INVESTABLE GREEN DATA CENTRES:

WHERE SUSTAINABILITY DRIVES PERFORMANCE

September 2025

GENERAL ATLANTIC

SYSTEMIQ

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This is a whitepaper developed by Systemiq in partnership with General Atlantic and its growth climate team at BeyondNetZero and infrastructure team at Actis, with contributions from GRESB and SDCL. It also draws from off-the-record conversations with a wide range of data centre industry experts and practitioners, including developers, operators, startups, and investors, as well as industry reports and company filings. The contents are intended for informational purposes only and are not investment advice, nor a recommendation of any investment product.

Executive Summary

- Data centres are expanding rapidly as demand for AI, cloud computing, and digital services soars. Yet this growth can sit uneasily alongside sustainability imperatives. **Getting data centre build-out right could unlock emissions reductions, but the path forward is not always clear to investors.**
- **For developers and operators, the immediate priorities remain speed to power, reliability, operational performance, cost, and license to operate.**
- **We believe that sustainable solutions can align with these financial and execution priorities.** Where that is the case, such alignment de-risks and accelerates the development of assets, presenting compelling investment opportunities.
- **Opportunities to bring solutions to scale already exist** through targeted investment strategies.
- **The geography of opportunity is uneven, with different forces shaping the landscape:** Europe is advancing sustainability-focused regulation; the US build-out is driven by the current administration and hyperscaler ambition; and Asia presents rapid demand growth paired with country-specific design parameters.
- Investors who understand how sustainability aligns with financial and execution imperatives will be **well-positioned to generate alpha while shaping the next wave of digital infrastructure.**

Introduction: AI, Data Centres, and the Sustainability Paradox

5%

HIGH RANGE ESTIMATE OF GLOBAL EMISSIONS DRIVEN BY AI IN 2030

Global data centre demand is surging, fueled by the exponential rise of AI, cloud computing, and digital services. Already one of the fastest-growing infrastructure segments, data centres currently consume 1.5% of global electricity.[1] Demand is expected to more than double by 2030,[2] potentially driving this sector to account for 5% of global GHG emissions.[3] Questions of sustainability are therefore at the heart of data centre build-out.

5-10%

POTENTIAL GLOBAL EMISSIONS REDUCTION DRIVEN BY AI IN 2035

At the same time, data centres are the enabling infrastructure for AI applications that could themselves be critical for driving down global emissions. Research from LSE's Grantham Research Institute and Systemiq shows that innovative uses of AI across power, transport, and food consumption could reduce emissions by 3.2-5.4 billion tonnes annually. This represents 5-10% of global emissions by 2035[4] – meaning, in theory, that the longer-term sustainability benefits enabled by data centres could outweigh the immediate sustainability challenges posed by building those data centres.

Developers and operators rarely prioritise sustainability for its own sake. Their focus is on speed to market, cost, and reliability. Projects are increasingly shaped by hyperscalers such as Microsoft, Amazon, Google, or Alibaba, whose strategic priorities dictate technology adoption and site selection. With AI and high-performance computing now existential to their business models, hyperscalers have the power to accelerate sustainability – or to entrench risks – across the entire ecosystem.

$64B

VALUE OF DATA CENTRE PROJECTS BLOCKED BY COMMUNITY PUSHBACK

The commercial risks of ignoring sustainability are growing. Already, $64B in US projects have been delayed or blocked due to community pushback over power and water use.[5] Other risks include the price volatility associated with fossil fuel dependence and regulatory risk deriving from shifting sustainability mandates and reporting requirements.[6]

SYSTEMIQ

Systemiq is the world's preeminent climate and system change company, and strategic partner to General Atlantic. Systemiq has published insights on clean energy investment opportunities in data centres, and supported corporates, developers, and investors on scaling sustainable data centres. This is complemented by on-the-ground implementation work, where Systemiq is advancing the build out of a sustainable data centre platform in the Nordics. Systemiq has also worked on the implications of AI in accelerating climate action, including research with the London School of Economics' Grantham Research Institute.

Against this backdrop, a pathway toward sustainability is emerging. Solutions are becoming not just "nice to have" but crucial to de-risking assets and supporting financial and execution goals. This may be one reason why the segment is on a growth trajectory: sustainable data centre solutions attracted over $3B in investment in 2024.[7]

This whitepaper maps areas in which solutions are ready to scale today and those where targeted investment can unlock growth in the near future. It also outlines how sustainability can serve as both a de-risking mechanism and a source of competitive advantage. The Appendix provides a deeper dive into sustainability dimensions in data centres for readers less familiar with the space. Our findings are intended for both technology-focused and institutional investors: those looking to back startups and emerging technologies or scale proven technologies and solutions, as well as those seeking to work with developers and operators to accelerate solution deployment in new data centre projects.

