is safe.

"My request is to prove to me that I have nothing to worry about," Solano said. "You know, prove to my community that we have nothing to worry about."

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INVESTIGATIVE UNIT • MONTEREY COUNTY

CEC Exhibit-18

A Battery Fire Deposits Heavy Metals into Elkhorn Slough

Lithium-ion battery components—nickel, manganese, and cobalt—were found at concentrations thousands of times greater after the fire. The implications for wildlife hang in the balance.

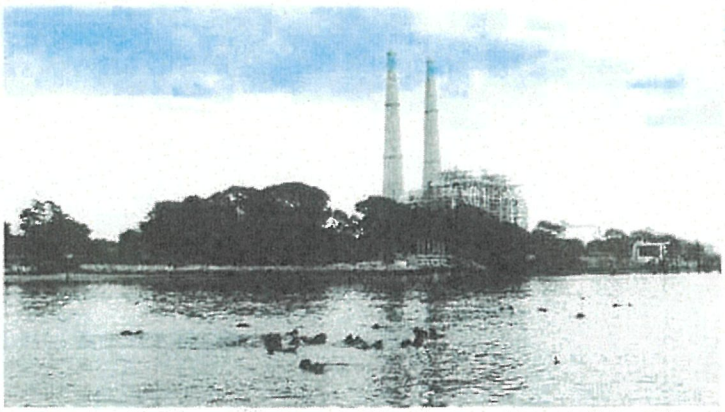
by Jillian Magtoto

February 6, 2025

Ivano Aiello trudged through marshy banks of Elkhorn Slough in Monterey on January 21st to collect samples from the soil's surface and subsurface, 3 to 5mm deep, as he's done for over a decade. This time, charred plastic debris littered the ground. Chunks of concrete lay scattered in pieces among mats of pickleweed. Five days earlier, a fire broke out about a mile away at Vistra Moss Landing Power Plant, the world's largest lithium-ion battery storage facility, according to the company. The smell of fire was gone, but he wondered what lingered in the soil.

Aiello took about thirty samples along the main channel of the marsh over the course of a few hours, and returned to his microscope at San Jose State University's Moss Landing Marine Lab (MLML), where he is department chair and a professor of marine geology. Out of the nearly 40 elements he detected in this quick sample, three elements—nickel, manganese, and cobalt—showed dramatic increases. When he typed the elements into his search bar, an ad for 300-

dollar lithium batteries popped up. "That's what I'm looking at," he thought to himself.



Moss Landing Power Plant overlooking the sea otters at Elkhorn **Slough (kqedquest via Flickr, CC BY NC 2.0); Elkhorn Slough aerial view (NOAA/Elkhorn Slough National Estuarine Research Reserve via Flickr, CC by 2.0)**

The fire at Vistra Moss Landing Power Plant, owned by Texas-based Vistra Energy, started January 16th and burned for three days, consuming 75 percent of the plant and its 100,000 lithium-ion cells. These rechargeable batteries store excess solar energy during the day, and deliver it to the grid at night, or on less sunny days. Heavy metals like the ones Aiello identified are often used in these batteries because of their ability to store large amounts of energy.

But these heavy metals are quite lightweight and travel far. The fire released contaminants that ended up at least two miles away, settling over the water and soil at Elkhorn Slough, the country's first estuarine research sanctuary and home to 700 species, several of which are threatened and endangered.

Aiello returned with his team, collecting 100 soil samples within a two-mile radius of the plant over the course of nearly three days. Nickel, manganese, and cobalt were present at concentrations hundreds to thousands of times greater than when he last measured them two years ago. Now, his laboratory, nonprofits, and public agencies are rushing to figure out what this means for the rest of the slough.

The metals "might start interacting with the environment," says Aiello. "What we need to study is whether they will become bioavailable"—whether they will absorb into the plant and animal tissues of life at the slough.

A pair Brandt's Cormorants camping on their nest (Jan Arendtsz via iNaturalist, CC by ND 2.0); a single Lewis's Moon Snail attached to a rock (nature1111 via iNaturalist, CC BY NC); and a squinting sea lion at Elkhorn Slough (Michael Kaufman via iNaturalist, CC BY-NC-ND)

Land meets the sea at Elkhorn Slough, a seven-mile stretch of water and wetland from Moss Landing to Watsonville, home to California's largest concentration of southern sea otters—about 150—and the state's second largest estuary. The flows of water between Monterey Bay and estuary creates opportunities for a diversity of salt and freshwater-loving species living among intertidal marshes, mudflats, oyster communities, and eelgrass beds, protected from harsh ocean waves. A hundred species of fish including bat rays and leopard sharks swim in its channel; 550 species of invertebrates like oysters and moon snails plant themselves on rocks and mud; hundreds of harbor seals and sea lions flank its docks and shores. The slough inhabits endangered species like the California brown pelican, California least tern, Santa Cruz long-toed salamander, and American peregrine falcon. "It's very essential habitat," says Aiello. "It's one of a few wetlands in California."

Before it was a preserve, Elkhorn Slough was a hub of fishing and farming. Farmers drained water from the slough to grow crops in the 1900s; the U.S. Army Corp of Engineers began dredging the mouth of the estuary every three years to make way for bigger ships in the 1940s. About half of the tidal marsh in the slough has been lost since then. Conservation didn't begin until 1971, when The Nature Conservancy began purchasing wetlands to protect the slough from major development. In 1979, the National Oceanic Atmospheric Association (NOAA) established it as an estuarine preserve owned and managed by the California Department of Fish and Wildlife (CDFW). Three years later, the Elkhorn Slough Foundation was established as a land trust and partner with NOAA and the CDFW. Since then, it has acquired and protected more than 4,200 acres—making it the largest landowner in the watershed.

As conservation accelerated, a PG&E power plant facility was also developing at the mouth of the slough. Marked by two 500-foot steam towers visible from Highway 1 and nearby farms, the plant began commercial operation in 1950—equipped with gas-powered turbine and steam generators cooled by ocean water. The plant changed hands among power companies a few times before Vistra Energy merged with previous owner Dynegy Moss Landing in 2018, becoming Moss Landing Power Company in 2020. While using much of the same infrastructure, the plant presented a way to store renewable energy for future use.

"I think there was actually quite a bit of enthusiasm on the part of the community," says Mark Silberstein, the executive director of the Elkhorn Slough Foundation. The plant presented a "way to store wind and solar power during peak production, when otherwise it would be wasted."

