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How to tackle fire risk at co-located renewables projects

Summary

The co-location of renewable energy assets is a growing trend and such schemes represent the fastest growing type of renewable energy project in the US, data shows. However, the financial risks posed by a potential fire event at a co-located project can be higher than those associated with standalone projects.

Despite this increased risk, there is a danger that owners of co-located renewables assets are focussing exclusively on battery storage fire risk, while ignoring the potential risks linked to solar and wind farms. Meanwhile, asset owners also need to consider that built-in fire suppression systems may be insufficient to meet the requirements of local regulations, which vary from state to state in the US.

Consequently, it is advised that owners of co-located renewables assets conduct a comprehensive cross-site fire risk analysis in order to develop an understanding of what the risks of failure are for each component. This will then enable asset owners to evaluate what is required from a fire risk assessment perspective in the locality in which the project is situated.

This report will:

- Show the extent to which co-located renewable energy projects are proliferating
- Explain why the financial risk associated with fires at co-located projects is greater than that facing standalone projects
- Explore why owners of co-located assets may be focusing on storage fire risk, but not necessarily solar and wind fire risk
- Explain why built-in fire suppression systems may be insufficient to meet local regulatory requirements
- How a comprehensive cross-site fire risk analysis can reduce fire risk and protect your company's reputation
- Explain what steps need to be taken to address fire risk at co-located projects

Co-located renewable energy projects on the increase

Co-located renewable energy projects – that is projects consisting of a combination of two or more of solar, wind and battery assets – are by far the fastest growing type of renewable energy project in the US. To illustrate the point, solar and battery storage, for example, will constitute 81 per cent of new electricity generating capacity in the US in 2024, according to data from the US Energy Information Administration (EIA).[1] This would represent an additional 36.4GW of solar and an extra 14.3GW of battery storage.

This trend is unlikely to change in the coming years. Recent figures from Berkeley Lab – a US Department of Energy Office of Science national laboratory managed by the University of California – show that solar and battery storage are – by far – the fastest growing resources in US grid interconnection queues. Combined, they account for over 80 per cent of new capacity entering the queues in 2023 – and, as Berkeley Lab has highlighted, the majority of solar (53 per cent) and battery storage (51 per cent) currently in interconnection queues are in a hybrid configuration.[2]

1 https://www.eia.gov/todayinenergy/detail.php?id=61424#:~:text=Developers%20and%20power%20plant%20owners,Preliminary%20Monthly%20Electric%20Generator%20Inventory

2 https://emp.lbl.gov/sites/default/files/2024-04/Queued%20Up%202024%20Edition_1.pdf

Financial risk at co-located projects higher than that for standalone assets

It is crucial that co-located renewables projects are brought forward as part of the transition to a zero-carbon economy. However, investors need to be aware that the financial risk associated with a fire incident at a co-located renewables project can potentially be much higher than that associated with a standalone battery storage project, wind farm, or solar farm, for example.

To give an indication of the cost of a fire event at a co-located renewables project, it's worth considering that a fire in an onshore wind turbine, for example, can be extremely damaging from a financial perspective even if it is not co-located with batteries or solar panels. Replacing an individual turbine damaged by fire is becoming increasingly expensive – costing up to $9 million – with 12-18 months of expected down time and subsequent revenue loss while a replacement turbine is secured.

To cite another example, battery storage fire incidents can cost developers, owners or operators up to $2 million as a result of the catastrophic loss of an asset and loss of revenue from up to 18 months' worth of downtime.

If there is a fire event at a co-located renewables project, there is the potential for the asset owner to not only incur the cost of damage to the asset in which the fire breaks out, but also damage to the co-located asset if the fire spreads. In addition, even if the fire does not spread to the co-located asset, it may need to be shut down while the fire is dealt with, which means a co-located asset could experience costly downtime even if it is not actually affected by fire. As a consequence, fires at co-located assets can have more damaging financial implications than a similar fire at a standalone asset.

According to a report by the independent energy research, analytics and consulting firm Cornwall Insight, from an insurance perspective "one of the major concerns with co-located assets is the fire risk from batteries".[3]

Meanwhile, risk consultancy WTW has said that the potential fire risk at co-located renewables projects means that "if there's a problem, small losses are unlikely" and that, especially for smaller sites, the "insurance premium generated is relatively small compared to the potential for an insurance loss", which is not conducive to encouraging insurers.[4] According to Cornwall Insight, these concerns are "not unique to co-located assets but can be exacerbated by the risk of a battery fire to other non-battery assets, especially in scenarios where the batteries are interspersed amongst generation assets".

