FIRETRACE™ International

REDUCING FIRE RISK

How to make wind farms even safer

Want to boost wind farm revenues? Introducing safety design standards for turbines – as well as standards for fire suppression – would reduce insurance costs and financial losses caused by downtime

Summary

Wind turbine fires can be extremely costly.

Indeed, the financial implications of such events can be astronomical for wind farm owners, especially when you consider that it can cost millions of dollars to replace a single turbine.

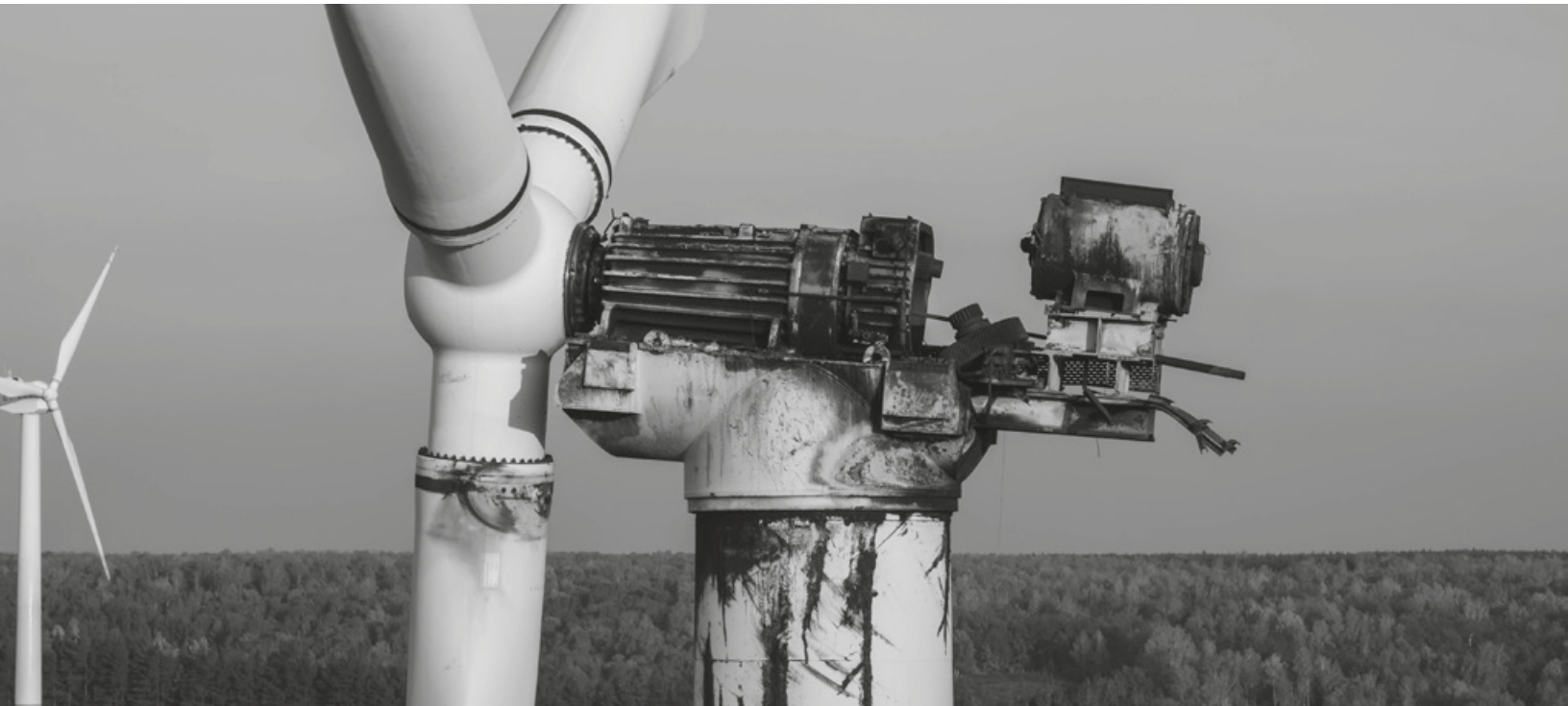
It's time that wind farm owners and operators got serious about the issue of fire. Now is the time to act on this issue, especially given that the US wind industry had its strongest year ever in 2020 – a total of nearly 17,000 MW of new capacity was added to the grid, representing an 85 percent increase on the previous year, according to data published by the American Clean Power Association.