Measuring Sustainability in Data Centres

Sustainability in data centres cannot be measured with a single metric or checklist. It is the result of a layered set of decisions across power, water, construction, hardware, and workload management. Data centres are also diverse and increasingly heterogeneous, with designs varying significantly based on region, operating requirements, ownership structures, and more. There are currently no global standards for what constitutes a "sustainable" data centre, though in general the best practice is to maximise energy and water efficiency and minimise both operational and embedded carbon emissions. More details on sustainability measurement are available in the Appendix of this paper.

For investors, this lack of consistency creates both a challenge and an opportunity. Without clear standards, it is difficult to compare projects or hold operators accountable. However, those who develop a working understanding of emerging best practices or push for higher-quality disclosures will be better positioned to mitigate commercial and execution risk. New initiatives such as GRESB's Data Centre Assessment, which is to be launched in 2026, are attempting to standardise reporting by identifying and describing the most material factors for data centre sustainability performance. The Assessment will leverage the existing GRESB Standards and the expertise of a dedicated Data Centre Working Group to bring together a range of metrics to provide a nuanced and actionable view of data centre sustainability, with a particular focus on power-related recommendations in the iMasons Climate Accord Maturity Model[8] and additional metrics for energy efficiency, water efficiency, health and safety, and other considerations.

Understanding the Financial and Execution Priorities of Stakeholders

Macro trends are defining the financial and execution priorities of data centre players. Foremost amongst these trends is increasing stress on power grids: data centre power needs are significant, and it is no easy task to build adequate generation and transmission to feed them. Power needs and operational complexities are set to grow further with increased adoption of AI and high-performance computing (HPC). Supply chains are becoming bottlenecked due to surging demand and unstable trade conditions. Further, as the power and resource needs of data centres are recognised, projects are also facing community pushback and regulatory tightening.

We have identified six financial and execution considerations that are driving demand for solutions:

- **Quick access to power:** Securing a power connection is currently the number one constraint on data centre expansion[9] and the first priority of developers. Any solutions which speed access to power will see uptake.
- **Reliability of power:** Data centres require constant, consistent access to large amounts of power – most locations built for AI applications require 99.99+% uptime, meaning less than 30 minutes per year when the power is not running. Solutions which either enable consistent backup power or help to smooth out intermittency and variations in power supply ensure that reliability requirements are met.
- **Speed of build-out once power is secured:** Power is not the only bottleneck to data centre build-out as other equipment (such as chips, servers, and cooling systems) is also becoming harder to secure. Solutions which circumvent or help ease supply chain congestion, or other execution difficulties, are of great value to developers.
- **Optimised performance for AI and HPC:** Data centres are required to accommodate increasing operational complexity to meet the needs of AI and HPC. Chips and servers designed for these purposes use more power and produce more heat. Energy demands from some AI tasks can be 'spiky', making them hard for data centres to handle. Solutions which can resolve these challenges may have a competitive edge.
- **Cost:** While data centre developers and operators have strong margins, sustainable solutions will need to be cost-effective if they are to be adopted at scale. Solutions that reduce costs by increasing internal efficiencies, or those that generate additional sources of revenue (e.g., from re-sale of excess heat), are especially appealing to operators.
- **License to operate:** Data centres will need to evolve to accommodate the concerns of local communities as well as emerging regulatory stipulations (e.g., around water use). Solutions which anticipate and mitigate these factors will serve to lower operational and financial risk.

Navigating the Landscape of Sustainable Solutions

Full range of sustainable solutions for data centres which emerged in our research.[10]

Prioritized for landscape analysis:
Some alignment between sustainability and financial / execution considerations, and several investment prospects available.

Not prioritized for landscape analysis:
Low alignment between sustainability and financial / execution considerations, or few investment prospects available

POWER SOURCING, GENERATION, AND STORAGE / FLEXIBILITY

- Software for site selection and power procurement
- On-site solar
- Microgrid-enabling technologies
- Small Modular Reactors (SMRs)
- Demand response software
- Short Duration Energy Storage
- Long Duration Energy Storage
- On-site wind
- On-site geothermal
- On-site bioenergy
- Hydrogen fuel cells
- Renewable diesel (biofuel) in generators
- Cogeneration / trigeneration

IT EQUIPMENT AND COMPUTE

- Semiconductor hardware tech
- Software for chip design
- AI training / inference efficiencies