Battery storage fire incidents can cost developers, owners or operators up to $2 million

3 https://www.cornwall-insight.com/wp-content/uploads/2022/12/Weightmans-Colocation-Insight-Paper-final.pdf

4 https://www.cornwall-insight.com/wp-content/uploads/2022/12/Weightmans-Colocation-Insight-Paper-final.pdf

Asset owners focusing on storage fire risk, but ignoring dangers of solar and wind power

There is a danger that owners of co-located assets focus on addressing fire risk associated with one particular asset – battery storage, for example – while overlooking fire risks linked to other assets. Given that the global deployment of energy storage is on the increase to make the use of wind and solar energy more efficient, the focus on energy storage fire risk is sharpening. For example, the US-based International Association of Fire Chiefs recently ran an energy storage fire risk campaign, which focussed on five key areas: recognition of hazards; firefighting operations; firefighter safety; post-incident considerations; and public education.

Meanwhile, FM Global has highlighted how lithium-ion batteries used in energy storage systems are vulnerable to thermal runaway, and consequently the insurer has issued fire safety recommendations based on fire tests conducted on energy storage systems used for commercial applications, such as manufacturing, office buildings, power generation and utility use. Elsewhere, DNV has carried out investigations into energy storage fire safety and has developed "explosion, fire and plume models" to assess the impact of an uncontrolled failure event and support the design of mitigation systems. The increased focus on battery storage fire risk is partly due to the fact that there have been 85 stationary energy storage failure events since 2011, according to a database compiled by the California-headquartered Electric Power Research Institute (which includes information about utility and C&I-scale energy storage failure events for which information is publicly available).[5]

In contrast to the significant attention given to battery storage fire risk, the danger of fire impacting on other types of renewables assets is often ignored. For example, some studies have concluded that there is a high likelihood that instances of solar farm fires are underreported. A study by the UK's BRE National Solar Centre – which detailed an investigation into a total of 80 potential PV-related fire incidents – ended with researchers concluding that they "strongly suspect a degree of under-reporting, especially amongst solar farms and domestic thermal events that were resolved by a solar installer/ maintenance engineer."[6] Meanwhile, despite the fact that data shows that one in every 2,000 wind turbines will have a catastrophic fire at some point in its lifespan according to insurance estimates, an alarming number of wind farm owners and operators have not taken the step of installing automatic fire suppression systems.

5 https://storagewiki.epri.com/index.php/BESS_Failure_Event_Database

6 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/786882/Fires_and_solar_PV_systems-Investigations_Evidence_Issue_2.9.pdf

Will focus on solar and wind-related fire risk intensify as awareness increases?

It's clear that there is a greater focus on battery storage fire risk than there is on solar and wind fire risk, despite the fact that the latter also poses significant dangers for owners of co-located renewables projects. This is especially a concern given that the focus on energy storage fire risk is often centred on power conversion systems, which are also present in solar and wind farms. Despite these notable risks, it is not yet clear whether the significant increase in hybrid projects (such as wind with storage and solar with storage) will result in regulations being introduced to mandate the mitigation of fire risk for wind and solar assets.

It is likely that that there will be a greater focus on solar and wind farm fire risk as awareness increases

Indeed, one of the reasons why asset owners may be overlooking the need to carry out fire risk assessments for the wind and solar elements of hybrid projects is because such checks are not a legal obligation. In contrast, asset owners are legally obliged to consider battery storage fire risk. In addition, some US states are introducing a further layer of safety regulations for battery storage projects – for example, in 2023, California introduced legislation that made it a requirement for battery storage facilities in the state to put in place emergency response and emergency plans, in addition to existing maintenance and operations requirements, in order to meet standards set by the California Public Utilities Commission (CPUC).

In instances where battery energy storage systems are being added to existing wind or solar farms, the focus is often on the fire risk associated with the new battery assets and there may be less inclination to take a holistic view of the entire site. However, with hybrid projects being increasingly built from scratch, it is likely that that there will be a greater focus on solar and wind farm fire risk as awareness increases.