Moss Landing Power Plant, just under mile north of the Moss Landing Marine Laboratory (Steve Ryan via Flickr, CC by SA 2.0); Elkhorn Slough marshland (Hazel Rodriguez/USFWS via Flickr, Public Domain)

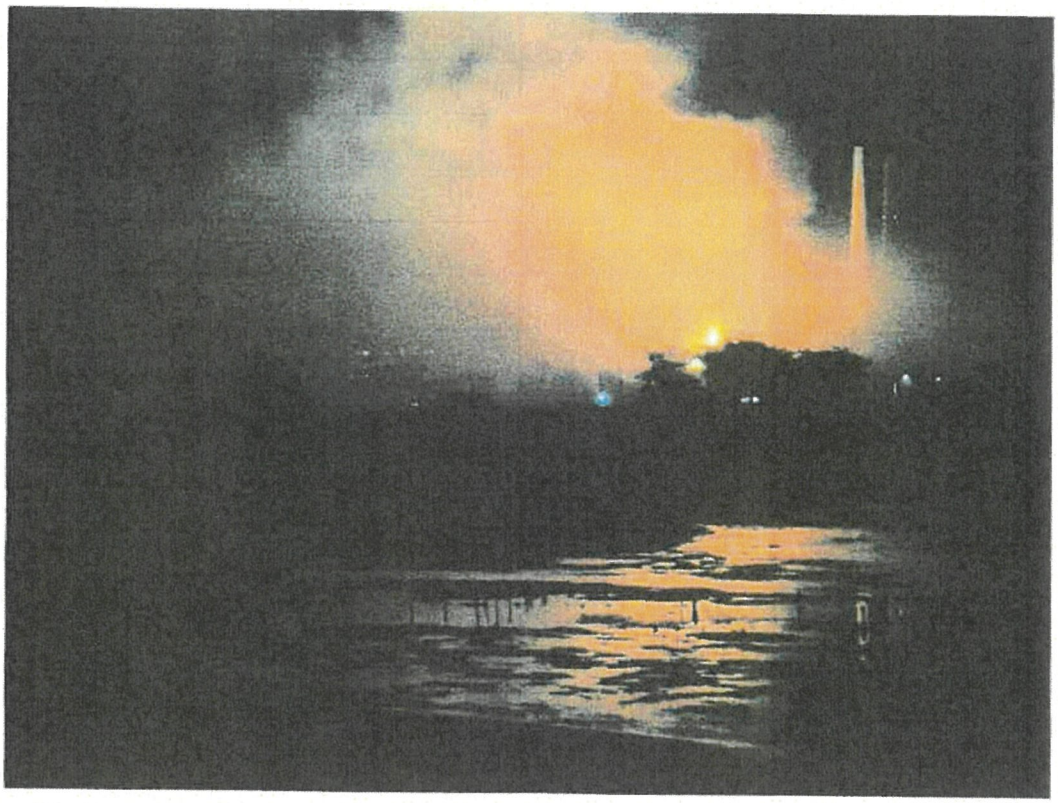
Lithium-ion battery plants, however, also pose dangers: fire, explosions, and toxic plumes and runoff. Overheating begins with thermal runaway, a phenomenon in which lithium-ion cells start uncontrollably heating up. While the heat should be able to escape from the cell, with damage, improper design, or a short circuit, the cell can generate heat faster than it can dissipate. Heat and pressure build in the battery, leading to fire and explosion, releasing gases like carbon monoxide, carbon dioxide, methane, and ethane. Fire ensues.

The Moss Landing Power Plant was no exception to these risks. After a couple of incidents of battery meltdowns and overheating, since the plant began operating in 2019, a fire erupted. Over 1,200 people were temporarily evacuated; Highway 1 closed for three days.

Vistra's overheating response system is designed to inject water directly onto the batteries to cool them off, and was working when the fire department arrived, says North County Fire Protection Department fire chief Joel Mendoza. But a few hours after the fire began, it escalated —quickly. "I think we made the right call by backing [the firefighters] out," says Mendoza. "It was just too much fire for anybody to handle at that point." Because the batteries were sealed, the fire department could not do much to suppress the fire, other than wait. "Imagine batteries burning inside a refrigerator," says Mendoza. "You're spraying water on the outside... but the battery is still burning inside."

A blaze this big was unexpected for local officials. Vistra's emergency response plans are "not designed for entire facility to go up like that," says Mendoza, and "did not account for a fire of this size," wrote Monterey County supervisor Glenn Church in an email.

"It is not hyperbole to call this worst-case or even beyond a worst-case scenario," wrote Church. "The flames went up to 250 feet, or about halfway up the stacks. There was smoke for about two days." The cause of the fire still remains unknown, according to the county. The evening of the fire, at the request of Monterey County, the EPA installed nine monitoring stations within the area of evacuation to test for hydrogen fluoride, a highly toxic gas produced by lithium-ion battery fires, and particulates from combustion. Neither contaminant was detected at levels that cause concern for human health, according to the EPA's statement in a press conference two days after the fire, though Monterey County citizens were left with headaches, nosebleeds, and metallic tastes in their mouths.



The Vistra Moss Landing Power Plant, ablaze from January 16th to January 18th (**Monterey County**)

Whether contamination reached soils remained an open question. In the meantime, the CDFW began preparing for the worst. "Out of an abundance of caution, CDFW is modifying activities that disturb soil and vegetation," says Krysten Kellum, a CDFW spokesperson. Kellum did not provide comment, however, on what these activities entail.

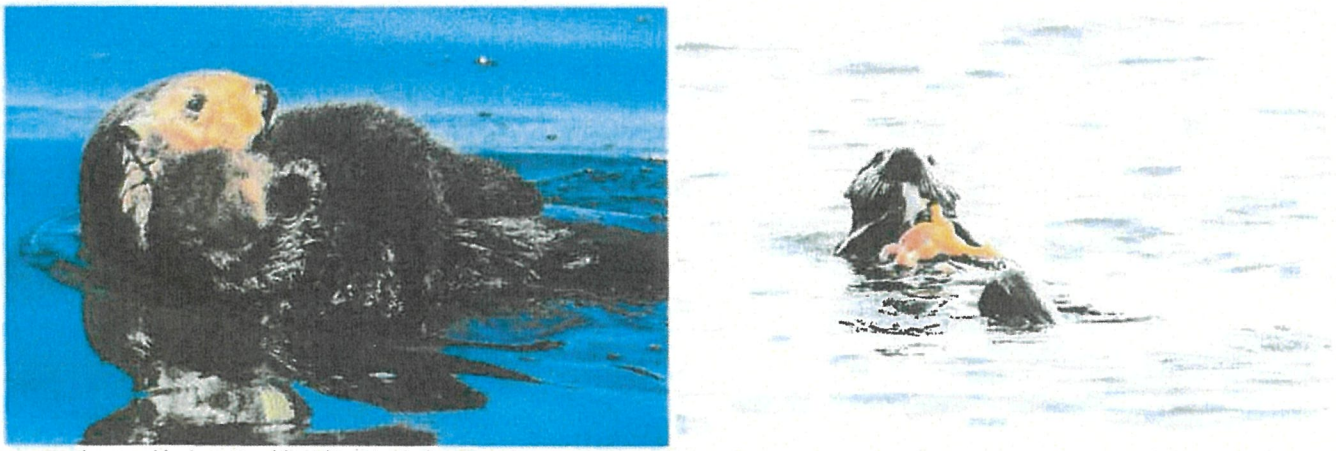
Nonetheless, Aiello decided to conduct soil testing himself, as soon as the evacuation orders were lifted for his laboratory.

"I was curious, because we just had a giant fire next door," he says, at a battery plant he did not realize could emit toxic chemicals. "It was completely off my mind," Aiello says. "My life was focused on completely different things than heavy metals."