COOLING

- Liquid cooling (immersion, direct-to-chip)
- Heat reuse
- Hybrid (adiabatic) systems
- Closed-loop systems
- Rainwater recycling
- Refrigerant tracking

POWER DISTRIBUTION

- High voltage DC systems
- Modular voltage conversion
- Solid-state transformers
- UPS with lithium-ion batteries

INFRASTRUCTURE AND OPERATIONS MANAGEMENT

- Software for system-wide efficiency (incl. DCIM, sustainability accounting)

MATERIALS

- Low-carbon cement
- Low-carbon steel
- Low-carbon other materials (e.g., aluminium)
- Alternative building materials

CONSTRUCTION AND EQUIPMENT

- Design for less material use
- Maintenance optimisation services / software
- Equipment re-use / re-sale platforms
- Modular / prefabricated infrastructure
- Specialist disassembly and recycling services
- Automated robotics for component separation
- Material recovery solutions

Source: Systemiq analysis

In the absence of clear regulation, sustainable solutions for data centres will only scale if they truly align with the financial incentives and mechanisms of data centre developers and operators. Therefore, while a wide range of possible solutions emerged from our research and discussions with industry players, we focus here only on those that offer some alignment between sustainability and financial impact, and for which investment opportunities already exist. This leads us to a more focused landscape view:

Landscape of Prioritized Sustainable Solutions[11]

- Very useful in resolving challenges
- Somewhat useful in resolving challenges
- Intensifies challenges
- Somewhat intensifies challenges
- Neutral impact
- *Varies by geography

Category	Solutions	DC Sustainability Impact	Financial and Execution Considerations					
			QUICK ACCESS TO POWER	RELIABILITY OF POWER	SPEED OF BUILD-OUT (EXCL. POWER)	PERFORMANCE FOR AI / HPI	COST	LICENSE TO OPERATE
Power sourcing, generation, and storage / flexibility	Software for site selection and power procurement	Medium-low	Very useful	Neutral	Neutral	Neutral	Neutral	Neutral
	On-site solar, including in microgrid setups	High	Very useful	Neutral	Neutral	Neutral	Somewhat intensifies*	Somewhat useful
	Microgrid-enabling technologies	Medium	Somewhat useful	Neutral	Neutral	Neutral	Neutral	Neutral
	Small modular reactors (SMRs)	High	Intensifies	Very useful	Neutral	Neutral	Intensifies	Somewhat useful
	Demand response software	Medium-low	Very useful	Somewhat useful	Neutral	Neutral	Neutral	Neutral
	Short Duration Energy Storage (SDES)	Medium	Somewhat useful	Somewhat useful	Neutral	Neutral	Neutral	Somewhat useful
	Long Duration Energy Storage (LDES)	Medium	Very useful	Very useful	Neutral	Neutral	Intensifies	Somewhat useful
IT equipment and compute	Semiconductor hardware tech	Medium-high	Neutral	Neutral	Somewhat intensifies	Very useful	Intensifies	Neutral
	Software for chip design	Medium	Neutral	Neutral	Neutral	Somewhat useful	Somewhat useful	Neutral

Landscape of Prioritized Sustainable Solutions[11] (cont.)

- ● Very useful in resolving challenges
- ● Somewhat useful in resolving challenges
- ● Intensifies challenges
- ● Somewhat intensifies challenges
- ● Neutral impact
- *Varies by geography

Category	Solutions	DC Sustainability Impact	Financial and Execution Considerations					
			QUICK ACCESS TO POWER	RELIABILITY OF POWER	SPEED OF BUILD-OUT (EXCL. POWER)	PERFORMANCE FOR AI / HPI	COST	LICENSE TO OPERATE
Cooling	Liquid cooling (immersion, direct-to-chip)	Medium (energy + water)	Neutral impact	Neutral impact	Neutral impact	Very useful in resolving challenges	Neutral impact	Somewhat useful in resolving challenges
	Heat reuse	Medium (energy + water)	Neutral impact	Neutral impact	Neutral impact	Somewhat useful in resolving challenges	Somewhat useful in resolving challenges	Very useful in resolving challenges
Power distribution	High-voltage DC power distribution systems	Medium	Neutral impact	Somewhat useful in resolving challenges	Somewhat intensifies challenges	Very useful in resolving challenges	Somewhat intensifies challenges	Neutral impact
Infra. & operations management	Software for system-wide efficiency (incl. DCIM, sustainability accounting)	Medium (energy + water)	Neutral impact	Neutral impact	Neutral impact	Somewhat useful in resolving challenges	Somewhat useful in resolving challenges	Somewhat useful in resolving challenges
Materials	Low-carbon cement	Medium	Neutral impact	Neutral impact	Somewhat intensifies challenges*	Neutral impact	Somewhat intensifies challenges*	Somewhat useful in resolving challenges*
	Low-carbon steel	Medium	Neutral impact	Neutral impact	Somewhat intensifies challenges	Neutral impact	Intensifies challenges	Somewhat useful in resolving challenges
Construction and equipment	Design for less material use (incl. specialized design companies and software)	Medium	Neutral impact	Neutral impact	Neutral impact	Neutral impact	Somewhat useful in resolving challenges	Neutral impact
	Maintenance optimization services / software	Medium	Neutral impact	Neutral impact	Neutral impact	Neutral impact	Somewhat useful in resolving challenges	Neutral impact
	Equipment re-use / re-sale platforms	Medium-low	Neutral impact	Neutral impact	Somewhat useful in resolving challenges	Neutral impact	Somewhat useful in resolving challenges	Neutral impact

