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Introduction

Australia and other carbon intensive nations must take drastic and urgent action to stop climate change impacts becoming irreversible. An important part of this action must include a rapid transition away from our current reliance on fossil fuels to a combination of renewables, storage and energy efficiency.

Sadly, the energy transition is increasingly bogged down in a culture war quagmire that is driven by conservative media, politicians and vested interests. Misinformation is rife, and shared widely on social media.

In the 2000s, the main arguments used against renewable energy tended to be claims about human and animal health and impacts on property values. Both of these have been soundly debunked over the years since then. One of the favoured arguments currently being used against renewable energy systems – including wind turbines, solar panels and batteries – is the 'threat' of increased fire risk.

While renewable power facilities do not pose a significant threat of increased fire risk, there are a range of issues that must be considered when it comes to battery storage.

With the rise of storage batteries, electric vehicles and grid and household scale renewables, we acknowledge that firefighters are facing new challenges. Fortunately, training is now widely available and more and more brigades are becoming skilled at responding to these new risks. The AFCA notes that the firefighting environment is constantly changing, and fire fighters are very good at adapting to change and learning new skills.

In this briefer we want to consider the risk profile of storage and the practicalities of responding to fires in Battery Energy Storage Systems (BESS) facilities. This is not intended to provide specifics on the practicalities of fire fighting, but we do offer links to some relevant resources from a range of Emergency Service authorities. We hope it helps to offset some of the misinformation and hysteria that is often promoted by anti-renewables activists by providing information from sources that you can easily verify.

What are battery energy storage systems?

Battery Energy Storage Systems (BESS) are installations that store and release electricity to support grid reliability. They consist of batteries that are able to convert electrical energy into chemical energy so that it can be stored. BESS import electricity when the network is generating more than is being used to charge, store it, and then release it when demand is high. This process is managed by a BESS monitoring system which uses real-time data from the National Electricity Market (NEM) to 'bid' into the energy market to charge or discharge electricity according to supply and demand. The electricity market is operated by the Australian Energy Market Operator (AEMO), who is responsible for balancing network supply and demand through a centralised bidding process.

Coupling batteries with renewable energy generation allows that energy to be stored during times of low demand and released (or dispatched) at times of peak demand.

Unlike many other forms of energy storage and generation, including coal fired power, batteries are particularly valuable because they provide flexibility. They can respond faster than other energy storage or generation technologies, and help maintain grid stability by turning on and off in fractions of a second. Batteries compete with gas fired power generation, which is the most expensive electricity source in Australia and typically bids into the market at peak demand. The rollout of competitively priced battery storage is likely to make electricity cheaper while decarbonising the grid.

Good planning is vital

As with other industrial facilities, there are inherent risks in BESS facilities and these can largely be managed in the planning phase of development. For instance in Victoria, the Country Fire Authority (CFA) says that its Specialist Risk and Fire Safety Unit works with developers to ensure fire safety is factored into renewable energy sites and has a series of guidelines on planning and managing fire. In the case of BESS facilities it is also essential that developers ensure that there are long-term service agreements in place to ensure facilities are maintained to standard.

Detection systems are placed in all BESS facilities which monitor temperature, voltage and gas emissions in real time, allowing facility managers to quickly identify any potential fire.

Fire prevention is complex and requires a comprehensive risk and mitigation strategy that extends beyond basic fire measures.

Sprinkler systems, for example, are critical to help control a blaze, but they aren't enough to fully mitigate a thermal runaway event. Operators should evaluate a range of factors, including:

- **Strategic placement** – Positioning ESS units away from critical equipment, high-traffic zones and infrastructure vulnerable to fire damage
- **Non-combustible enclosures** – Constructing battery housing with materials that inhibit fire spread and mitigate the impact of potential explosions
- **Separation and ventilation** – Spacing battery racks sufficiently apart to prevent cascading thermal runaway and installing robust ventilation and temperature controls
- **Emergency response and redundancy** – Developing detailed emergency evacuation, fire suppression and redundancy plans, acknowledging limited firefighting resources at remote locations
- **Ongoing maintenance and upgrades** – Implementing routine inspections, early fault detection and regular system upgrades to identify safer battery technologies as they emerge

The role of insurance. Like other commercial facilities, BESS require insurance coverage. BESS fire incidents have had an impact on the insurance market. In its report into reducing fire risk in BESS, Firetrace presents evidence that the appetite to cover energy storage projects has declined, with some insurers even exiting the market. "This has resulted in increased premiums, higher excesses, and difficulties in securing 100% cover". The benefit of this is the fact that it increases pressure on developers to ensure best possible design and

management, to ensure they can afford insurance coverage, increasing overall safety of these facilities.