As the industry is expanding so is the associated risk.

The problem is that such efforts face significant obstacles. We need to ask: where are the fire safety standards for wind turbines? Introducing such standards would reduce the amount of fire events, therefore reducing downtime and limiting the impact on wind farm revenues.

Crucially, as we highlight in this report, it would also result in a reduction in insurance costs. In addition, it would also lessen the reputational risks posed to the wind industry by wind turbine fires.

Meanwhile, the lack of comprehensive data related to wind farm fire events is another problem for insurers. We, as an industry, should give serious



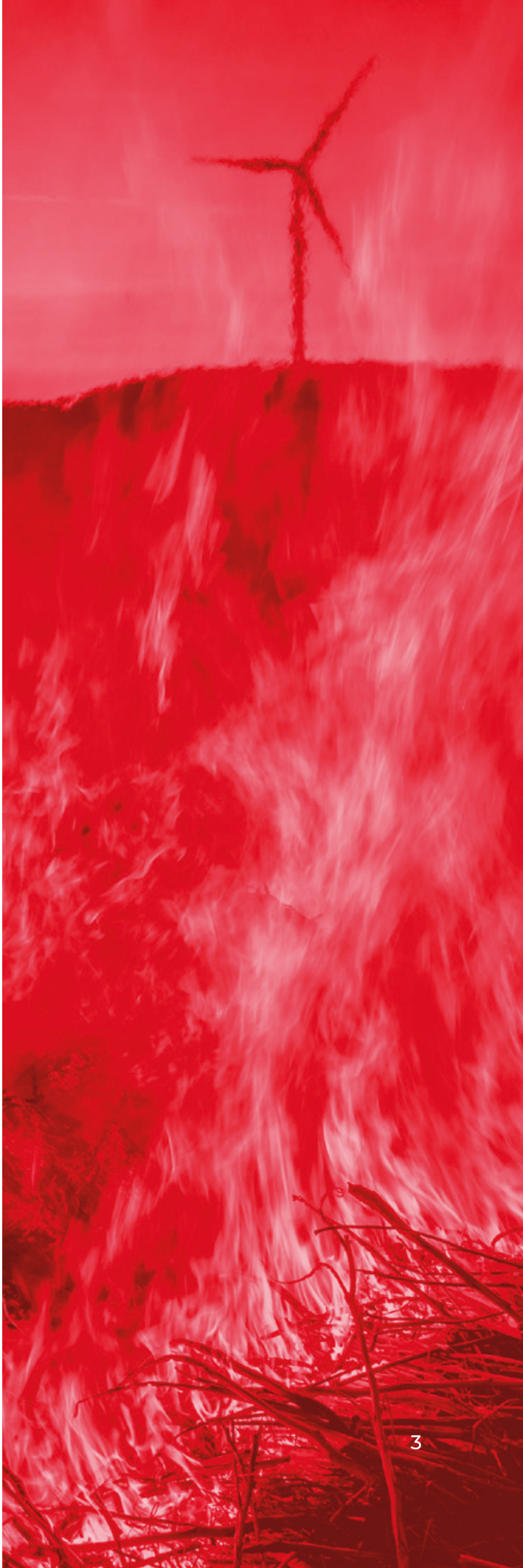
consideration to this issue – the more data insurers have, the more likely they will provide more reasonably priced insurance cover. Indeed, some insurers are unwilling to underwrite such risks at all because, without data, they cannot properly assess their potential exposure.