Source: Systemiq analysis

POWER SOURCING, GENERATION, AND STORAGE / FLEXIBILITY

Power is both the most important factor in data centre sustainability and the number one execution concern of developers. Most data centres rely on grid connections. As power demand soars, these are increasingly constrained. They are also not amenable to influence from developers seeking better environmental attributes, given their dependence on the carbon intensity of power generation in a particular geography. Developers who cannot secure connections to grid power are exploring other options. Some are turning to natural gas-powered turbines to bridge generation needs in the short term, especially in areas where natural gas is cheap. However, this route is not immune to sourcing constraints, delay, and volatility: waitlists and manufacturer backlogs for gas turbines are significant,[12] and fossil energy prices are unpredictable. For example, original equipment manufacturers of gas turbines have recently estimated up to 7-year wait times for new customers.[13] Developers are therefore turning to a range of solutions that can offer alternative, more sustainable, and consistent power.

- **Software for site selection and power procurement:** Specialist software can help identify overlooked pockets of energy within existing grids. These solutions can accelerate access to power, although their sustainability impact may be constrained by local generation options.
- **On-site solar, including in microgrid setups:** On-site solar panels, often paired with storage, present a clean alternative to gas turbines where land area permits. Solar power can help data centres get online faster, either supplementing grid power, speeding connection times through demand flexibility (see below), or providing a full off-grid configuration (a “microgrid”). Microgrids can match the reliability standards of data centres if deployed in conjunction with backup generation in the form of either gas or long-duration energy storage (LDES).[14] Solar and storage economics are improving rapidly,[15] reaching cost parity with fossil fuels in many locations. On-site renewable energy generation can also help prepare data centres for anticipated regulatory changes, a particular concern in the EU. Solar panels may become a preferred option in areas with enough sun and land, if on-site power helps data centres to get online quickly and if the cost of storage continues to drop.

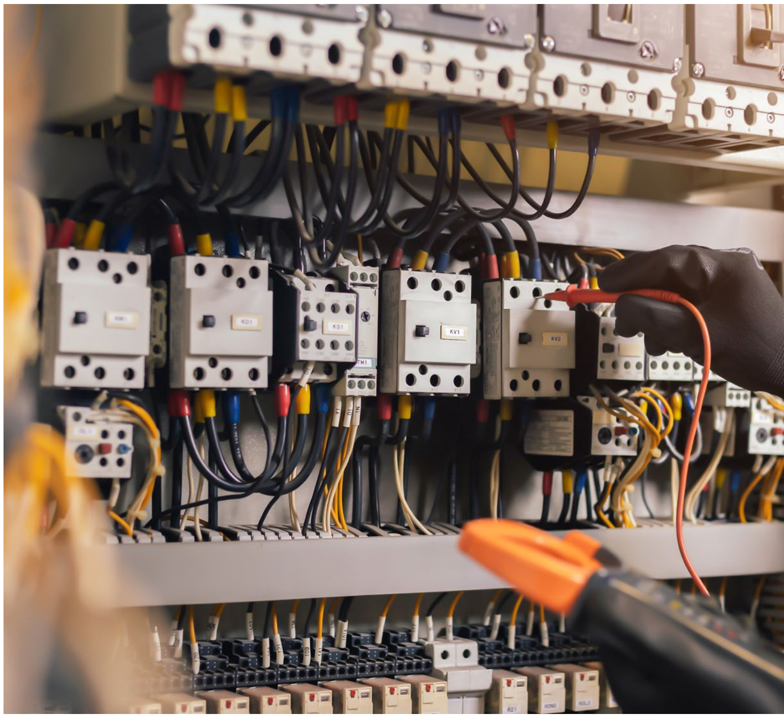
- **Microgrid-enabling technologies:** Not all investors will choose to bring microgrid (infrastructure) projects into their portfolios, but some might consider investing in enabling technologies such as software for smart grid management or modular solar and storage units. These solutions can speed access to power if they can make microgrid adoption easier for data centres.
- **Small Modular Reactors (SMRs):** SMRs are receiving significant investment attention due to their potential to provide reliable, non-emitting on-site power. The segment is commercially immature (TRL 6-7)[16] since SMRs are expensive and face long permitting processes, but they could be attractive longer-term bets. As with solar, provision of on-site, non-emitting power through SMRs could be attractive as regulatory environments evolve.
- **Demand response software:** An alternative approach for developers is to change their own demand profile. Some are exploring offering a degree of flexibility – agreeing to stop taking power from the grid during periods of high demand – in return for faster access. A recent study suggests that building just 2.1 hours of flexibility into new data centres could unlock nearly 100GW of grid capacity across the US.[17] Hyperscalers are experimenting with this approach,[18] though questions remain around feasibility and how agreements with utilities should be structured.[19] Software solutions can support demand response by helping data centres adjust their power consumption and shifting from grid to on-site or backup power, ensuring that reliability is maintained even when power is variable.