Retrofitting fire suppression systems is more expensive

From an economic perspective, it is prudent to address the potential fire risks impacting on all the elements of a hybrid renewables project. It is possible to achieve economies of scale by tackling all aspects of this issue at the same time. It is also worth noting that the retrofitting of fire suppression systems to existing renewables projects is more expensive than incorporating them into the original design.

However, retrofitting is often the only option for renewables asset owners, particular in the case of projects that include battery storage systems. Energy storage fire risk regulations in the US are developing haphazardly on a state-by-state basis, a scenario that is creating considerable confusion and forcing energy storage owners to retrofit fire suppression systems in order to comply with evolving regulatory frameworks.

Built-in fire suppression systems may be insufficient

It is also important to remember that, while some battery energy storage systems do come with built-in fire suppression systems, these may still not be enough to satisfy the requirements of the US state in which they are based. Indeed, some asset owners are discovering they have to actually remove the system and incorporate an alternative to comply with the relevant local regulations. Each US state may have a different fire code, which results in an array of different regulations informing the design and installation of energy storage systems in each state. Some US states adopt the International Fire Code (IFC) for energy storage, while others adhere to the National Fire Protection Association (NFPA) code.

Furthermore, the differing approaches to fire risk by state are exacerbated by the fact that NFPA and IFC fire code cycle adoption varies by state. For example, as of April 1, 2021, there were eight states on the 2012 cycle, 23 states (plus the District of Columbia) on the 2015 cycle, 17 states on the 2018 cycle, and two states (California and New York) on the 2021 cycle.[7]

Best practice for owners of co-located renewables projects involves identifying the fire risk hazards posed across the entire site. This could involve performing a fire risk analysis across all of the component parts of the project or a hazard analysis across the entire site.

Best practice for owners of co-located renewables projects involves identifying the fire risk hazards posed across the entire site

7 https://www.mayfield.energy/technical-articles/fire-codes-and-nfpa-855-for-energy-storage-systems/

Comprehensive fire risk analysis can protect your company's reputation

Conducting a comprehensive fire risk analysis of all elements of co-located renewable energy projects – and taking steps to mitigate those risks – is vital in order to ensure community support for such schemes. Battery storage projects in the US and Canada, for example, have had to be postponed as a result of fire risk concerns raised by local communities. In April 2023, residents in Maryland's Price George's County opposed plans for a lithium-ion battery storage system citing fire and explosion risks.[8] Meanwhile, in the New York borough of Staten Island, plans for 120MWh of battery storage were withdrawn due to the local community's fears about fire risk and potential exposure to toxic chemicals.[9]

Not taking steps to mitigate fire risk and then experiencing a fire event could be extremely damaging for community relations and make it harder to obtain permission for future installations. Furthermore, as co-located renewables projects expand and become more complex with the addition of new assets, project owners need to be aware of how the associated fire risk is evolving and the potential impact on the local community.

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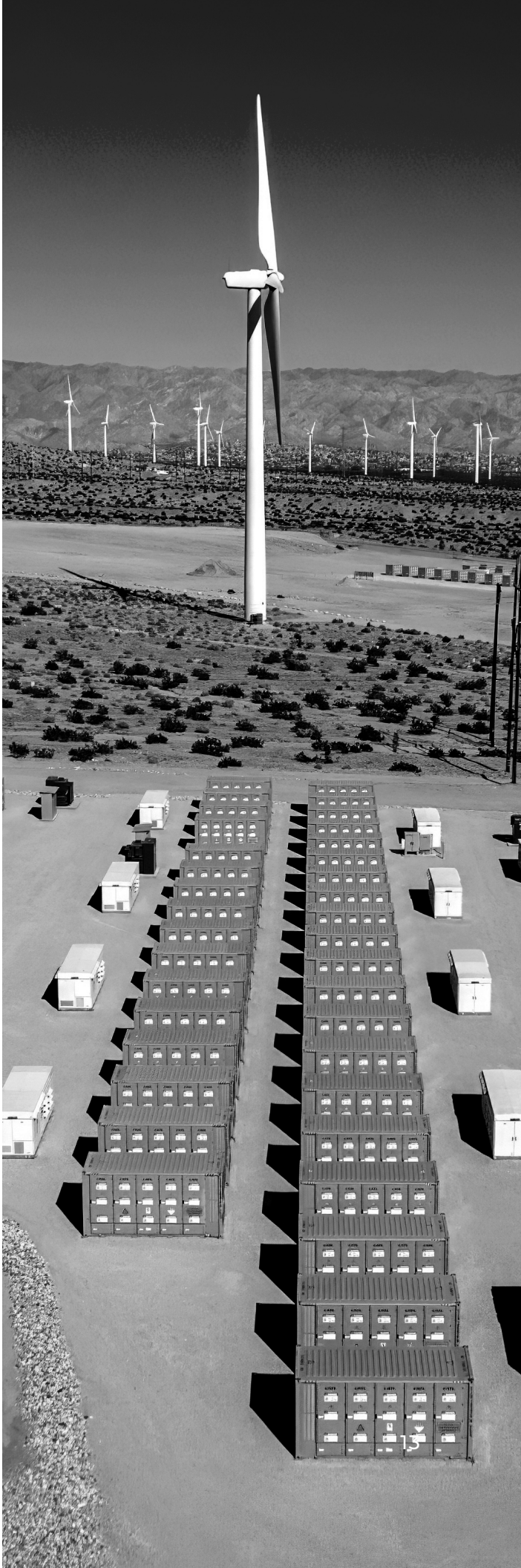
8 https://insideclimatenews.org/news/14042023/lithium-battery-storage-maryland-prince-georges-county/