For the past decade, Aiello has been studying soils at restoration sites in Elkhorn Slough, measuring grain size, moisture content, and soil composition. When Aiello introduced elemental analysis into his studies in 2023, he began building a baseline of data for future comparisons—handy for measuring the impacts of disaster. After the fire, he went back to his survey sites: 100 locations in various upland, riparian, and marsh environments. "What we're finding is that there's a variability within the area," he says. "But it's all high, maybe much higher, in some cases."

Though he has yet to complete his investigation, he has already noticed some patterns. "The highest concentration seems to be occurring where the wetlands are," says Aiello. And there's a likely explanation.

Not only can the metals be deposited through airborne deposition, but also in runoff and tidal flows, according to Wesley Heim, head of the MLML marine pollution studies lab. His lab began collecting samples on January 31st to track metals that might enter the slough through runoff. "Once in the slough, these metals can bind to sediments in marshes and mudflats, where they can accumulate over time, or dissolve in the brackish water, making them more mobile," Heim wrote in an email. "Cleanup will be very difficult, if not impossible."



A mother and baby otter (davidjcook via iNaturalist, CC by NC 4.0); An otter eating a tentacled lunch at Moss Landing (Allan Hack via Flickr, CC by SA 2.0)

Consequences for wildlife will be a painful waiting game, especially when the state's largest density of southern sea otters lies at risk. As of now, "we haven't yet found any unusual wildlife mortality from this event," says Ross Robertson, communications director of the Elkhorn Slough Foundation. "But it's too early to say that that's not going to happen."

"Because otters are at the top of the estuarine food chain, they are exposed to higher levels of heavy metals than the organisms they consume," writes Heim. Heavy metals can be absorbed by aquatic plants and travel up the food chain to marine invertebrates, including crabs, sea urchins, clams, mussels, and snails—which otters eat in daily quantities weighing a quarter of their body weight. Impacts on the otters will take time to see, Heim writes. "But I think it is possible given the amount of heavy metals being found."

As Aiello and his colleagues measure heavy metals, the Elkhorn Slough Foundation is monitoring wildlife as an indicator of the slough's health, through one species in particular.

"We've done some collections of oysters," says Silberstein. Native Olympia oysters have naturally grown in the slough since they were reintroduced in 2012, pumping water through their gills and trapping particles in their mucus. "Focusing on filter feeders is a good place to start...if you want to know how compounds are flowing through these aquatic ecosystems."

Baby oyster restoration in 2018 (Luke Gardner/California Sea Grant via Flickr, CC by 2.0) and a California Jackknife Clam, also a filter feeder, at Elkhorn Slough (nature1111 via iNaturalist, CC by NC 4.0)

For now, Vistra has closed the doors to its battery facility, and will continue operating its natural gas energy production right next-door, writes Church. Vistra's third-party consultant company, CTEH, will "continue to monitor air quality up to the site boundary indefinitely," according to Vistra's response website. "There is a robust plan on removing the rest of the building" and disposing of the remaining batteries, says Mendoza. While the recent days of rains may ring alarm bells for water pollution, the good news is that "the runoff will remain on scene," he says. "They have ways of shutting down their storm drains... so that none of it goes off site and to any of the waterways, including the slough or the ocean."

Aiello and his colleagues, meanwhile, are continuing to return to their survey sites every day to understand where the particles are going. But heavy metal sampling isn't cheap.

"We need to get some funding; some of what we're doing is kind of pro-bono," he says. "We're doing what we can."

About the Author

Jillian Magtoto

CEC Exhibit-19

READY, SET, GO!

BE EMBER AWARE

Embers are burning pieces of vegetation or other flammable material and are the leading cause of structural damage and home loss from a wildfire.

In order to successfully protect your home, you need to understand the real threat during a wildfire.

Once they're picked up by strong winds, embers can travel as much as five miles in front of the active front of a wildfire. Before flames get anywhere near your home, embers can land in dry or flammable vegetation or small open spaces on your roof or walls, and ignite, threatening your home.

If embers fall on and ignite nearby plants, the radiant heat created by the fire can burn combustible siding, doors, or window frames. Radiant heat can also cause windows to break, creating openings that allow flames and embers to enter your home. Once the home is on fire, it will create more embers that can be picked up by winds, travel to other homes and neighborhoods, and increase fire damage for the entire community.

Embers create a huge threat during a wildfire. It's the steps you take now to make your home and landscaping more ember-resistant that will protect your family, your home, and your community during the next wildfire. Take responsibility!

Orange County Fire Authority

www.ocfa.org/RSG

For more information, please visit the OCFA website or call (714) 573-6774 to schedule a Wildfire Home Assessment.

CEC Exhibit-20

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A pod of harbor seals lounging on the banks of Elkhorn Slough (Judy Gallagher via Flickr, CC by 2.0)

NEW MEXICO NEWS

Santa Fe ranks 12th in the west for greatest wildfire risk

by: Rachel Knapp
Posted: Sep 18, 2019 / 10:30 PM MDT
Updated: May 24, 2021 / 03:50 PM MDT

SHARE

SANTA FE, N.M. (KRQE) – A New Mexico city was recently ranked as having one of the highest risks for wildfires in the west. If there's a fire, it would be expensive.

Breathtaking views of mountains and forests, many people have a stunning view of the Capital City from their backyards. It's the natural beauty that draws people to build their homes here in Santa Fe, but all that vegetation raises concerns when it comes to fires.

"This is a real risk," said Alan Hook with the Santa Fe Water Division. "We're in the west and fire is part of the landscape."

The State Forest office created the Greater Santa Fe Fireshed Coalition, saying the Capital City is, and has been, an extreme fire risk. A new report from Core Logic backs this up, ranking Santa Fe 12th in the west for cities with the greatest fire risk.

A fire there would be extremely costly. The study said more than 23,000 homes in the Santa Fe area face an extreme wildfire risk, estimating a whopping $7.28 billion worth of reconstruction if those homes go up in flames.

"That would be a big loss," said Hook. "Insurance companies look at that and its real potential impact to the community of Santa Fe."

The homes at most risk are in the outskirts of the city.

"People in this field have always known this," said Greater Santa Fe Fireshed Coalition Chair Eytan Krasilovsky. "But it's good to hear this information that confirms what our information shows, but it is troubling and we have a lot of work ahead of us."

That work includes forest thinning, which the Forest Service said some homeowners have tried to stop.

"So we don't want this catastrophic wildfire to occur, but from the city's perspective, we're doing all we can do prevent that," said Hook.

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"That would be a big loss," said Hook. "Insurance companies look at that and its real potential impact to the community of Santa Fe."

The homes at most risk are in the outskirts of the city.

"People in this field have always known this," said Greater Santa Fe Fireshed Coalition Chair Eytan Krasilovsky. "But it's good to hear this information that confirms what our information shows, but it is troubling and we have a lot of work ahead of us."

That work includes forest thinning, which the Forest Service said some homeowners have tried to stop.

"So we don't want this catastrophic wildfire to occur, but from the city's perspective, we're doing all we can do prevent that," said Hook.

The last major fire near Santa Fe was the Pacheco Canyon wildfire in 2011. It was caused by a campfire and burned more than 10,000 acres.