How often do fires happen?

It is important to differentiate between a large, commercial facility (a BESS) and other forms of fire involving a battery in a consumer item like an electric vehicle or charger for a device like a laptop or e-scooter. There are literally millions of these products in use across Australia, many of poor quality with low safety standards, and often improperly used (for instance when people leave batteries on charge well beyond the recommended limit). The NSW Rural Fire Service (RFS) estimates that 'about one in every 100 fires attended by Fire and Rescue New South Wales (FRNSW) involves a lithium-ion battery or battery device'.

In contrast, major battery fires remain rare in large systems.

The Electric Power Research Institute's BESS failure incident database provides a global perspective on the frequency of fires in BESS facilities. The database was created to inform energy storage industry stakeholders and the public on BESS failures. As is noted by the database, 'it is instructive to compare the number of failure incidents over time against the deployment of BESS… The global installed capacity of utility-scale BESS has dramatically increased over the last five years, and while failure incidents continue to occur, the overall rate of incidents has sharply decreased. The failure rate dropped by 98% from 2018 to 2024 as lessons learned from early failures have been incorporated into the latest designs and best practices'.

On a global scale, it should be noted that an analysis of BESS fire incidents in the United States revealed that the incidents involved early-generation systems lacking modern safety features. Improved safety measures in newer systems have significantly reduced risks.

In Australia, fires have broken out in two battery projects, at the Victoria Big Battery and more recently the new Bouldercombe battery built by Genex Power in Queensland. Both resulted in minor damage and damage to two Tesla Megapack modules that had to be replaced at each site.

What are fires in BESS facilities like?

BESS fires are a risk primarily associated with lithium-ion batteries and are most often caused by thermal runaway, a chain reaction where a single overheated cell causes neighboring cells to fail, leading to a fire that is difficult to extinguish. Contributing factors include electrical faults like short circuits and overcharging, physical damage to the batteries, and manufacturing defects. Fires can also lead to explosions and the release of toxic smoke, and reignition is a common and persistent risk.

In terms of fire fighting strategies, the emphasis is on defensive, not direct, suppression. Generally specialists recommend a 'let it burn' approach. That is: to protect adjacent buildings and infrastructure (the 'exposures') through containing the outward spread of the fire away from the facility. Ensure that any crews near the fire are wearing breathing apparatus and that other firefighters and any community members are a safe distance away, with obvious containment lines to keep people out (flagging, barriers, bollards,

eflares, etc). Firefighters then let the fuel consume itself. As long as the thermal event is contained (in the facility) then the fire becomes a manageable event.

What is in the smoke from a BESS fire?

The possibility of a fire occurring and spreading toxic fumes across local community is a common and legitimate fear for people living close to any industrial facility. Many residents in the west of Melbourne will remember the explosion and subsequent fire that occurred on Coode Island in Melbourne on 21 August 1991, when a 600,000 litre chemical storage tank filled with acrylonitrile exploded and caught fire. The fire burned various hazardous chemicals including acrylonitrile, phenol, methyl ethyl ketone and benzene forming clouds of potentially toxic black smoke up to 30 km from the site, prompting the evacuation of Footscray Primary School, nearby buildings and ships, and closure of roads.

In the case of BESS systems being proposed in rural areas, we do accept that any new human activity where there was none before increases fire risk. The question is: how do we manage the risk, and how do we respond if a fire does happen?

The gas composition in a battery fire is quite similar to that of a house fire. The emission of toxic gases from a BESS fire can be a larger threat than the heat generated by the thermal runaway.

When lithium-ion batteries go into thermal runaway, they can emit deadly gases such as hydrogen fluoride and carbon monoxide for hours without catching fire (which highlights the need for good monitoring of the facility, as is dealt with in the Planning section above). When they ignite, the smoke and chemicals released (including hydrogen cyanide and hydrogen chloride) can lead to respiratory problems for those living or working near the BESS.

