actis

BUILDING INFRASTRUCTURE RESILIENCE

December 2025

OVERVIEW

Many investors are looking for greater optionality and diversification as the risks around stubborn inflation, lower growth and overexposure remain. Infrastructure needs almost $64 trillion of investment over the next 25 years. That's equivalent to 1.7% of global GDP per year. Emerging markets account for $43 trillion of this, reflecting their greater development needs and typically faster economic growth.[1]

Many of these markets are blessed with abundant natural resources – solar, wind and gas – that are necessary for the global energy transition and they are well-placed to deliver attractive yields. They also need the build out of transmission, distribution, and storage that must accompany renewable-heavy base loads.

Taken together, this infrastructure represents both a huge investment opportunity and a means of large-scale decarbonisation.

For many investors who have experienced this opportunity and its powerful returns profile, the question now is no longer whether to invest, but how to create resilient assets.

Recent disruptions show how swiftly value can be lost when critical infrastructure fails.

On 28 April 2025, a massive power outage disrupted electricity supply across Spain, Portugal, and parts of southern France, affecting over 60 million people. Spain abruptly lost approximately 15 GW of electricity—about 60% of its total consumption at that moment.

On 16 April 2024, unprecedented rains and flooding in Dubai brought major roads to standstill and forced a closure of the international airport. The CEO of Emirates estimated the event cost the airline $110 million in damages.[1]

In early 2025, a major grid disruption in Chile caused a country-wide blackout.

These outages were once unprecedented but are becoming more frequent. They are a stark reminder of how reliant we are on critical infrastructure, the widespread impact of disruption on people, and the financial cost of failing to build resilience. Infrastructure does fail from time to time and for various reasons, so resiliency – minimising how often failure can occur – must be central to how we invest and operate.

Building resilience – whether for power or other critical infrastructure – is fundamental for many reasons. It allows for continuity in delivering essential services – power, data and transport to economies, countries and their citizens. It also protects value in the assets we own and operate, as well as returns for investors, while maximising the potential for an exit given buyers will always look to stress test assets for their next time horizon. This is particularly important when considering climate risk to maximise safety and minimise insurance premiums from rising.

Assets that stay online through floods, fires or grid shocks keep communities functioning, reinforce an operator's social licence, and protect investor interests.

In this paper, we look at how investors in infrastructure assets such as data centers, toll roads, power and utilities can build resilience to climate change and other risks.

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INFRASTRUCTURE NEEDS

$64tn

INVESTMENT OVER THE NEXT 25 YEARS[1]

SOURCE: 1. https://www.aberdeeninvestments.com/en-us/investor/insights-and-research/how-large-are-global-infrastructure-needs-us

CLIMATE RESILIENCE IN INFRASTRUCTURE ASSETS

68% OF INVESTORS HAVE CONDUCTED CLIMATE RISK ASSESSMENTS FOR AT LEAST SOME OF THEIR ASSETS. BUT ONLY...

32% HAVE COMPLETED COMPREHENSIVE, PORTFOLIO-WIDE RISK ASSESSMENTS.

Extreme weather is becoming more volatile, frequent and severe, and we have less ability to rely on historic data patterns to predict future events. In contrast, events such as seasonal flooding, extreme heat and wildfires – events that the insurance industry refer to as 'non-peak perils' – have increased steadily and predictably since the late 1980s. In fact, 2024 was the warmest year of global temperature going back to 1850 and the last decade has been the warmest on record. [3]

Despite the widespread implications for businesses, insurance and infrastructure, most companies remain underprepared. S&P Global reported that only one in five companies currently has a plan to adapt to risks associated with climate change.[2]

According to a 2023 Global Infrastructure Investor Survey, 68% of investors have conducted climate risk assessments for at least some of their assets. But only 32% have completed comprehensive, portfolio-wide risk assessments.

Infrastructure investors are building and operating assets that provide critical services and it's imperative that these assets continue to operate uninterrupted.

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In growth markets, this is even more important, as they tend to be more exposed to physical climate events, and crucially their legacy infrastructure has less adaptive capacity, making them more vulnerable. During any investment due diligence, it's vital to understand the chronic and acute hazards, the degree of exposure and the level of risk, and the capital required to build resilience.

