247 ENERGY

Battery Fire Risk and the Non-Flammable Alternative

How thermal runaway shapes the cost, siting, and insurability of energy storage, and what it means to remove the hazard rather than manage it.

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FOREWORD

The Risk That Shapes Everything

Of all the questions that decide where and how energy storage gets built, the quietest and most consequential is fire. It rarely appears as the headline reason for a decision, yet it shapes almost every one. Where a system can sit, how far it must stand from a building, what suppression it needs, what an insurer will cover and at what price, and whether a project is permittable at all are governed, in the end, by the risk that the storage might burn.

For the dominant storage chemistry, that risk is real and inherent. Lithium-ion can enter thermal runaway, and a lithium fire behaves unlike an ordinary fire: it is hard to extinguish, prone to reignite, and capable of spreading from one cell to the next. The industry has learned to manage this well, with testing, spacing, detection, and suppression. But management is expensive, it constrains where storage can go, and it never reduces the underlying hazard to zero, because the hazard is part of the chemistry.

I write this paper because there is a different way to treat the problem, and the distinction matters. A risk can be managed, or it can be removed. 247 Energy builds storage on supercapacitor technology, which stores energy physically rather than chemically and therefore cannot enter thermal runaway at all. That is not a better mitigation. It is the absence of the hazard. The purpose of these pages is to explain the fire risk honestly, what it costs and why, and then to explain what changes when the risk is not there to manage.

This is not a scare. Lithium-ion is a sound technology operated safely every day. But fire is the constraint that quietly sets the terms for storage projects, and any buyer or investor weighing those projects is better served understanding it clearly than leaving it as an assumption in the background.

James Troch, Chief Executive Officer, 247 Energy

THE CONTEXT

What Thermal Runaway Is

Why a battery fire is not an ordinary fire

Thermal runaway is a self-reinforcing failure in a lithium-ion cell. When a cell is damaged, overcharged, overheated, or carries a manufacturing defect, it can begin to generate heat faster than it can shed it. That heat drives reactions inside the cell that generate still more heat, and the process accelerates. The cell vents flammable and toxic gases, and the temperature can rise to the point of fire.

What makes this dangerous at scale is propagation. A storage system packs many cells closely together. A single cell in runaway heats its neighbours, which can push them into runaway in turn, so a failure in one cell can cascade through a module and beyond. The energy that makes the system useful is also the energy that feeds the fire, and it is released in a way ordinary firefighting is poorly suited to stop.

A lithium fire resists extinguishing for a specific reason: the cell supplies its own heat from internal reactions, so cooling the outside does not necessarily halt the process inside. Fires can reignite hours after they appear to be out, and the volumes of water needed to cool a large installation are substantial. The gases released are flammable and toxic, which adds an explosion and exposure hazard to the fire itself. None of this is exotic. It is the well-documented behaviour that fire services and insurers now plan around.

The probability of any single cell failing is low, and good engineering keeps it low. But probability multiplied across thousands of cells, over years of operation, in real conditions, is not zero, and the consequence of the rare event is severe. That combination, low likelihood and high severity, is exactly the profile that drives conservative design, strict siting, and cautious insurance. The hazard does not have to be common to govern the decision. It only has to be possible and serious, and it is both.

THE MECHANISM AT SCALE

How a Storage Fire Unfolds

From one cell to a site-level event

Understanding why fire risk shapes storage decisions means following what happens when the rare event occurs. It begins with a single cell losing control, often invisibly, inside a sealed enclosure. Early detection systems look for the first signs, the off-gassing and temperature rise that precede open flame, because the window to intervene before propagation is short.

If intervention fails or comes late, the failure spreads. Heat from the first cell pushes adjacent cells toward their own runaway, and the event grows from a cell to a module to, in the worst case, a whole unit.

The flammable gases vented along the way can accumulate and ignite, turning a fire into a deflagration. This is why modern installations include gas detection and deflagration venting, not only flame suppression: the gas is a hazard in its own right.

> ***The energy that makes a storage system useful is the same energy that feeds the fire. Containing it is the central problem of lithium storage safety.***

Extinguishing the event is harder than stopping an ordinary fire. Because each failing cell generates its own internal heat, suppression has to cool the cells faster than they can reheat themselves, which can take very large quantities of water over extended periods. Even then, cells that appear cooled can reignite as internal reactions continue. Fire services increasingly approach a large lithium fire as something to contain and cool while it burns out, rather than something that can be quickly put out.

The result is that a single failure can become a multi-hour, water-intensive, hazardous event with the potential to damage everything around it. This is the scenario that every layer of design, siting, and insurance around a lithium installation exists to prevent or contain. The effort is proportionate to the consequence, and the consequence is what makes fire the quiet governor of storage projects.

THE CONSEQUENCES

What the Risk Costs Before Anything Burns

Siting, suppression, permitting, and insurance

The largest costs of fire risk are paid by every installation that never catches fire. They are the price of preventing and containing the rare event, and they attach to the project from the first day regardless of whether the hazard ever materialises.