This brings us on to a key point. If more data was available, and the insurance industry had access to it, wind farm owners and operators would be likely to save considerable sums in insurance premiums.

This report looks at these issues in more depth, in addition to hearing from industry experts about the best ways of protecting against wind farm fires.

Tamarindo Group would like to thank the following industry leaders for their participation in the Reducing Fire Risk roundtable, and for their permission to be quoted in this report:

- **Chris Streatfeild**, Independent Health & Safety Consultant, Renewable Safety and former Director of Health & Safety, RenewableUK
- **Alan Tucker**, Managing Director, Renewable Energy Loss Adjusters
- **Angela Krcmar**, Global Sales Manager - Wind, Firetrace International
- **Guillermo Rein**, Professor of Fire Science, Imperial College, London
- **Joe Banks**, Head of Technical Services, Harvest Energy Services



Wind farm fires: The financial risks

Turbine fires cause substantial financial losses for the wind industry.

Wind turbines are getting bigger all the time in terms of capacity. The upside of this is greater efficiency from an energy production perspective, but the downside is that, when there is a fire, the damage and associated disruption is multiplied.

It's a growing problem best illustrated by considering that ten years ago a wind turbine fire may have cost $1 million. However, more recent figures show that costs have rocketed with a total loss now causing $7-8 million of damage on average.

Average wind turbine fire damage costs: ten years ago vs. today

Chris Streatfeild, an independent health and safety consultant at Renewable Safety and former director of health and safety at RenewableUK, says that when a turbine catches fire, the downtime can be significant and there are substantial "direct and indirect" costs associated with replacing gearboxes and nacelles, for example. "A lot of people don't have a full understanding of the real-world costs," he says. "When we had smaller turbines, you could sometimes absorb the costs, but with the move to mega-turbines, any downtime can have considerable operational impacts."

The integrity of most modern large wind turbines – including their safety standards – has improved substantially in recent years. However, Streatfeild, argues that one of the key challenges is that there is still an absence of a clearly defined, harmonized international design standard for the safety elements in wind turbines. He continues: "The most effective fire safety measures are those that have been designed into the turbine – so called 'inherent safety'

features. Many of these are already in effect standard design features – such as lighting protection – for example." However, Streatfeild says there remain "significant opportunities to further embed fire prevention – for example, reducing failures and sources of ignition, and low flammability material specification.

He adds that other opportunities include incorporating better fire protection – including containment systems, alarms, and suppression systems – into the turbine's fundamental design. Streatfeild says a new IEC [International Electrotechnical Commission] Standard (61400-30) is currently under development and "this is considering fire risks".

Another major issue, according to Streatfeild, is that owners and operators sometimes adopt "too narrow a focus" when looking at the cost-benefit analysis in relation to fire risks. He says this can mean that the benefits of optional fire protection measures are not always given the necessary attention, "especially when looking at the benefits across the full life cycle of the turbine". Streatfeild continues: "I would strongly encourage any owner of an asset to ensure fire risks are given the full attention they need. This is not a one-off exercise – fire risk assessments should be revisited on a regular basis".

The most effective fire safety measures are those that have been designed into the turbine

Worryingly, the signs are that most wind farm owners and operators do ignore fire risk. There are more than 340,000 wind turbines around the world, and, according to UK ultrasonic technology manufacturer Coltraco, the "vast majority have no fire suppression system installed".

Only one wind turbine original equipment manufacturer (OEM) has ever made fire suppression systems mandatory on all of its turbines and, even in that instance, it was only on certain platforms. But even that OEM has subsequently ceased to make it a requirement, meaning it is now optional.

Many leading OEMs have the ability to integrate fire suppression systems when turbines are manufactured – but the fact is, at this point in time, end-users have to 'opt in' if they want protection.

Insurance industry calls for fire suppression standards

Introducing standards for fire suppression systems could be an industry game-changer.