SOURCE: 2. https://www.spglobal.com/esg/insights/adaptation-planning-is-the-next-step-for-companies-to-prepare-for-climate-risk.
3. https://climate.copernicus.eu/global-climate-highlights-2024

IMAGE: Carrefour Majid Al Futtaim - 17 MWP - Yellow Door Energy

FACTORING CLIMATE RESILIENCE CONSIDERATIONS INTO INVESTMENT DECISIONS

Using GPS co-ordinates for our 225 assets, we carried out a climate hazard assessment against each one to a resolution of 25 square kilometres.

Last year Actis worked with AXA Climate to undertake a top-down climate scenario analysis across our portfolio. Using GPS co-ordinates for our 225 assets, we carried out a climate hazard assessment against each one to a resolution of 25 square kilometres.

The assessment considered chronic and acute climate hazards that were most likely to negatively impact each asset under three different climate scenarios, using timeframes to 2030 and to 2050, to efficiently deploy capex, safeguard workers, and protect returns.

We then held a climate risk and resilience workshop where each of our companies were able to dig into their specific climate scenario analysis outputs. Several of our companies, such as Emicool in UAE, are quantifying the potential commercial implications, further assessing their long-term resilience status, and developing adaptive strategies to align with national resource conservation targets and maintain competitive advantage.

Another example is in Bangladesh where the country is vulnerable to flooding. We undertook extensive due diligence on the impact of flooding before acquiring a gas power generation plant. We wanted to understand the magnitude of the risk from overland, fluvial and coastal flooding, and the capex required to build greater resilience.

Detailed technical analysis using a flood routing model and satellite imagery was conducted to assess future flood risk due to predicted changes in extreme rainfall, sea-levels, and the storm surge from tropical cyclones.

Our analysis concluded that the site, which is elevated by more than four metres, is sufficiently resilient to current risks but further investment was required to protect the power plant and its workers in the medium to long term.

Since our investment, the embankments adjacent to the river have been raised and structurally strengthened, the stormwater drainage system has been upgraded to increase its capacity, and we developed a flood resilience action plan for the workers at the site.

This analysis will be crucial in the context of a deal exit and safeguarding valuation, given future buyers will inevitably diligence climate vulnerability too.

In Brazil, HRZ, an Actis energy transmission business, is operating in a sector that is growing and attractive but is exposed to physical climate risk – specifically wildfire, downburst, heavy precipitation and erosion. For investments in this sector, we perform a focused physical climate risk assessment, which pinpoints hazards and risks that are most salient to the specific asset. We then consider options to enhance resilience for the most at-risk assets, and perform a cost benefit analysis per mitigation measure to identify those which will be implemented. The outputs of this analysis inform our investment decisions and enable us to underwrite any necessary adaptation capex.

In analysing climate risk holistically, we need to consider not only the site perimeter of an asset, but the surrounding areas and nearby communities. For example, a standard resilience measure is to ensure that drainage systems can accommodate excess runoff from heavy rainfall. However, beyond channelling water away from a site, it's crucial to ensure that large volumes of water are not then directed towards homes, farms, fields or even local watercourses, where damage threatens livelihoods, property, safety and licence to operate.

For Actis' Indian road assets in India, events typically occurring once every 100 years are occurring more frequently with higher volumes stressing drainage systems, affecting asset integrity (with associated implications for user road safety) and increasing road maintenance costs. These learnings have led to tying technical due diligence with climate resiliency and building in insurance and maintenance costs to ensure road quality while maintaining returns.

BUILDING RESILIENCE IN ENERGY ASSETS

With energy assets specifically, we need to better consider how climate change will impact energy yield forecasts. How will changing weather patterns affect wind speeds for turbines or irradiation patterns for solar panels? Heat waves bring down solar panel efficiency by up to 1.5 per cent per 5°C temperature increase.

Besides considering impacts on asset integrity, it's important to factor in secondary affects from extreme weather, such as how workers might be prevented from operating them. In parts of India and the Middle East, for example, temperatures are already exceeding safe biological thresholds for humans at certain times, and our companies are already adapting shift patterns to reflect this.