- **Short-Duration Energy Storage (SDES) (<8 hr duration):** Batteries are a critical underlying technology for clean power generation solutions. They speed access to power by increasing the reliability of on-site renewables, thereby unlocking this option for data centres. They also help with demand response, allowing data centres to stick to reliability and uptime requirements when they are not drawing power from the grid.
- **Long-Duration Energy Storage (LDES) (>8 hr duration):** If brought to commercial scale, LDES could be foundational in facilitating several of the above power options. For developers and operators, their immediate appeal lies in their ability to support demand flexibility and thereby provide faster access to power. In the longer term, they might provide clean backup power and help data centres avoid diesel generators, which are the primary backup power choice today but face increasing regulatory scrutiny. However, for this to happen, costs need to come down significantly. While many LDES configurations exist, lithium iron phosphate (LFP) and organic flow batteries are the most common in pilots, making them the most promising options as of now. Some kind of add-on energy storage solution (SDES or LDES) may become mandatory for data centres in the future as governments seek ways to ease pressure on grids.

IT EQUIPMENT AND COMPUTE

Much of the energy consumed by a data centre goes into chips and servers, which run compute, storage, and networking tasks. In the past, demand for increased compute was generally able to be met by increased IT equipment efficiencies, so data centre build-out was gradual rather than spiking to meet new needs. However, AI demand is upending this dynamic: compute demand is being met with a surge of new data centres, not just more efficient processing. New IT equipment solutions which process compute tasks more efficiently could, therefore, reduce the number of new data centres that are built.

- **Innovative semiconductor hardware tech:** Advanced multichip packaging and chip-level optical interconnects are among the innovations making semiconductors more efficient. These technologies are currently expensive and hard to source. Their ability to handle AI and HPC compute makes them a promising longer-term option for data centres.



- **Software for chip design:** Software can also be used to help identify more efficient chip designs. Efficiencies have clear financial and execution benefits: fewer chips and servers are required, avoiding supply chain delays and saving costs.

COOLING

Cooling systems in data centres prevent IT equipment from overheating. Traditionally, data centres require significant amounts of energy or water to do this, but new cooling solutions are emerging that are both energy- and water-efficient. These can improve operational performance and mitigate future risks such as droughts and local water stress.

- **Liquid cooling:** Liquid cooling includes both direct-to-chip and immersion technologies. Such technologies can reduce electricity use by 15-20% and water use by 30-45% compared to traditional air-cooling systems.[20] Crucially for developers and operators, liquid cooling is necessary to cool AI and HPC-focused components with higher power density. Costs for these solutions vary, but higher upfront prices can be offset by power and water savings down the line. Strong adoption of liquid cooling technologies is currently being driven by operational performance benefits, increased testing and confidence in their performance, and reasonable financial trade-offs.

- **Heat re-use:** An extremely efficient option for removing heat is heat re-use, which takes the 40-60°C heat produced by equipment and sells it for applications outside the data centre, such as district heating systems, generating revenue and reducing the load on on-site cooling infrastructure in the process. The main constraint to this approach is that developers must identify customers for the heat who are physically proximate. Currently, heat re-use is limited to geographies with a regulatory imperative (e.g., Germany). However, as AI drives power densities higher, data centres will start to produce higher-temperature heat which could be useful to a larger set of businesses. Regulation will also continue to drive demand. Heat re-use is a high-impact sustainable solution with growing financial and execution appeal.