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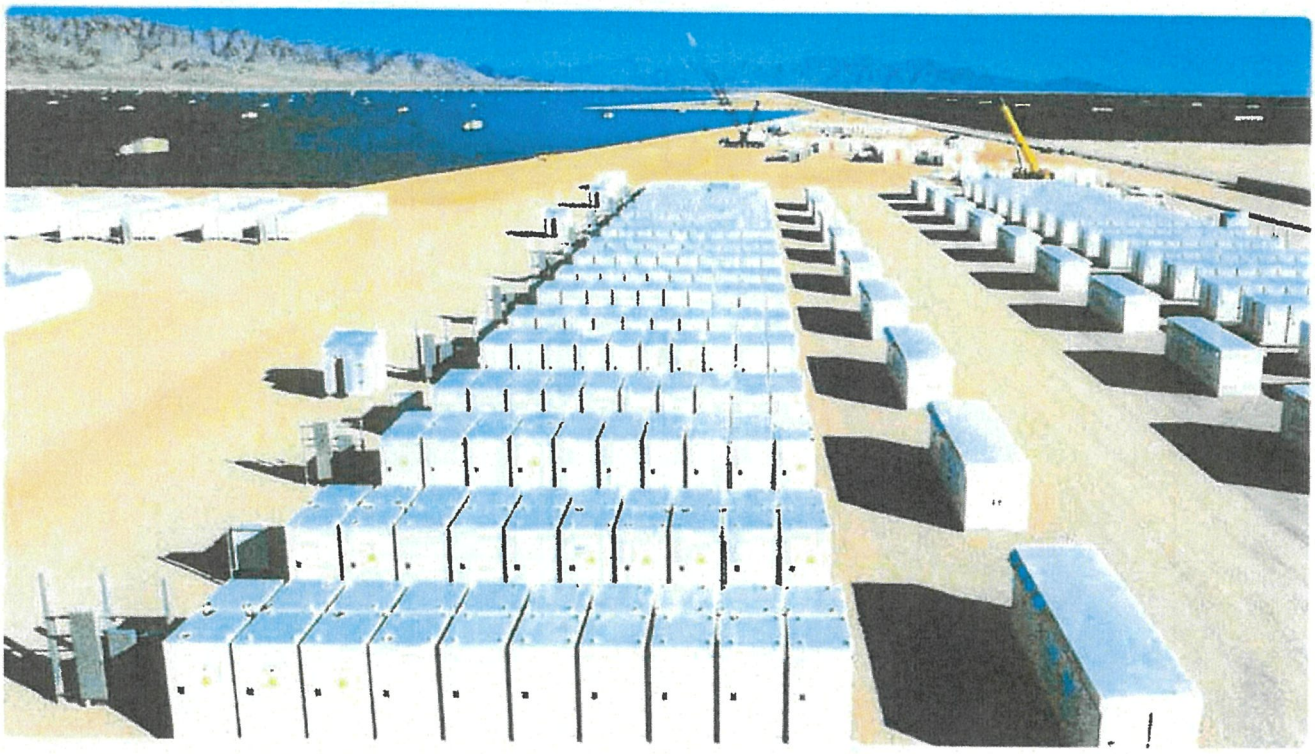
Resources for the Energy Industry

Battery Energy Storage System (BESS) Technology Growth and Risks

By Travelers | [illegible]



Renewable energy sources, such as solar and wind, are projected to generate 44% of all power in the U.S. by 2050,[1] which is increasing demand for the battery energy storage systems (BESS) needed to store this energy.

Unprecedented public investment in clean energy — afforded mainly by the Infrastructure Investment and Jobs Act (IIJA) (2021), the Inflation Reduction Act (2022) and the CHIPS Act (2022) — is fueling much of this growth. Market stakeholders include entities involved in the manufacturing, sales, installation, maintenance and operation of BESS facilities.

One unique BESS hazard is battery fire and/or explosion caused by thermal runaway, or the rapid uncontrolled release of energy from a battery cell. Thermal runaway can be caused by an internal short circuit, which can be caused by mechanical, thermal or electrical damage to the battery before, during or after installation.

3. Environmental pollution and health hazards

Some chemicals used to make batteries may be hazardous. Even when the best safe handling practices are followed, accidents can happen – and any damage caused during the manufacturing, transportation or disposal process can expose people working or living in or near a BESS facility to harmful gases or pollute the surrounding soil and groundwater.

Thermal runaways require a significant amount of water to cool and control. Potentially hazardous chemicals released during the fire can pollute the water used to fight it, contaminating any soil or groundwater absorbing the runoff.[5] Fumes released can also be a risk to the public and first responders.

Effective BESS risk management

Managing BESS-related risk depends on planning, preparation and having a trusted, experienced partner. With a dedicated team of energy experts and Claim specialists, Travelers has been providing **specialized coverage and risk control solutions** to support owners and operators in the rapidly growing renewables industry for over 30 years.

To learn more, visit **Travelers Insurance for the Renewable Energy Industry** or contact your agent today.

Sources:

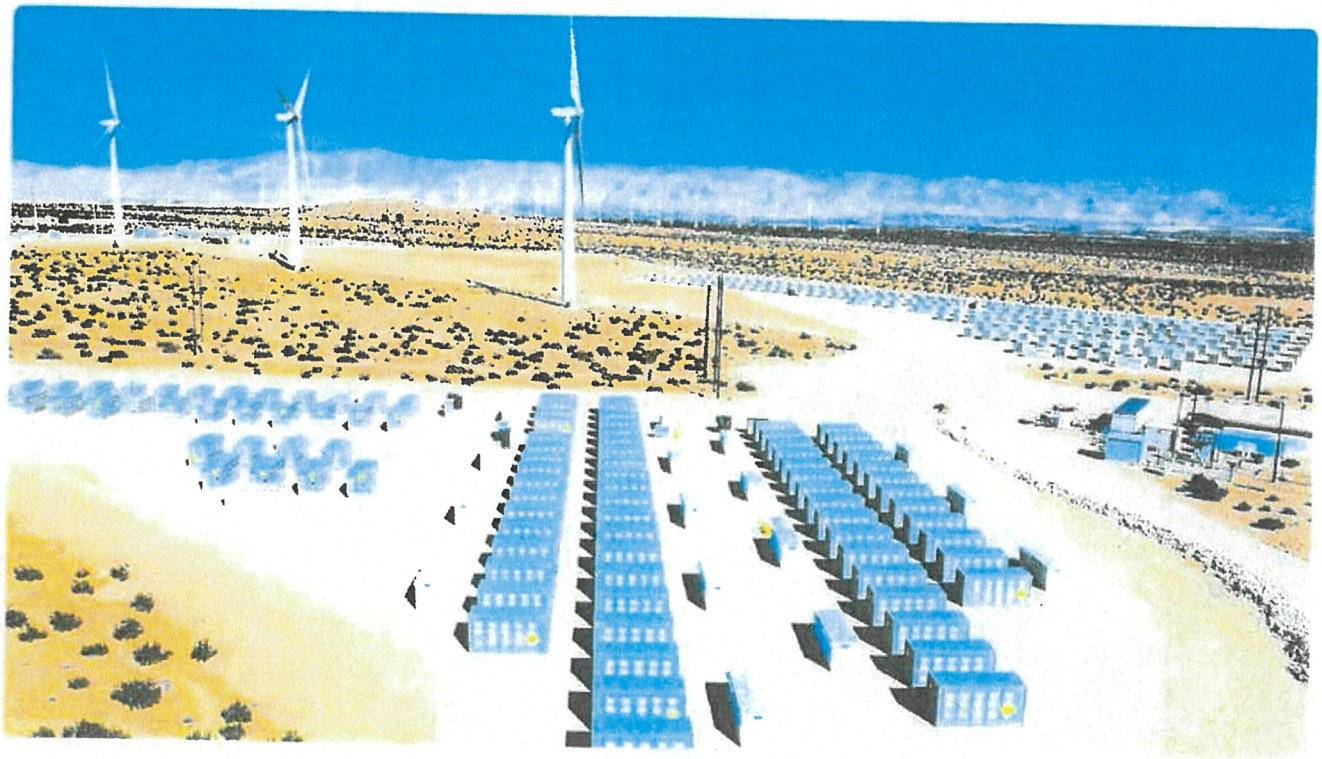
[1] EIA projects that renewable generation will supply 44% of U.S. electricity by 2050, U.S. Energy Information Administration, March 18, 2022. - https://www.eia.gov/todayinenergy/detail.php?id=51698