There is an elevated duty of care to workers in terms of worker welfare and Health and Safety, particularly in some growth markets where heat, humidity and acute events can cause extreme environments.

IMAGE: Bahrain Mall Solar Power Plant - Yellow Door Energy

RESILIENCE AS A PREREQUISITE FOR INSURANCE

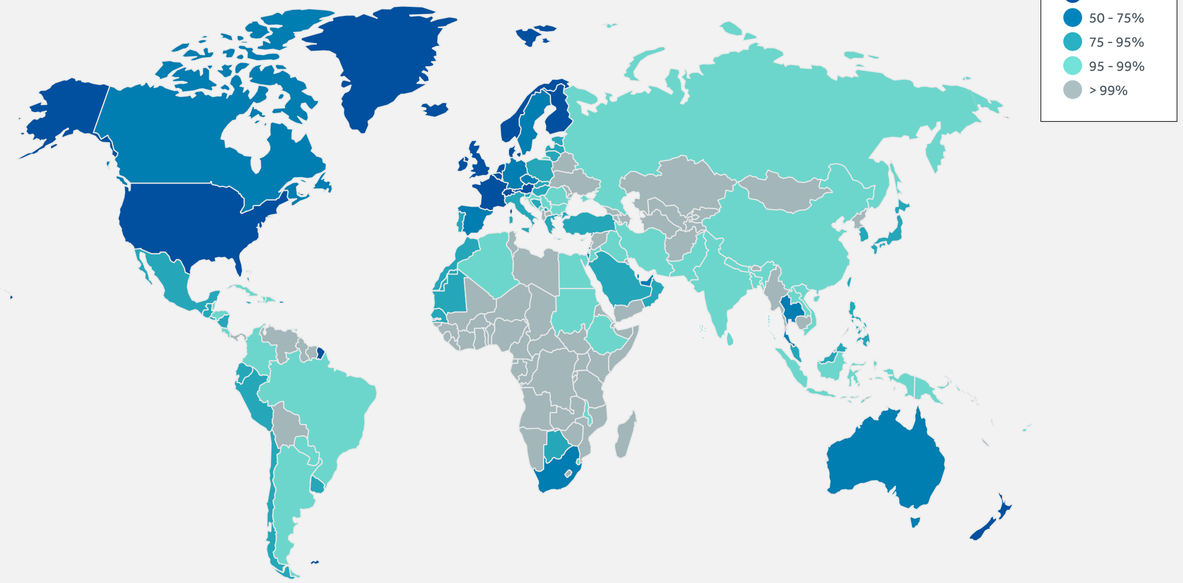
Some of our businesses have been able to negotiate lower insurance costs now they can demonstrate they've invested in resilience

Natural disasters have caused more than $131 billion in losses so far in 2025.[4]

It's not just about protecting asset valuation. As climate risks increase, insurance premiums are rising. They must be factored into planning and costs. But you must be able to secure the insurance in the first place. Some of our businesses have been able to negotiate lower insurance costs now they can demonstrate they've invested in resilience; however, as insured losses rise, with 2024 the third costliest year on record for the insurance industry,[4] considerations are moving from affordability to availability of insurance, and investment in resilience will increasingly become a prerequisite to securing insurance cover.[5]

Globally, there is an estimated 60% protection gap for insurance against climate-related losses.[6]

PROTECTION GAP SINCE 2000 BY COUNTRY



$131bn NATURAL DISASTERS HAVE CAUSED MORE THAN $131 BILLION IN LOSSES SO FAR IN 2025[4]

60% GLOBALLY, THERE IS AN ESTIMATED 60% PROTECTION GAP FOR INSURANCE AGAINST CLIMATE-RELATED LOSSES[6]

SOURCE: 4. https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2025/natural-disaster-figures-first-half-2025.html
5. https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2025/natural-disaster-figures-2024.html
6. AON; 2025 Climate and Catastrophe Insight Report

CREATING GREATER RESILIENCE THROUGH AI

Long before an asset goes live, AI tools can model potential climate and grid hazards to help choose future proof sites, interconnection points, and access routes that will remain operable under 2030 and 2050 conditions.