POWER DISTRIBUTION

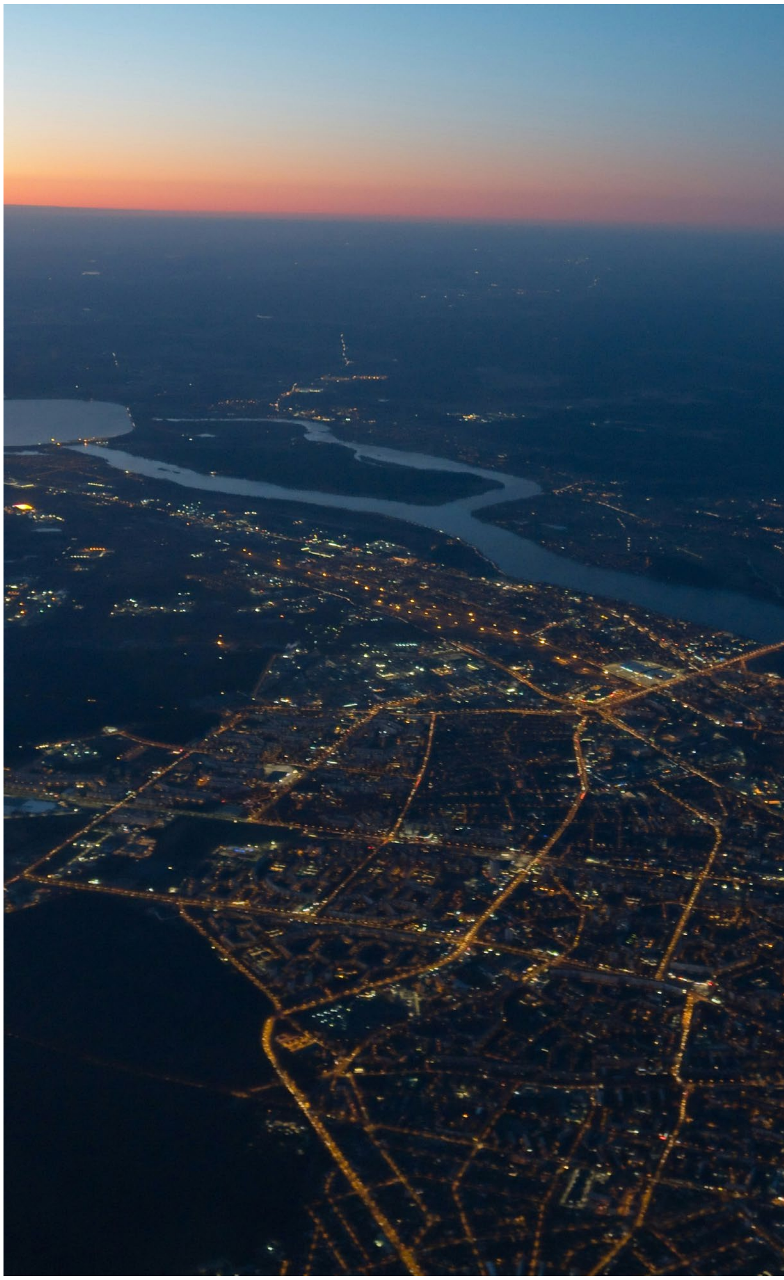
Power distribution systems ensure that electricity arrives at servers and components at the right voltage and prevent disruptions from power fluctuations.

- **High-voltage DC power distribution systems:** Some data centres are piloting higher-voltage direct current (DC) power systems. These drive energy efficiencies, reduce energy losses and physical footprint, and make it easier to deliver stable power to dense, variable workloads. In so doing, they increase reliability and equip data centres to better handle the operational complexity of AI and HPC. Higher-voltage systems are not yet at commercial scale, making components more difficult and costly to source. However, operational benefits could begin to outweigh these financial considerations as data centre power needs grow and loads become more variable.

INFRASTRUCTURE AND OPERATIONS MANAGEMENT

The IT equipment, cooling systems, and power distribution systems of a data centre can be managed centrally to optimise their resource use (energy and water) and satisfy other operational metrics.

- **Software solutions that drive system-wide efficiencies:** Given similarities in the data they collect and report on, Data Centre Infrastructure Management (DCIM) tools and solutions for tracking and reporting on sustainability metrics can be grouped together. Increased adoption of such software solutions is driven by their ability to drive down costs, anticipate sustainability tracking and accounting requirements, and better manage the complexity of AI and HPC hardware. They themselves benefit from the acceleration of AI, as demonstrated by a recent announcement of AI reducing operational inefficiencies in cooling systems to drive a 15% reduction in water use.[21]



MATERIALS

The use of low-carbon materials by data centre developers and operators is largely a function of hyperscaler demand; several hyperscaler Net Zero targets include Scope 3 embodied emissions reductions. Coupled with potential regulatory requirements for new builds, these pressures make the discovery and deployment of new materials and building approaches key to ensuring license to operate.