[2] Bloomberg New Energy Finance (BNEF), 2019 Long-Term Energy Storage Outlook, Bloomberg NEF, New York, 2019 – as cited in Energy Storage Grand

Resources for the Energy Industry

Lithium-Ion Battery Energy Storage Systems (BESS) Risks

By Travelers



There is growing demand for lithium-ion battery energy storage systems (BESS), and for good reason. Consumers, businesses and public and private organizations can benefit greatly from BESS. Benefits include cost savings through time-shifting (i.e., storing energy when the cost is low for use during times when energy is expensive), improved quality of power supply and availability of emergency backup power.

According to the U.S. Department of Energy, the lithium-ion battery energy storage segment is the fastest-growing rechargeable battery segment worldwide and is projected to make up the majority of energy storage growth across the stationary, transportation and consumer electronics markets by 2030.[1]

What is a BESS?

What are the hazards of lithium-ion battery energy storage?

While lithium-ion BESS offer multiple benefits, they [illegible] present significant hazards. Understanding the risks and having a plan in place to address them is an important consideration when adding a BESS to [illegible] business electrical system.

Fire hazards

Understanding the unique fire risks presented by BESS is critical. Some fire suppression systems may be ineffective and improper firefighting techniques can worsen the outcome, potentially causing additional harm to people and property.

A battery fire can generate chemical gases with potential to cause an explosion, especially if they are not properly ventilated. If a fire occurs, emergency response efforts must be tailored for the individual BESS site.

Fires in a BESS are often a result of a process called thermal runaway. This occurs when a battery cell creates heat that it cannot adequately dissipate. The resulting dynamic temperature increase in the cell and adjacent cells creates a cascading effect. The phenomenon can occur in a battery cell that has internal defects, has had internal damage, been exposed to heat from an external source or been overcharged, or it may be due to a battery management system failure [illegible] malfunction.

Key controls for BESS owners to prevent and/or mitigate fire losses include:

- Proper handling and installation.
- Effective operations and maintenance (O&M) performed by qualified personnel.
- Adequate protection from vehicle/equipment damage (e.g., bollards).
- Collaboration with the fire department to develop a fire response plan that accounts for:
  - BESS chemistry.
  - Location.
  - Protective features (such as fire suppression and explosion venting).
- Knowledge of manufacturer-specific requirements (e.g., maintenance frequency, intervals).
- Effective battery management system (BMS) monitoring.
- Other site-specific considerations.

Chemical release hazards

Chemical release hazards

Chemicals contained within a battery can be released during a fire and may create an explosion. Chemical releases may also contribute to liquid pollution when mixed with firefighting water, potentially contaminating soil or groundwater.

Key controls to help prevent losses related to chemical releases include:

- Proper site design that contemplates water management (retaining berms, dikes, drainage) and equipment location.
- Proactively developing proper containment systems.
- Thorough emergency preplanning.

Stranded energy hazards

When batteries are damaged, they can still contain energy. This "stranded" energy should be dissipated prior to interaction with or removal of impacted cells. If not handled properly, the damaged batteries could cause injury, including electrical shock.

Only qualified personnel should perform maintenance and repair work on BESS. BESS owners consider the following for preventing stranded energy related losses:

- Proper contractor selection for installation and ongoing O&M (e.g., proper high-voltage training where applicable, effective lockout/tagout protocols).
- Preventing unauthorized personnel from accessing BESS.

How might lithium-ion BESS hazards affect your organization?

As you weigh the benefits and costs associated with owning and operating a BESS, it's important to consider the potential exposures and how they may impact your organization's personnel and property. Consider working with an insurance carrier that has in-depth experience in the renewable energy industry.

Travelers works with customers across the United States who own and operate battery energy storage systems. Our experienced Loss Control professionals is well-versed in both battery risks and fire protection. Through collaboration, we provide customers with tailored risk solutions and services to address their unique risks and exposures.

Learn more about Travelers' expertise in renewable energy. Ask your insurance agent how a robust insurance program from Travelers can help protect your organization.

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CEC Exhibit-23

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COMMUNITIES

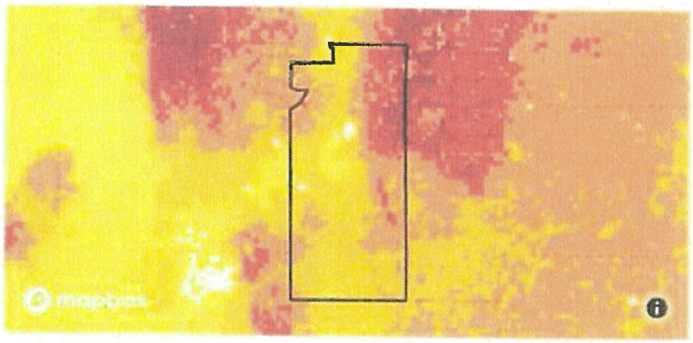
Search by community, tribal area, count... | Overview | Risk to Homes | Wildfire Likelihood | Risk Reduction Zones | Vulnerable populations

New Mexico

Santa Fe County has a high risk of wildfire—higher than 85% of counties in the US.