Many third-party technical and environmental due diligence partners are now using digital tools to help speed-up climate scenario analysis. This analysis involves crunching through large amounts of variables and undertaking a scenario analysis approach – it will be interesting to see how AI can advance this process and improve quality of outputs.

AI can strengthen resilience in other ways too, from inception to operation. Long before an asset goes live, AI tools can model potential climate and grid hazards to help choose future proof sites, interconnection points, and access routes that will remain operable under 2030 and 2050 conditions.

In design, generative optimisation and physics-informed models stress-test elevations, drainage, foundations, cable routes, thermal loads, and spare-parts strategies—trading small upfront capex for large reductions in future downtime.

During development and permitting, natural-language and computer-vision tools digest public comments, surveys, satellite and LiDAR data to anticipate constraints—wetlands, setback buffers, haul-road fragility—and adapt earlier, protecting schedule and quality.

In construction and commissioning, phone and drone imagery paired with AI compares as-built assets to Building Information Modelling (BIM) visuals and auto-generates punch lists, which identity defects. These defects are then able to be resolved before evolving into latent faults that show up as outages in year one.

Once in operation, assets can then benefit from forecast-driven playbooks. For example, in Actis' own portfolio companies we are trialing hyper-local weather forecasts to drive 'next 2 hours' dispatch. We use AI models predictive maintenance and SCADA anomaly detection. We use drones to spot issues with solar panels, highways and pipelines, and new LLM tools are being implemented that are able to track an organisation's responsibility across all its contracts and how it's performing against service agreements.

On the commercial side, AI is helping automate the Power Purchase Agreement sales process, finding new customers, pricing contracts, and offering new ways to service those customers at scale.

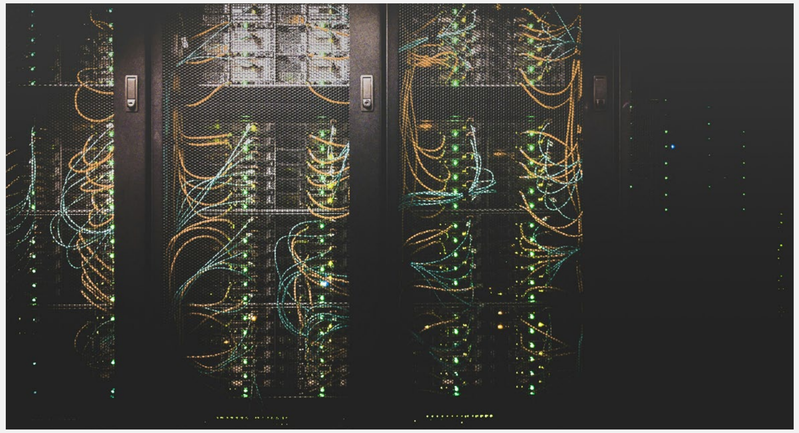
The result is a loop: better siting and design, faster permitting, higher build quality, safer operations, and stronger financing terms—all reinforced by timely, data-driven decisions.
All the new technology means security must advance in lockstep. AI can model likely attack paths across IT and OT, tune detection to process-level anomalies, and help drive realistic tabletop exercises so teams rehearse failure safely.

RESILIENCY IN DATA CENTERS

Data centers, housing critical customer information for banks, telecommunications providers, and many other companies are necessarily built with multiple layers of redundancy when it comes to power.

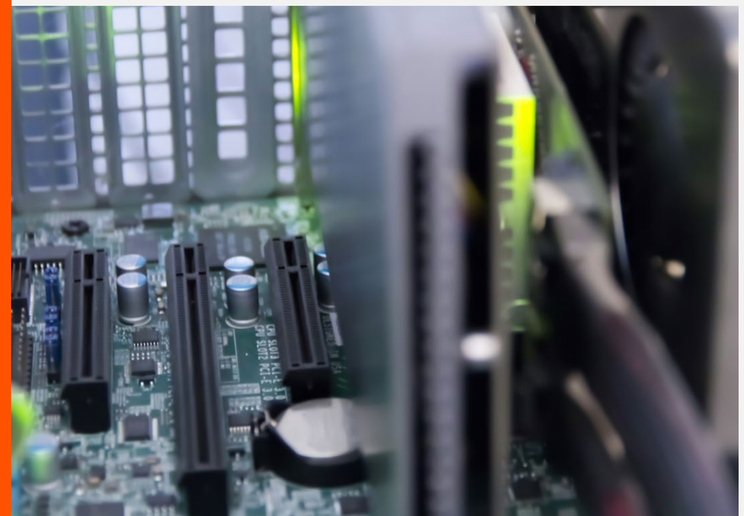
Typically, there are at least two feeds of the full gross power from the grid. In the rarest instance when both fail, the Uninterruptible Power Supply (UPS) kicks in for the first 10 minutes. This allows the diesel generators to start automatically to provide non-stop power for the entire data center.