Alan Tucker, managing director of Renewable Energy Loss Adjusters, says that when loss adjusters investigate fires, factors that are considered include when the last maintenance was done, the maintenance history and how the fire was dealt with: “For example, are technicians using their own fire extinguishers? Or are there built-in fire suppression systems.”

The industry needs to develop a standard that says fire suppression is expected, Tucker says. If that happens, there will be fewer fire events, he adds. Tucker also says that, as a consequence of this, “uptime is better and there is less cost for the owners and the off-takers”.

Mandatory detection systems are certainly an emerging trend. Angela Krcmar, Firetrace’s global sales manager – wind, points out that, in the last year, France and Belgium have introduced new regulations that mean all turbines must have fire detection systems. “There needs to be an understanding of the best methods of fire suppression,” she says.

That said, while fire detectors do the job of finding a fire, the issue of how to extinguish the fire remains. This is why fire suppression systems are so important – they are activated once a fire is detected and ensure that the fire is put out in just a few seconds, with the result that not only is the turbine saved, but also the millions of dollars of expense caused by a total loss.

How insurers could incentivize fire suppression

Insurers could drive this process forward by offering credits on premiums to manufacturers, owners or suppliers that have fire suppression systems built into their equipment, says Tucker, adding that loss adjusters look at how incidents are being managed. In addition, the industry needs to look at what materials they are using, according to Tucker: “Specifically, the need to use non-combustible lube oils and other non-combustible materials.”

Tucker says you can expect that, on average, one in every 2,000 wind turbines will have a catastrophic fire and some of these machines can cost $4.5 million to replace. He adds that, with regard to lightning protection systems, there is a “long way to go”. Tucker says many such systems do not match the 200-kilovolt recommendations.

Surge protection systems manufacturer Raycap has quoted studies showing that, during the first year of operation of a newly installed wind turbine, 85 percent of downtime is lightning-related, and that the cost of lightning-related damage and repair will often exceed $250,000. Meanwhile, a study conducted in Germany revealed that 80 percent of wind turbine insurance claims related to lightning strikes.

1 in 2,000 wind turbines will have a catastrophic fire

Cost of insurance ‘will go up’

The industry’s determination to tackle fire risk is questioned in some quarters.

However, Krcmar argues that most parties do take fire seriously from a financial, safety and reputational risk perspective. “They want to eliminate fire risk,” she says. “Insurers are very aware that it’s only a matter of time before fire suppression is standard.” Krcmar also says it is worth insurers providing an incentive in this respect. “Insurance is not profitable now, so insurers want to eliminate risk to be able to increase their coverage. Insureds want premium reductions because it’s very expensive and they want to be insured in case of a huge fire event – they do not want gaps in coverage but do want better policies.”

But the issue is insurers want more exact data. Krcmar says some insurers are hiring data analysts to look at claims data and get a better understanding of the issue. “Will insurers get returns if they provide incentives? I think yes, but the issue is proving that and providing credible sources.”

The insurance industry has experienced a “soft market” of late, meaning rates were low, Tucker says. “But insurers have made losses on projects they insured – there has been a change in the last year, while there is a lot of capacity in the market, not every insurer writes this line of business, and those that do take quite big hits,” he adds. “Insurers now have to make books of business profitable so the cost of insurance will go up.” Tucker also says that deductibles are increasing therefore there is not really an incentive for implementing fire suppression measures.

A fire in one of your turbines can significantly increase your insurance premiums and raise your deductible levels, and this will mean that your insurance becomes even more expensive.

But that’s not all. A wind turbine fire can cause months of aggravation. Root cause analysis investigations, negative news coverage, and replacing the destroyed turbine are painful parts of what is a long process of getting a replacement turbine to generate revenue. Meanwhile, with premiums increasing, you could be in for a shock when you see how much your risk exposure and pricing have changed after a single fire event. You may face restrictions on the type of cover you can get.