Risk to Homes

High

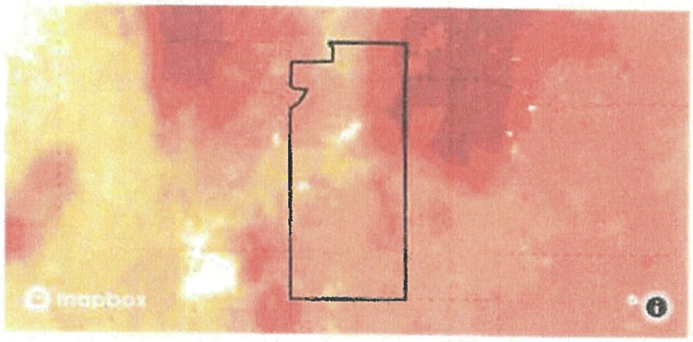


Risk Reduction Zones

High

Wildfire Likelihood

High

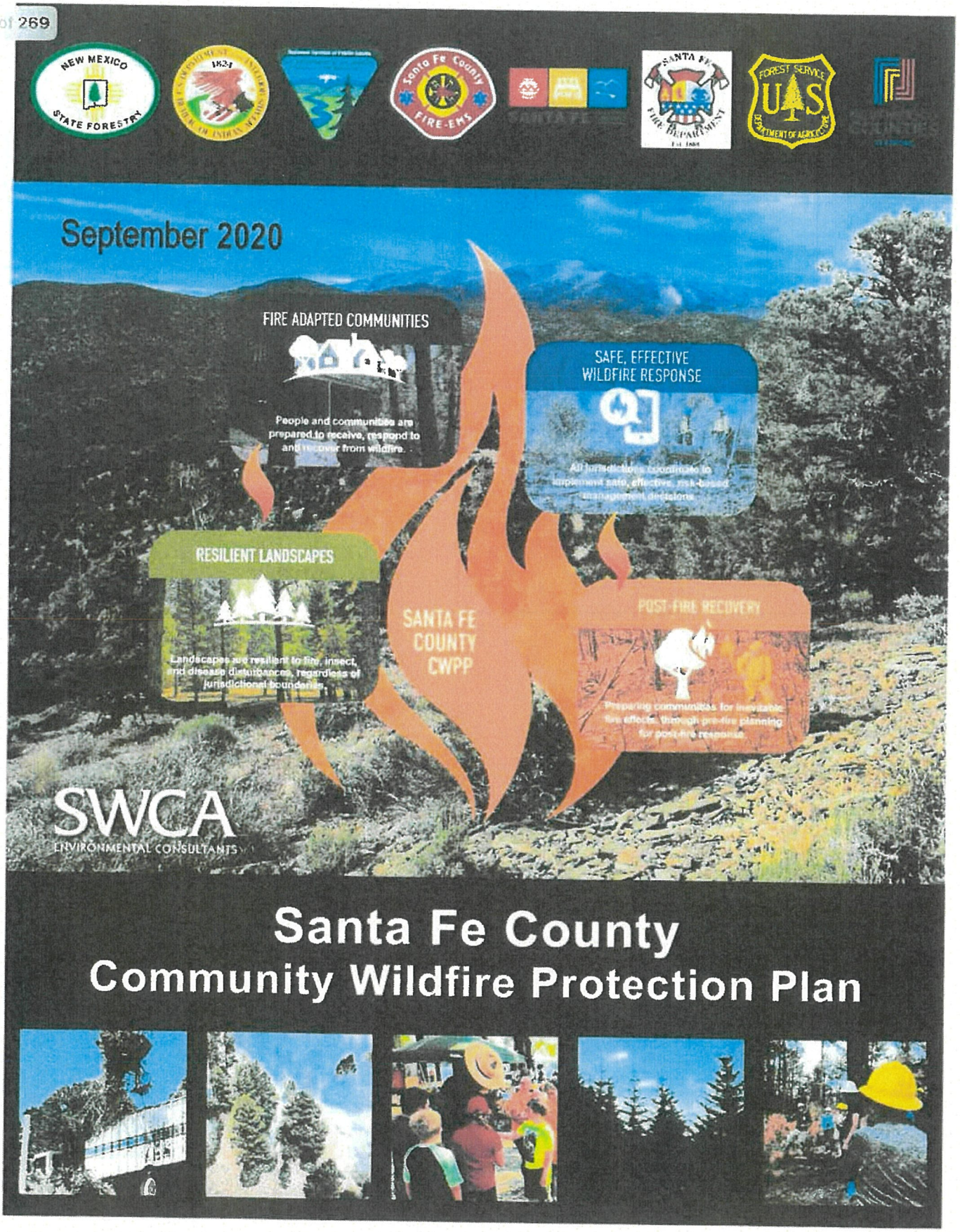


Vulnerable Populations

Med

Identify your most relevant actions

Everyone has a part to play in reducing wildfire risk. Select a role to highlight tools, tips, and programs that can help.



Although fire suppression is still aggressively practiced, fire management techniques are continually adapting and improving, especially in light of changing climate. Management of fire for resource objectives is an option for land managers in the County. Due to scattered human developments (homes, ranches, and farms) and values (residential and commercial structures, historic and natural values) throughout the WUI, suppression in WUI areas will always have to be a priority. However, combining prescribed fire and managing wildland fire for resource objectives with effective fuels management and restoration techniques have been proven to help re-establish natural fire regimes and reduce the potential for catastrophic wildfires on public lands associated with heightened risk due to a warming climate. The use of prescribed fire on private land is a decision to be made by the landowner, and it is acknowledged that given the prevailing drought such a management technique may not always be feasible in the County.

FIRE RESPONSE CAPABILITIES

Planning and Decision Support

As wildfires have continued to grow in size and severity over the last decade, this has led to fire managers needing to institute more robust pre-fire planning as well as adapt and improve decision-making tools in order to reduce risk to fire responders and the public and assess impacts on ecological processes.

A primary decision tool utilized by fire managers across all agencies is the Wildland Fire Decision Support System (WFDSS), a system that assists fire managers and analysts in making strategic and tactical decisions for fire incidents (WFDSS 2015).[6] WFDSS combines desktop applications for fire modeling into one web-based system. It provides a risk-informed decision process and documentation system for all wildland fires and it also introduces economic principles into the fire decision process in order to improve efficiencies which also ensuring safe and effective wildfire response.

One intent of WFDSS is to ensure that when fire response decisions are made, they fall in line with agency land and resource management plans. Agencies have recently been moving away from the traditional written fire management plans and instead are developing spatial fire management plans that can be housed within WFDSS (WFDSS 2015). The Santa Fe National Forest for example will have all management requirements and strategic objectives for fire management, contained within WFDSS, so that in the event of a fire, incident managers are considering this information when making decisions and developing strategic direction for the wildfire incident (WFDSS 2015).

Another tool employed by fire managers in pre-fire planning is the potential operational delineation (POD). PODs combine fire modeling with expertise from local fire practitioners and managers to identify potential locations where fire suppression could be effective (Caggiano et al. 2020; Harden 2020). This concept was tested in northern New Mexico during the 2019 fire season on seven New Mexico fires, including land in the Santa Fe National Forest. This pilot project demonstrated the effectiveness of PODs for decision support. It is anticipated that these processes will continue to be used in future fire planning across jurisdictions.

Fire Resources

The availability of resources is dictated by the state and federal wildland fire season. From approximately April 15 through July 15, resources are plentiful around the region. This time period is considered the Southwest fire season, so multiple crews, engines, helicopters, and air tankers are available. However, from July 15 to October 31, firefighting focus often changes to other regions such as to the Northwest and California. During this period, the time frame to obtain resources is extended, sometimes taking up to 48 hours. During the winter months, obtaining resources is difficult as many firefighters are employed seasonally from April through October. Given the changing fire regimes, wildfires now occur throughout the entire year, extending beyond the state and federal designated wildland fire season. Resources are limited for fires that occur outside of this time frame.