The sizing and redundancy of both UPS and diesel generators depends on the region, grid reliability, and hyperscaler (client) requirements. Areas known for frequent grid issues due to hurricanes, like Miami, would for example require longer duration diesel generator backups. Hyperscalers and business critical customers such as banks, financial institutions, also have their own redundancies and backups in the event of extended shutdowns.



In February 2025, a transmission line failure caused a 7-hour power outage in Chile. Actis' three data center sites were not impacted thanks to appropriately sized and tested UPS and diesel systems, and efficient operational processes able to assess fuel capacity and activate backup power systems.

But grid failure is not the only risk facing data center operators. The structural integrity of the site is essential too. In April 2024, a 7.4-magnitude earthquake hit Taiwan during the construction of Actis' data center in Taipei. Due to the resilient design, following a brief work suspension to inspect the core and shell of the structure, it was determined that the data center was unaffected and the construction continued on-time and on-budget. The data center has been certified resilient to potential climate risks until 2050, even under a severe downside scenario.



GRID RESILIENCE

The Iberian blackout was not the result of a single failure, but of a system pushed beyond its design boundaries by a combination of factors. This event is a clear illustration of how grid architecture must evolve alongside the energy transition. While this was triggered by a rare event, its rapid escalation into a continental-scale blackout reflects a broader pattern. Today's grids are being asked to deliver 21st-century energy goals on 20th-century, multi-part infrastructure.

Critically, the blackout was not a failure of renewables, but of the system's inability to integrate and manage them under stress. Low inertia, lack of real-time damping, insufficient forecasting accuracy, and coordination gaps between national systems all contributed to the vulnerability. These are known technical risks, and they are growing more relevant as renewable penetration increases and legacy generators retire.

Wildfire is another risk that poses a threat to the resilience of many electricity grids, including Actis' electricity distribution investment in Türkiye, Ulug. To mitigate wildfire risk for Ulug, we increased inspections of high-risk equipment; accelerated the replacement of wooden poles with steel and concrete poles; implemented fire breakers and sand pits to contain the spread of wildfires and increased emergency response time.

From an investment perspective, the implications are clear. Just as capital has flowed into wind, solar, and distributed energy assets, we think the next wave of opportunity lies in enabling infrastructure, via technologies and systems that allow clean energy to be delivered reliably at scale, such as grid-forming inverters, energy storage, flexible thermal or hybrid peaking plants and high-voltage transmission upgrades.

Some of Actis' renewables assets are upgrading equipment to provide ancillary services such as frequency control and supporting grid stability.

The IEA's landmark net zero roadmap report states that annual investment in grids needs to expand from $260 billion today, to $820 billion per year by 2030.[7]

For energy investors, this could mark an inflection point. Reliability and resilience should no longer be just a grid operator's concern. Understanding these dynamics can help position capital not just to react to disruptions, but to enable stable, scalable, and sustainable grids.

The IEA's landmark net zero roadmap report states that annual investment in grids needs to expand from...

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PER YEAR TODAY, TO...

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PER YEAR BY 2030[8]

SOURCE 7. IEA, Net Zero by 2050: A Roadmap for the Global Energy Sector, p.21

Actis is a growth market investor in sustainable infrastructure.

Actis builds and operates critical infrastructure, providing investors access to what it believes are the fastest-growing themes influencing the global economy – clean energy, digital infrastructure and transport.

Through Actis' global footprint of 17 offices, it invests at scale, with over 20 years' experience. Since inception, Actis has raised US $27 billion.

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