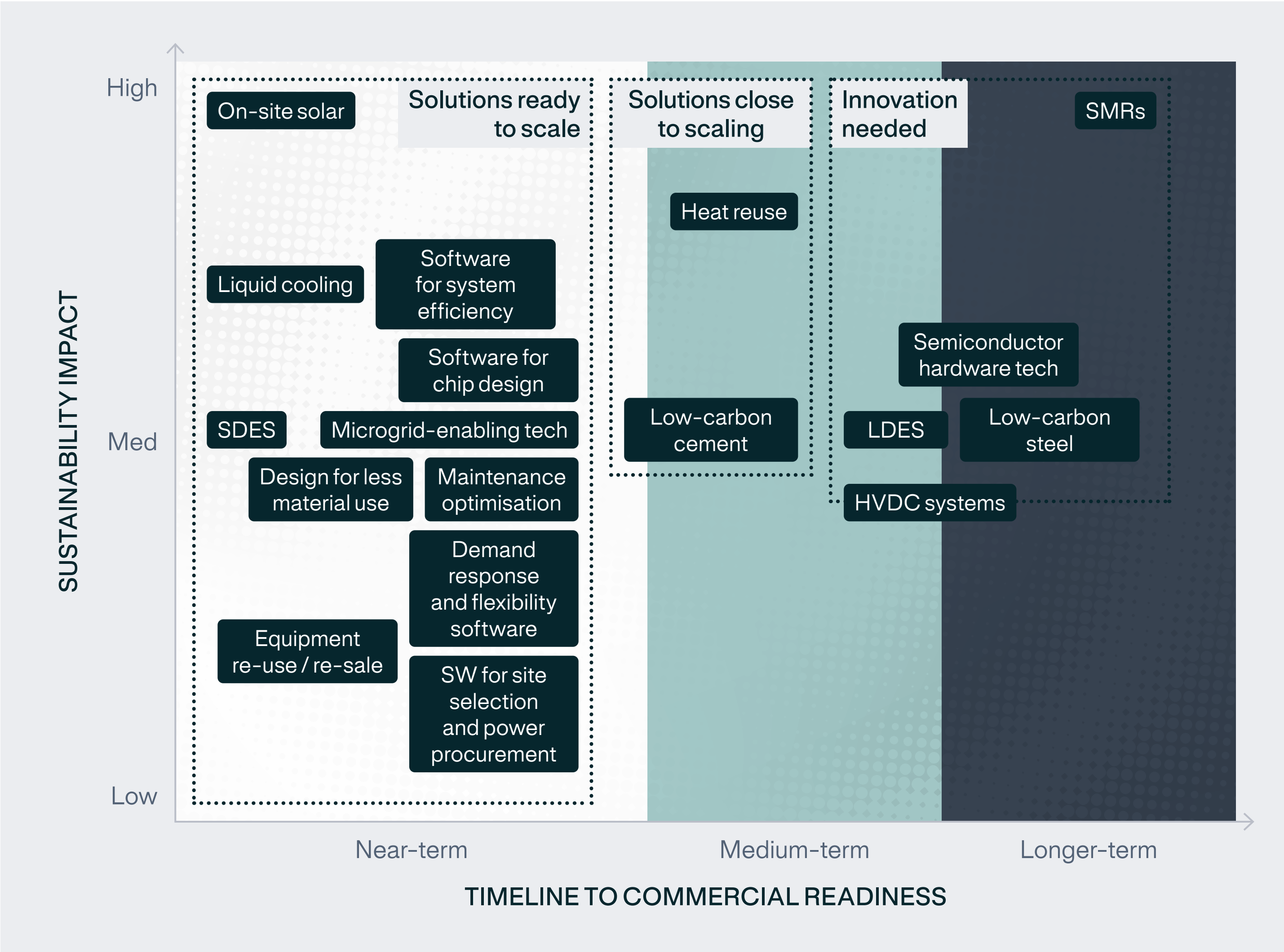
- **Low-carbon cement:** There is a broad landscape of solutions addressing the emissions intensity of cement, but none, as of now, have reached significant scale. With that being said, hyperscalers are currently driving several initiatives to scale these solutions. Solutions include clinker replacements, such as calcined clay, which can be cost-effective for developers but can also be hard to access quickly and therefore have the unwelcome potential to slow down new builds. Carbon capture, utilisation, and storage (CCUS) technologies are under development but remain expensive.
- **Low-carbon steel:** Low-carbon steel options remain nascent and expensive. The technologies with the most promise for scaling are direct reduced iron (DRI) and electrified steelmaking.