[6] WFTDSS: https://wfdss.usgs.gov/wfdss/WFDSS_Home.shtml

Santa Fe County Fire Department

Volunteer and career firefighters at the County and community level have similar capabilities throughout the entire year, while state and federal responders are affected by fire season. In spite of the continuous level of capabilities, ebbs and flows occur within the volunteer service. Recruiting and retaining volunteers is challenging due to people's lifestyles and the training requirements one must follow to be a volunteer firefighter. Although several volunteer firefighters are present in the County, not all are available to respond to every fire. The County Wildland Division has taken steps to have a fire crew all year round for county response.

Santa Fe National Forest

The Santa Fe National Forest provides fire response on USFS land in the County. Fire management and suppression protocols are directed by the Forest Plan.

On USFS land, the USFS has the responsibility for initial attack (initial response). The USFS maintains Mutual Aid Agreements (MAA) with the New Mexico State Forestry Division (NMSF), the County, and the NPS. Under the MAA, agency personnel may respond to incidents outside their agency boundaries.

The management of wildfire ignitions for multiple resource objectives (managing naturally burning fires in forests as a tool for helping to restore forest health and mitigating the escalating costs of fire suppression) is practiced on federal land but depends upon a thorough assessment of risk to values at risk in the WUI. Depending on the location and nature of a wildfire, USFS policies outline appropriate management responses to guide district personnel in the application of specific suppression techniques. All large wildfire response would be based upon assessment using WFDSS.

In wilderness areas, the Santa Fe National Forest supervisor must approve the use of helicopters, portable pumps, and chainsaws, as well as the construction of helispots. The Southwestern Regional Forester must approve the use of motorized vehicles and bulldozer line construction. Fire strategies call for:

- restoring fire to the ecosystem;
- using prescribed fire to reduce hazards;
- managing wildland fires so that air quality issues are compatible with local, state, and federal laws; and
- minimizing suppression impacts to wilderness as well as impacts to the surrounding area.

The USFS has the following resources available for fire suppression throughout the County:

- Santa Fe Supervisors Office
  - 3 – Type 3 Incident Command
  - 2 – Operations Section Chiefs
  - 3 – Task Force Leaders
  - Santa Fe Hotshots
- Espanola Ranger District
  - 2 – Type 3 ICs/Division Supervisors
  - 1 – Type 4 Engine
  - 1 – Type 6 Engine
- Pecos/Las Vegas Ranger District
  - 2 – Type 3 ICs/Division Supervisors
  - 1 – Type 3 Engine
  - 1 – Type 6 Engine

CHAPTER 3 – WUI HAZARD AND RISK ASSESSMENT

PURPOSE

The purpose of developing the risk assessment model described here is to create a unique tool for evaluating the risk of wildland fires to communities within the WUI areas of Santa Fe County. Although many definitions exist for hazard and risk, for the purpose of this document these definitions follow those used by the firefighting community:

> *Hazard* is a fuel complex defined by kind, arrangement, volume, condition, and location that forms a special threat of ignition and resistance to control.
>
> *Risk* is defined as the chance of a fire starting as determined by the presence and activity of causative agents (National Wildfire Coordinating Group [NWCG] 1998).

The hazard and risk assessment is twofold and combines a geographic information system (GIS) model of hazard based on fire behavior and fuels modeling technology (Composite Risk/Hazard Assessment) and a Core Team generated assessment of on-the-ground community hazards and values at risk.

From these assessments, land use managers, fire officials, planners, and others can begin to prepare strategies and methods for reducing the threat of wildfire, as well as work with community members to educate them about methods for reducing the damaging consequences of fire. The fuels reduction treatments can be implemented on both private and public land, so community members have the opportunity to actively apply the treatments on their properties, as well as recommend treatments on public land that they use or care about.

The Santa Fe County Hazard Mitigation Plan (HMP) (Santa Fe County 2018) lists wildfire hazard as a highly likely hazard, with extensive spatial extent, with a critical magnitude/severity and high overall significance.

FUELS AND TOPOGRAPHY WITHIN THE WUI IN SANTA FE COUNTY

The southern half of the County is predominantly composed of grassland fuels, transitioning into shrubsteppe- or shrubland-dominated fuels to the north. Forested communities exist primarily in the higher elevations of the Sangre de Cristo Mountains in the northeastern portion of the County. Grassland communities are primarily characterized by shortgrass prairie, which is relatively sparse and usually occurs on flat to rolling topography at lower elevations. Grasslands may occur as pure herbaceous stands, as a shrubsteppe community, or as a juniper savanna.

Grasslands

Grassland fires have the potential to move quickly under dry, windy, and steep conditions and can easily spread at a surprisingly rapid rate, often reaching over 300 feet per minute. Many authors have suggested that the historical fire-return intervals (FRIs) for grasslands throughout the seventeenth to early nineteenth centuries are thought to have been every 5 to 10 years (Leopold 1924; Swetnam et al. 1992). Fire-suppression policies may have contributed to declining fire frequency in this cover type, but other interacting factors may have contributed as well. About the time of the Civil War, intensive livestock grazing is thought to have been responsible for a decline in grassland fires (Touchan et al. 1996; West 1984). Heavy grazing reduced the fuels available to propagate fire spread and also reduced competition with herbaceous plants, tipping the balance in favor of the woody species. Woodland encroachment, increased tree density, and altered fire behavior characterize many former grasslands of the Southwest. Once woody plants become dominant, their long lifespans and their ability to extract both shallow and deep soil moisture can maintain a woodland condition indefinitely (Burgess 1995). Frequent fire plays a significant role in grassland nutrient cycling and successional processes, and long-term exclusion may produce irreversible changes in ecosystem structure and function (McPherson 1995).

Piñon-juniper Woodlands

One of most common vegetative communities in the County is piñon-juniper woodland. These woodlands are some of the most poorly understood ecosystems in terms of fire regimes, but recent research suggests that fire may have been a less-common and less-important disturbance agent in piñon-juniper woodlands compared with adjacent ponderosa pine and grassland ecosystems. In a recent review of piñon-juniper disturbance regimes, Romme et al. (2007) has subdivided the piñon-juniper cover type into three subtypes: areas of potential woodland expansion and contraction, piñon-juniper savannas, and persistent woodlands. These categories are helpful in separating the broad piñon-juniper cover type into distinct communities, which are subject to different climatic, topographic, and disturbance conditions.

Areas of potential expansion and contraction are those zones wherein the boundaries of the piñon-juniper ecotones have shifted. As mentioned previously, many grasslands in the Southwest have been colonized by trees as a result of a complex interplay of environmental factors. The issue of woodland encroachment into grasslands goes hand in hand with the assessment of historical conditions of the woodlands. These shifting boundaries have been widely documented (e.g., Gottfried 2004) but the historical condition of the ecosystem may be relative to the time scale of evaluation. Betancourt (1987) has suggested that the changing distribution patterns seen in the last century may be part of larger trends that have occurred over millennia and not the result of land use changes. Overall, it is believed that greater landscape heterogeneity existed previously in many of these areas that are now uniformly covered with relatively young trees (Romme et al. 2007).