Anti renewables campaigners often cite the example of the fire that happened in early 2025 at the Moss Landing battery storage facility in California, often billed as ‘one of the largest battery energy storage systems in the world’. The facility is on the site of a closed power plant, and it’s right next to a natural gas power plant that is still operating. The smoke plume from the fire at Moss Landing released hazardous gases such as hydrogen fluoride and also soot and charred fragments of burned batteries that landed for kilometres around the site. At the time of the fire, local residents evacuated. People living in the area reported headaches and respiratory problems, and some pets and livestock fell ill.

The energy in rechargeable batteries comes from the flow of electrons released by lithium atoms in the anode moving toward the cathode.

In the type of batteries at the Moss Landing facility, the cathode was rich in three metals: nickel, manganese and cobalt. These batteries are prized for their high energy density and relatively low cost, but they are also prone to thermal runaway.

According to reports after the fire, investigations showed sharp increases in nickel, manganese and cobalt in the local environment compared with data from before the fire.

They noted that this would have been from cathode material that could have been carried into the smoke plume and then deposited onto the ground.

They noted that 'over the following months, we found that surface concentrations of the metals dropped sharply after major rain and tidal events, but the metals did not disappear. They were remobilized. Some migrated to the main channel of the estuary and may have been flushed out into the ocean'. There is now a research group, composed of a range of academic institutions, which are tracking bioaccumulation of heavy metals in the ecosystems of the adjacent wetlands and estuary (called Elkhorn Slough).

Researchers from San José State University noted the lessons from this fire for new BESS facilities:

- A California law passed after the fire requires stronger containment and monitoring at large battery installations and meetings with local fire officials before new facilities open
- they noted that 'how soil is tested is also important'

They also noted that 'newer lithium-ion batteries that use iron phosphate cathodes are also considered safer from fire risk'. Lithium iron phosphate (LFP) cells are more stable than older chemistries such as nickel-manganese-cobalt.

Environmental contamination from a BESS fire

Rural areas will be concerned about protecting the quality of their ground and surface water. A legitimate question to be asked is whether a fire at a BESS facility would pose an unacceptable risk to water supplies due to run off from fire fighting efforts.

The following is taken from the American Clean Power report *Assessment of Potential Impacts of Fires at BESS Facilities.*

The environmental consequences of BESS fires have been a subject of increasing scrutiny. However, data from real-world incidents, experimental studies, and environmental monitoring efforts indicate that BESS fires have a minimal long-term environmental impact compared to other large industrial and structural fires.

Concerns about soil and water contamination primarily arise from firefighting suppression efforts, particularly when large volumes of water are used. However, most available data from real-world incidents and testing does not support the notion of widespread contamination risks. Key findings include:

Firefighting Water Runoff: The consensus best practice for response to a BESS fire is to allow the BESS to consume itself and provide cooling water to targets if needed. Unless there is direct suppression water applied to the BESS on fire, any cooling water applied will be similar to rain and no potential contaminants will be included in any runoff. While lithium-ion battery fires produce chemical byproducts, studies show that their solubility in water is low, limiting the potential for groundwater contamination if direct suppression efforts are performed. Additionally, standard stormwater management practices help prevent runoff

from reaching natural water sources in the event that the fire department determines that suppression efforts are required.

Environmental Sampling Results: In past BESS fire incidents where environmental sampling was conducted, water and soil samples did not reveal hazardous contamination levels requiring remediation.

The large fire at Moss Landing (referenced in the section above) resulted in contamination of local environments with heavy metals - nickel, manganese and cobalt. What anti renewables campaigners often neglect to acknowledge is that the area that burnt at Moss Landing were ‘indoor installations, set up inside the shell of a building left over from the natural gas plant that used to be on the site. The project is an unusually large example of repurposing an old building for energy storage’ rather than a purpose built facility like what is found in Australian BESS facilities.

Impacts on local brigades

AFCA accepts that some brigades hold concerns about having to respond to a fire at a BESS facility because they lack the training and potentially the specialist equipment they need to respond safely. Where BESS facilities are sited in rural areas, local brigades may lack members who have training in structural fires, managing hazardous materials, and use of breathing apparatus.