> ***The largest costs of fire risk are paid by every installation that never catches fire. Prevention and containment attach to the project from day one.***

The first cost is siting. Because a lithium fire can spread and is hard to extinguish, codes and good practice require separation distances between units and between storage and occupied buildings, property lines, and other hazards. On a constrained site those distances can be the difference between a project fitting and not fitting. Storage that must stand well clear of the building it serves loses some of the value of being on site at all.

The second cost is the safety systems themselves: gas and heat detection, deflagration venting, suppression, and the monitoring that watches for the first sign of trouble. These are necessary and they work, but they are capital and maintenance cost that exists solely because the underlying hazard does.

The third is permitting. Authorities assessing a lithium installation are assessing a recognised fire hazard, which lengthens and complicates approval, particularly in dense or sensitive locations.

The fourth cost, and increasingly the most visible, is insurance. As large storage fires have occurred, underwriters have grown more cautious, raising premiums, tightening terms, demanding specific protections, and in some cases declining cover for installations they judge too exposed. Insurance is no longer a formality at the end of a storage project. It is a live constraint that can shape the design and the economics, and it is driven directly by the fire risk the chemistry carries.

THE INDUSTRY RESPONSE

Managing the Hazard, and Its Limits

What mitigation can and cannot do

The storage industry has responded to fire risk seriously and effectively. Cells and packs are engineered to high standards, with battery management systems that monitor voltage, current, and temperature to catch problems early. Installations undergo large-scale fire testing designed to show how a unit behaves if a cell fails and whether a fire will propagate. Detection, venting, suppression, and separation distances combine into a layered defence.

This work has made lithium storage far safer than it would otherwise be, and it should be acknowledged rather than dismissed. A well-designed, well-tested, well-sited lithium installation is a low-probability fire risk. The industry deserves credit for the discipline it has built around a genuinely difficult hazard.

But mitigation has a structural limit. Every measure described above manages a hazard that remains present. Detection shortens the response time; it does not remove the failure mode. Suppression and venting contain the event; they do not prevent it. Separation distances limit the damage; they do not stop the fire. Each layer reduces probability or consequence, and the layers together reduce both substantially, but none can take the underlying hazard to zero, because the hazard is intrinsic to storing energy in a chemical reaction that can run away.

This is the honest boundary of the managed approach. It is good, and it is not the same as the hazard being absent. For many installations the managed risk is acceptable and the cost of managing it is worth paying. But the residual risk, and the permanent cost of holding it down, are real, and they invite a different question: what if the hazard were not there to manage in the first place?

THE ALTERNATIVE

Removing the Hazard at the Source

Why a supercapacitor cannot enter thermal runaway

There is a category of storage for which the fire problem does not arise, because the mechanism that causes it is absent. Supercapacitors store energy physically, in the separation of electric charge, rather than chemically. There is no chemical reaction to overheat and run away. The defining failure mode of lithium storage is not mitigated in a supercapacitor. It does not exist.

The difference is one of kind, not degree. A supercapacitor module generates far less heat in normal operation and is far less sensitive to ambient temperature, and it cannot enter the self-sustaining thermal reaction that turns a single lithium cell failure into a site-level fire. 247 Energy storage is built on this technology precisely so that the hazard which governs lithium projects is removed rather than managed.

> ***A risk can be managed or it can be removed. Supercapacitor storage removes the fire hazard, because the failure mode that causes it is not part of the physics.***

Removing the hazard changes the whole structure of cost and constraint that surrounds an installation. Storage that cannot burn in this way does not need the separation distances a fire-propagating technology requires, so it can sit close to the building it serves and on sites where distance is scarce. It is suitable for environments lithium cannot safely enter, including ATEX-classified areas where explosive atmospheres may be present and any ignition source is unacceptable. The layers of detection, venting, and suppression that exist to contain a chemical fire are not needed to contain a hazard that is absent.

This is not a claim that supercapacitor storage is free of all engineering care; every electrical system must be designed and installed properly. It is the narrower and stronger claim that the specific, severe, hard-to-extinguish fire hazard which defines lithium storage is not present. For a buyer or an insurer, that is the difference between assessing a managed hazard and assessing one that is not there.

WHERE IT DECIDES

Where Fire Risk Decides the Project

The sites and uses most exposed

Fire risk matters everywhere, but there are settings where it moves from a cost to the deciding factor. The first is storage near people. Any installation close to a warehouse full of workers and stock, an office, a retail space, or housing carries a consequence profile that makes the fire question central rather than incidental. Removing the hazard is worth most exactly where the people and the value are closest.

The second is the constrained site. Urban locations, dense industrial parks, rooftops, and small yards often cannot provide the separation distances a fire-propagating technology requires. On these sites the choice is frequently not between two storage technologies but between storage that can be sited at all and storage that cannot. A non-flammable system can occupy space a lithium system is barred from.