Piñon-juniper savannas are found on lower elevation sites with deep soils where most precipitation comes during the summer monsoon season. Juniper savanna, the most common savanna in New Mexico, consists of widely scattered trees in a grass matrix (Dick-Peddie 1993). Similar to grasslands, the range of savannas has decreased as tree density has increased, but the mechanisms for tree expansion are complex as is the subject of current research. Significant scientific debate currently exists over the natural FRI for savannas, but most experts agree that fire was more frequent in savannas than in persistent woodlands.

CEC Exhibit-25

After Huge Monterey County Battery Fire, Locals Describe Headaches, Nausea and a Taste of Metal

By Juan Carlos Lara Save Article

A view of flames at Moss Landing Power Plant Units 6 on Pacific Coast Highway in Monterey Bay, California on Jan. 16, 2021. (Handout/Cal Fire/Reuters via Getty Images)

Hazy skies, a rank, perhaps acidic smell in the air, and a lingering taste of metal. Later — headaches, sore throats and nausea.

Residents in the Monterey and Santa Cruz areas have reported such health issues in the wake of last week's massive fire at a Monterey County energy storage facility, fearing they are related. Authorities have said they didn't detect toxins in the smoke, but some experts worry the test results aren't giving the full picture — and now state and local officials will be conducting further testing.

Eva Faste said she was outside her home in the Santa Cruz Mountains with her dogs when she first started getting a headache and a sore throat.

She didn't think much of it until that night when her phone

buzzed with an alert about a battery storage facility that had caught fire roughly 25 miles away in Moss Landing.

"I woke up the following morning, my nose was bleeding, and since then, I've been feeling worse every day," Faste said. Her sore throat, along with stomach problems and low energy, have persisted into this week, even though the fire has since died out.

The Jan. 16 fire started at what is reportedly the largest lithium battery storage facility in the world, with over 100,000 batteries used to store solar power and other forms of electricity to help supply the grid. The flames raged for hours, igniting the batteries stored within the facility and sending a dark plume of smoke high into the air until 80% of the building and its contents were consumed.

Lithium battery fires are notoriously difficult to extinguish and, as is often the case, emergency responders decided to let the fire burn itself out.

Since then, a Facebook group about possible fire-related symptoms has ballooned to more than 2,000 members. People have mentioned, along with Faste's symptoms, a metallic taste in their mouth and a persistent smell in the air.

One person who spoke at Tuesday's Monterey County Board of Supervisors meeting compared the sensation to what they experienced while receiving chemotherapy.

"I live in Prunedale. I have never had a metallic taste in my mouth before," Heather Griffin said. "Yes, there are people who burn fires in their fireplaces; we do, too. But I've never had a metallic taste."

The day after the fire began, the U.S. Environmental Protection Agency began monitoring the air for small particulate matter and hydrogen fluoride, a highly toxic gas emitted by lithium-ion battery fires. Officials set up nine nearby monitoring stations and did not detect harmful levels of either pollutant, the agency said,

adding that the sensors for hydrogen fluoride can also detect other compounds.

"To be conservative and most protective of public health, our operations assumed anything we were detecting was hydrogen fluoride, which is the most harmful of these mineral acid gases," the EPA said in a statement. "And, as noted before, no hydrogen fluoride exceeding health standards was detected."

California Approves $2.5 Billion Fire Relief Plan Ahead of Trump's Pacific Palisades Visit

A contractor hired by Vistra simultaneously tested for most of the same compounds and received similar results.

However, experts said sensors are unlikely to pick up hydrogen fluoride once the main smoke plume has died down.

"These chemistries dictate to us that those compounds are not going to last for a very long time in the air," said Michael Polkabla, the principal industrial hygienist with BioMax Environmental, a consulting firm specializing in hazardous materials and industrial hygiene. "So it's really irrelevant to measure hydrogen fluoride hours after the plume passes because it's going to be gone."

And although the full list of specific elements within Vistra's batteries is not publicly known, Polkabla has a few other pollutants he's concerned about.

"The metals — lithium, nickel, magnesium, cobalt are kind of the big four that would be produced and could have settled. These all have individual toxicities associated with them," Polkabla said.

A fire burns at Moss Landing Power Plant on Thursday, [illegible]. (Courtesy Hugo Flores Cantú)

Dustin Mulvaney, an environmental studies professor at San José State University, agreed, adding that a more comprehensive test would have required sending a drone into the smoke plume to test hydrogen fluoride there. He, like Polkabla, also worries about the other pollutants that the fire could have let off.

"You may think of a fire as a big chemical reactor doing an uncontrolled chemical reaction," Mulvaney said. "So it's actually the fire itself is sometimes manufacturing pollutants."

He added that the smoke plume could have carried some heat-resistant materials like metals or PFAS, also known as forever chemicals, because they take a very long time to break down.

"I think the public that's experiencing these symptoms is going to want to know what they were actually exposed to," Mulvaney said. "And I don't think that those EPA sensors are telling the full story of what was in that plume."

The EPA clarified that it did initially test for other compounds, including carbon monoxide and ammonia, then transitioned to focusing on particulate matter and hydrogen fluoride because they "are the two contaminants of concern from a battery fire that would pose a potential immediate health risk through inhalation."

On Jan. 20, four days after the fire started, the EPA ended its monitoring.

With the fire now over, Mulvaney and Polkabla both said that the best way to learn about the pollutants that were dispersed is to test soil and water samples both at the facility and in neighboring regions — including environmentally significant areas like

Monterey Bay and the Elkhorn Slough.

"Those particles are not necessarily going away unless they're removed," Polkabla said. "If they're a hazard, we need to identify what it is and have a protocol for how to remove that."

During a Wednesday press briefing, Vistra's Senior Director of Community Affairs, Brad Watson, said the company might test the soil "if there are indications around the site that there might be some compounds or constituents that we think need to be tested."

Monterey County officials used similarly indefinite language during the meeting, but by Thursday afternoon, Supervisor Glenn Church announced that local and state officials plan to do both water and soil testing.

"I think there's been a lot of concerns from folks and in this area of what is really out there. So we're looking into that," Church said.

The county Health Department said late Thursday that local and state partners will work together on collecting samples of water, debris and dust at the Vistra facility and in nearby areas, though they have not yet determined a timeline. Additional water and soil testing will follow, county representatives said.

When an Oakland Hills Home Caught Fire Near Closed Station, the Response Was Slow

Health officials added that residents who may have found residue from the fires on their property are urged to use caution when cleaning up.

In the meantime, some continue to worry about what they are potentially being exposed to.

Faste and her husband are considering leaving the area for a while in the hopes that her symptoms will diminish once she's farther from the site of the fire.

"We're debating what to do, you know? We live here. I have a disability, so it's really hard for me to go places. I'm in a wheelchair most of the time, so it's complicated," Faste said.

The couple will likely book a short-term rental or stay with family

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The couple will likely book a short-term rental or stay with family for about a week and then reevaluate. Although the move won't be easy, Faste said she has a compromised immune system and worries she'll get worse if they stay.

"We kind of moved in the mountains to be in the clean air," she said. "So it's kind of sad that we will have to leave because the air is not good."

California News

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LA ist

$2 billion levee project breaks ground in Stockton

STOCKTONIA

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