But the fact is that many local crews are trained for multiple hazard types, including thermal events involving batteries. A skills/ qualifications assessment may be needed for local brigades where a BESS facility is proposed, with support to ensure that crews can be adequately trained.

Campaigners amplify the threat of fire

As happens with wind turbine fires, which are both rare and relatively easy to contain, anti-renewables campaigners will often seek to inflame community fears around fire risk by amplifying any incident that does occur, no matter how rare. Photos then get shared on social media, often without people checking the details on the event. So, if you see an image or story about a fire in a BESS facility, please ask yourself:

- What is the source of the image?
- Who shared it for you to see and are they a reputable source?
- And when and where did the incident occur?

Often images of old fires get re-circulated. For instance, one of the highest-profile incidents happened when a coolant leak triggered thermal runaway during the construction of Tesla’s ‘Big Battery’ project in Victoria in 2021. The incident destroyed two Tesla Megapack units, triggered a warning for toxic smoke and took four days before firefighters deemed the site under control. Anti-renewables campaigners neglect to mention that changes had since been made to prevent any future fires in that facility, including each Megapack cooling system being inspected for leaks before on-site testing, and the introduction of a new "battery module isolation loss" alarm to firmware.

While new BESS facilities often spark community concerns, the fact is that fires are very rare and can be contained. While campaigners will often seek to claim this is new, untested technology, in reality BESS systems have been in use for many years and in Australia many mining operators are rapidly switching to wind and solar combined with battery energy storage systems (BESS) to reduce operational costs, enhance energy security and lower emissions. There are many more systems already in operation than anti-renewables activists would have you believe.

BESS can increase local energy security

In rural and regional areas, a community or commercial scale storage facility can enhance energy security by providing back up electricity when power lines are damaged by events like floods or fires.

Local BESS can make the best use of the power being generated by the community. The high uptake of rooftop solar – more than 3.5 million Australian homes now have solar panels – has seen households generate large amounts of energy during the day. But that's also created a new challenge. The excess solar creates congestion on the transmission network. A local community or neighbourhood battery puts this excess energy to good use, storing excess solar and then sharing it back with the community later on – helping to balance the grid and reduce reliance on fossil fuels.

Cairn Risk Consulting sums up a sensible approach to BESS:

BESS is a cornerstone of green energy grids. Like all emerging technologies, knowledge of BESS hazards and the means of managing them is constantly evolving. Developers, operators, regulators and all other stakeholders of BESS projects have a duty to keep abreast of the latest lessons learned. Whilst significant incidents involving BESS have been rare, the rapid increase in deployment of BESS heightens the likelihood of future incidents if the correct approach to risk management is not adopted.

Rather than fearing a proposal for a BESS, forward looking communities embrace the concept and engage with government processes and developers to ensure best practise planning and development of facilities, and that the community is able to maximise the benefits of a BESS being built locally.

Further information and resources

How safe BESS unlock cheaper and greener power in mining:

https://greenreview.com.au/trending/how-safe-bess-unlock-cheaper-and-greener-power-in-mining/

Battery fires in Australia raise safety concerns for big storage projects

https://internationalfireandsafetyjournal.com/battery-fires-in-australia-raise-safety-concerns-for-big-storage-projects/

Three steps to reduce battery storage fire risk (covers fire suppression systems, battery management system and spacing of units within BESS facilities)

https://www.pv-magazine-australia.com/2023/09/19/three-steps-to-reduce-battery-storage-fire-risk/

Battery storage in Australia

https://arena.gov.au/renewable-energy/battery-storage/

Managing fire risk - BESS

https://www.ausnetservices.com.au/-/media/project/ausnet/corporate-website/files/projects-and-innovation/battery-energy-storage-system-fire-risk-management-fact-sheet.pdf

Renewable energy fire safety - CFA (including battery storage systems)

https://www.cfa.vic.gov.au/about-us/what-we-do/renewable-energy-fire-safety

AFAC guidance to industry stakeholders for the development of an overall strategy for fire safety at a Battery Energy Storage System

https://afac.com.au/resources/large-scale-battery-energy-storage-system-installations

AFCA briefer on renewables and fire

https://australianfirefightersclimatealliance.org/2025/09/30/renewables-and-fire-risk-what-are-the-facts/