9 https://www.silive.com/business/2023/01/plans-withdrawn-for-community-opposed-lithium-ion-battery-storage-system-on-staten-island.html

How to address fire risk at co-located projects

It is prudent for owners of co-located renewables projects to take steps to identify the fire risk hazards posed across the entire asset suite. This would enable them to develop an understanding of what the risks of failure are for each component and then evaluate what is required from a fire risk assessment perspective in the locality in which the project is situated.

In the context of battery storage systems, fire suppression systems should form a key element of any strategy for tackling fire risk. Consideration should also be given to the inclusion of a battery management system, which monitors, controls, and optimises performance of an individual or multiple battery modules and can control the disconnection of the modules from the system in the event of abnormal conditions.



Meanwhile, from a solar asset perspective, recommendations include: ensuring solar systems are regularly tested by independent third parties; incorporating additional safety components; creating standardized quality assurance measures; and ensuring defective or prematurely aged components are promptly replaced.

With regard to wind assets, performing an effective fire risk assessment (FRA) is crucial in order to increase the probability of saving on costs incurred due to turbines being damaged or destroyed (as 90% of the time, a fire in an unprotected turbine leads to a total loss of the wind turbine). Fire risk assessments will also reduce the risk of injuries to personnel and protect your organisation's reputation as well as that of the wind industry as a whole.

Fire risk assessments will reduce the risk of injuries to personnel and protect your organisation's reputation

Conclusion

Co-located renewable energy assets – that is projects consisting of a combination of two or more of solar, wind and battery assets – constitute the fastest growing type of renewable energy project in the US. It is vital that such projects are brought forward as part of the transition to a zero-carbon economy. However, investors need to be aware that the financial risk associated with a fire incident at a co-located renewables project can potentially be much higher than that associated with a standalone battery storage project, wind farm, or solar farm, for example. Failing to address this issue could result in the much needed deployment of co-located renewable energy assets stalling due to community opposition rooted in fears about fire risk.

If there is a fire event at a co-located renewables project, there is the potential for the asset owner to not only incur the cost of damage to the asset in which the fire breaks out, but also damage to the co-located asset if the fire spreads. In addition, even if the fire does not spread to the co-located asset, it may need to be shut down while the fire is dealt with, which means a co-located asset could experience costly downtime even if it is not actually damaged by fire.

Yet there is a danger that owners of co-located assets will focus solely on addressing fire risk associated with one particular asset – battery storage, for example – while overlooking fire risks linked to other assets. This represents a significant risk, especially when you consider that, for example, replacing an individual wind turbine that has been damaged by fire is becoming increasingly expensive (costing up to $9 million) with 12-18 months of expected down time and subsequent revenue loss while a replacement turbine is secured.

Consequently, owners of co-located assets are advised to take steps to identify the fire risk hazards posed across the entire asset suite. This could involve performing a fire risk analysis across all of the component parts of the project or a hazard analysis across the entire site.

Would you like to talk about the risks in this report? How about your approach to fire risk in your portfolio?

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