How to protect against fire

More can be done to prevent wind turbine fires.

Guillermo Rein, professor of fire science at the Department of Mechanical Engineering at Imperial College, London, says the reasons for wind turbine fires frequently include lightning strikes and mechanical failure in the gearbox. “Multiple ignition sources are packed together in an intimate situation with the fuels, such as plastics, cables and oils,” he says. However, Rein adds that the design of turbines has improved, and they are becoming safer due to a reduction in fuels and “ignition sources”.

Streatfeild highlights that a key challenge when trying to better understand fire risks, as well as how to manage them, is the lack of “reliable safety and operational metrics”.

While there are some data sets available, the variable quality – in addition to a “lack of normalisation and contextual information” – means it is difficult, and possibly wrong, to draw any simplistic conclusions.

Rein also highlights the lack of information about wind turbine fires and, consequently, he admits that he has “no idea if the wind turbine industry should be more or less concerned about safety, but for sure there has to be a level of concern.” Rein says there are layers of fire protection that can be introduced, and these can include prevention, which may involve “decreasing the amount and flammability of fuel”.

Another layer of protection involves detecting fires as soon as possible, while yet another step relates to protecting people through evacuation. There is also compartmentalization, which means not letting the fire spread within the turbine. In addition, there is suppression, which includes the use of sprinklers, fire extinguishers and water. However, Rein adds that it is unclear whether the industry wants to do this and such innovations can "take time".

Firetrace's fire suppression systems are used by approximately 3 percent of wind turbines worldwide. When all fire suppression system manufacturers are taken into account, around 6 to 7 percent of all wind turbines have this protection.

The lack of significant data is a major issue, emphasizes Rein. He adds: "Are the numbers we have seen an overestimate? Or an underestimate?" It's not clear, he says.

Krcmar says obtaining data on wind turbine fires is challenging. "The data is not available publicly, each individual OEM, end-user and insurance loss adjuster has different data, but it isn't part of the public domain."

Krcmar adds that layers of fire protection could be implemented cost effectively at the outset of the project. Krcmar also says the costs associated with fires in wind turbines is not publicly discussed. She continues: "The industry needs to get more comfortable with talking about the issue."

Layers of fire protection could be implemented cost effectively at the outset of the project

Occupational exposure: The changing risk profile

Loss of life is one of the most important considerations when analyzing turbine fire risk, says Joe Banks, head of technical services at Harvest Energy Services. “We do a lot of training with technicians in relation to the emergency action plan, how to execute it, how to communicate, how to get yourself out of the tower and on the ground with your team,” he adds.

In this respect, wind farm reliability should be a key consideration. Streatfeild stresses its importance in relation to wind farms because he argues that, invariably, a reliable wind farm is a safe wind farm. He adds: “There is an assumption that there is minimal occupational exposure – it’s true that usually people aren’t in the plant when it is running, but technicians can introduce hazards if they are doing maintenance tasks, such as hot work, for example.”

Occupational exposure is changing rapidly in relation to offshore wind, according to Streatfeild. “When we do campaign maintenance offshore, we are seeing larger, multiple teams working on a turbine because we want to minimize downtime – that automatically changes the risk profile,” he says.

Meanwhile, Banks says grass fires in areas where turbines are located are also a major concern. In this respect, from an equipment perspective, important considerations include how equipment goes back together [after maintenance] and whether technicians are qualified. He adds: “For example, do they [technicians] understand the calibration that goes into aligning different pieces of equipment?”

Banks says that there are doubts as to whether today’s technicians have developed the trade skills their predecessors used to have because technicians are now more commonly entering the profession via educational programs. Banks argues teaching programs should have a greater focus on the fact that “one misalignment could create a potential fire.”

Insurance loss adjusters need data

Despite fire data being badly needed, the industry is reluctant to share it.

Tucker says that, due to competition between manufacturers, they do not want to publicize fire data. However, he adds: “Adjusters or brokers need to run these types of databases – they need to show the results of not tackling the issue.”