The third is the hazardous environment. Sites handling flammable materials, fuels, solvents, or dusts, including ATEX-classified zones, treat any ignition risk as unacceptable. Conventional battery storage is difficult or impossible to deploy there. Storage that cannot enter thermal runaway can serve these environments directly, opening uses that the dominant chemistry effectively forecloses.

The fourth is anywhere insurance or permitting has become the binding constraint. Where an underwriter will not cover a lithium installation on acceptable terms, or an authority will not approve one in a sensitive location, the absence of the fire hazard is not a marginal advantage. It is what makes the project possible. In all of these settings the fire question is not one input among many. It is the input that decides.

THE STRATEGIC CASE

What Removing the Risk Is Worth

Counting the value of a hazard that is not there

The value of removing the fire hazard is easy to underrate because much of it is invisible. It shows up as costs not incurred and constraints not encountered, which are harder to see than a line on an invoice. Counted properly, it is substantial.

On the direct side, a non-flammable system avoids the capital and maintenance cost of fire-specific safety systems, the land cost of separation distances, and the conditioning that temperature-sensitive chemistries need. On the indirect side, it can lower insurance premiums and ease the terms underwriters demand, because the asset they are assessing carries less risk. It can shorten and simplify permitting, because the authority is assessing a lower hazard. And it can unlock sites and uses a fire-propagating technology cannot occupy at all, which is value that simply does not exist for the alternative.

There is also a resilience and reputational dimension. A fire at a storage installation is not only a direct loss. It is a disruption to the operation it serves and a reputational event for the business that owns it. Removing the possibility removes a tail risk that, while unlikely, is severe enough to matter to any operator and any investor who has to account for it. The expected cost of a rare catastrophe is real even when the catastrophe never happens.

For an investor, the calculation is the one this paper has made throughout. A managed hazard carries a permanent cost and a residual risk. An absent hazard carries neither. Where the application allows it, choosing the technology that does not have the hazard is not a safety preference layered on top of the economics. It is part of the economics, and frequently a favourable part.

THE DIRECTION OF TRAVEL

Why This Matters More Each Year

Fire risk is becoming more decisive, not less, for three converging reasons. The first is scale. As storage is deployed in far greater quantity and in far more places, the absolute number of installations near people and in sensitive locations rises, and with it the aggregate exposure that codes, insurers, and authorities must respond to.

The second is experience. Each significant storage fire informs the response of regulators and underwriters, and the direction of that response is consistently toward more caution: stricter testing, larger separation distances, tighter insurance terms. The cost and constraint of holding the managed hazard down are trending upward, which widens the advantage of not having the hazard at all.

The third is siting pressure. The same forces driving storage demand are pushing it into denser, more constrained, more sensitive locations, close to the buildings and operations it serves. Those are precisely the locations where a fire-propagating technology is hardest to place and a non-flammable one is easiest. As storage moves closer to people, the value of removing the fire hazard rises with it.

The conclusion is straightforward. Fire is the quiet constraint that shapes storage projects, the managed approach to it is good but bounded, and the cost and difficulty of management are rising as deployment grows and moves closer to people. A technology that removes the hazard rather than managing it answers the constraint directly, and the case for it strengthens with every year that storage becomes more widespread and more tightly sited.

Storage Without the Fire Hazard

247 Energy develops, builds, and operates energy storage built on supercapacitor technology, chosen so that the fire hazard which governs conventional storage projects is removed rather than managed. The technology stores energy physically rather than chemically, so it cannot enter thermal runaway, and it generates little heat in normal operation.

Because the hazard is absent, the systems can be sited close to occupied buildings and on space-constrained sites without the separation distances a fire-propagating technology requires, and they are suitable even for ATEX-classified areas where explosive atmospheres may be present. They contain no rare or expensive metals, operate from minus twenty to plus fifty-five degrees Celsius, run quietly at around fifty-five decibels, and switch between charge and discharge instantly. 247 Energy warrants the modules for ten thousand cycles or ten years, with a projected lifetime of up to fifty thousand cycles.

The systems are available in rack-mounted and containerised configurations, in form factors from one kilowatt to ten megawatts, and they can integrate with existing lithium-ion installations or stand alone. This lets operators place non-flammable storage exactly where fire risk would otherwise constrain or prevent a project.

Beyond on-site storage, 247 Energy develops, builds, and co-invests in utility-scale battery energy storage parks rated at 100 MW and above, with a current European pipeline spanning two regions and five countries and a combined capacity of 505 MW / 2,025 MWh. We retain skin in the game in the assets we develop, and we work with co-investors and partners who share a long-term view of energy infrastructure.

For operators and insurers weighing the fire risk of a storage decision, and for partners interested in the technology or in co-investment, we welcome direct engagement. We can discuss specific sites and applications in detail, including those where separation distances, permitting, or insurance have made conventional storage difficult, under appropriate confidentiality arrangements.

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