The offshore industry has a particular problem in this context because offshore fires are more costly, says Tucker. He adds that, anecdotally, in the previous ten years, gearboxes were the major source of fire. “Now it’s more electrical switch gear and transformers, but we don’t have a lot of data.”

With regard to fire suppression systems, some are beset by problems, according to Banks. “For example, if they are inadvertently set off during a major corrective, depending on the suppressant agent and system, it can be difficult [for technicians] to breathe,” he says. “The system has to be robust – if they are inadvertently set off, they introduce another hazard.” In addition, ‘on-board’ monitoring – such as smoke

alarms or 360-degree digital cameras – should be considered, according to Banks. With regard to the issue of technicians experiencing breathing difficulties, Firetrace uses the gaseous fire suppression agent FK-5-1-12 because it is safe for occupied spaces, making it a better option than an aerosol for the inside of a turbine.

On the subject of data sharing, Streitfeild highlights that there are industry precedents such as the SPARTA data-sharing platform, which enables offshore wind farm owners and operators to benchmark performance. Platform participants include EDF, RWE, Ørsted and the Crown Estate.

Meanwhile, Streatfeild proposes that another approach to tacking the problem could be a "more robust process of turbine safety certification that would involve providing assurance that a specified type of turbine type meets a specified fire safety standard". He continues: "In part, this is addressed via existing type approval processes – however the lack of a suitable fire safety standard means that there are no accepted normalized standards that can currently provide this assurance."

Streatfeild adds: "People investing in wind farms want a certification standard that will provide safety assurance. Standards and certification systems could be more robust."

People investing in wind farms want a certification standard that will provide safety assurance

Wind industry must unite on issue of fire safety

It's important that there is industry coordination when it comes to addressing the issue of fire safety in wind farms.

Better certification and standards would create an opportunity for a fire reporting system, according to Streatfeild. "We only have 50 companies that cover the entire global giga-wattage [of wind power] – data will show that the risk profile is low." Meanwhile, Tucker argues that when a standard is developed, insurers would be likely to offer deductions on premiums if turbines meet the said standard.

However, Banks highlights a potential problem that could arise with the development of a fire safety standard for wind turbines. “A standard could stifle innovation,” he argues. Banks also warns that OEMs may say that wind farm owners or operators must avoid using any turbines other than theirs or it will mean their warranty is voided.

If the issue of fire safety is tackled in an unregulated way, “it could end badly”, says Krcmar. She cites the example of plans to use “fireballs” in Brazil to tackle turbine fires, and says that if these go off, they will have a corrosive effect.

When a standard is developed, insurers would be likely to offer deductions on premiums if turbines meet the said standard.

Conclusion

Wind farm owners and operators need to get serious about the issue of fire risk.

A wind farm fire can cost up to $8 million in damages. And yet the industry is failing to take the necessary steps needed to ensure it has adequate insurance coverage.

One of the first challenges will be getting the industry to talk more openly about the issue of fire risk, but there is sufficient reason to be optimistic that this can happen. For example, the industry does have a track record of sharing data as the SPARTA data platform proves.

Building on this existing trust and industry cooperation will ensure that the industry significantly decreases the extent of the damage it suffers as a result of fire.

Only when the industry takes this step can it put itself on a sounder financial footing and thus enable itself to prosper further in the years to come.

Key steps the industry should take are:

- Introducing harmonized international design standards for wind turbine fire safety
- Introducing a system of certification for wind turbine fire safety
- Sharing more data about fire events – this will enable insurers to better assess the risks and mean they will be more willing to underwrite them
- Adopting a coordinated approach to fire safety

By taking these steps, the wind industry will:

- Reduce the chance of suffering a significant financial hit due to a wind turbine fire
- Reduce the cost of insurance cover for fire events
- Reduce the risk of the wind industry suffering serious reputational damage due to fire events

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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