CONSTRUCTION AND EQUIPMENT

Various solutions are available to improve construction and equipment sustainability. Most align well with cost reduction goals, and some can also improve the speed of build-out.

- **Design for less material use:** Design software can minimise the space requirements of data centres and even provide options for retrofitting commercial buildings for data centre use. Specialised architecture and design companies also fit into this category.
- **Maintenance optimisation services and software:** Solutions that extend the lifetime of equipment have an outsized impact on embodied emissions[22] and drive clear cost reductions.
- **Equipment re-use and re-sale platforms:** Specialised data centre equipment, especially AI-enabled chips, is expensive and prone to supply chain delays. Reuse and resale platforms could help data centres to speed procurement and build-out while reducing costs.

Deploying Capital Where Technology is Ready to Scale



Source: Systemiq analysis[23]

In the short term, **solar, SDES batteries, microgrid-enabling tech, liquid cooling, software solutions, and construction or equipment-focused solutions** all present promising opportunities for investors to explore – as all also create meaningful financial benefits. Different solutions will be more or less attractive to different types of investors.

- We see **infrastructure yield plays** available for commercially proven solutions with stable returns: solar, batteries, and liquid cooling top this list.
- **Growth capital opportunities** lie in enabling technologies with accelerating adoption, especially software solutions such as DCIM, semiconductor or construction-focused design software, products targeting microgrid management and demand flexibility, or equipment re-sale marketplaces. General Atlantic BeyondNetZero is a growth equity fund exploring these opportunities – see below for our approach and select portfolio companies with sustainable data centre solutions.

- Certain investors might also explore **consolidation strategies** to help scale enabling services companies, such as maintenance optimisation specialists.
- For investors with more appetite for high-risk, high-reward bets, a few solutions present promising **venture opportunities**. Targeted LDES deployments that bring data centres online faster could justify high upfront costs and help scale adoption. High-voltage DC distribution systems need pilot deployments and testing before a broader range of data centres will be comfortable adopting them, but they could become a new standard for AI-optimised deployments. Innovative hardware technologies for semiconductors could take off, similarly to GPUs, given their fit for AI and HPC workloads. Likewise, continued testing and development of SMRs can help ease current permitting and technology challenges that drive up costs and hinder speed to deployment.

Some technologies are close to commercial maturity but need targeted actions to align financial incentives and overcome barriers to scale. For example, proven low-carbon cement options exist but face challenges to scaling due to upfront manufacturing investment requirements, perceptions in the market, and the absence of standards.[24] Developers can help bring low-carbon concrete solutions to scale by driving up demand via offtake agreements – which we are already beginning to see with hyperscalers.[25] Investors can also support the supply side through investment into novel low-carbon concrete manufacturing. The adoption of heat re-use solutions is slow and location-dependent today, with each new data centre project needing to identify local heat consumers, establish contracts with them, and figure out the best delivery method for heat. Establishing reference designs, expanding business models, and standardising contracts will all help with scale – the Net Zero Innovation Hub for Data Centres is a good reference point on this effort.[26]

General Atlantic (GA) BeyondNetZero is GA's dedicated climate growth equity fund with a team of experienced investors, advisors, and partners who identify and scale growth-stage companies whose products, platforms, or services support emissions reductions. These reductions contribute to decarbonization directly, through displacement of high-emitting alternatives, or indirectly by enabling others to decarbonize through better systems or data.

Portfolio companies providing solutions for sustainable data centres:

GRESB is a leading provider of sustainability data and benchmarks for real estate and infrastructure investments, representing approximately USD 9 trillion AUM[27] and enabling organizations to assess and improve their sustainability performance. GRESB is developing a new Data Centre Standard in partnership with iMasons / Climate Accord to address the sector's complexity and provide investors with actionable insights.[28] This instrument focuses on the most material issues facing institutional investors, including grid impacts, community engagement, energy efficiency, water conservation, and worker health and safety.

SDCL (Sustainable Development Capital LLP) is a specialist investor in energy efficiency and decentralized energy solutions. By funding and developing targeted infrastructure projects, SDCL aims to provide data centres with on-site generation, advanced cooling, and energy storage systems that can cut emissions, lower costs, and relieve pressure on strained grids.

Adapting Strategies to Regional Realities

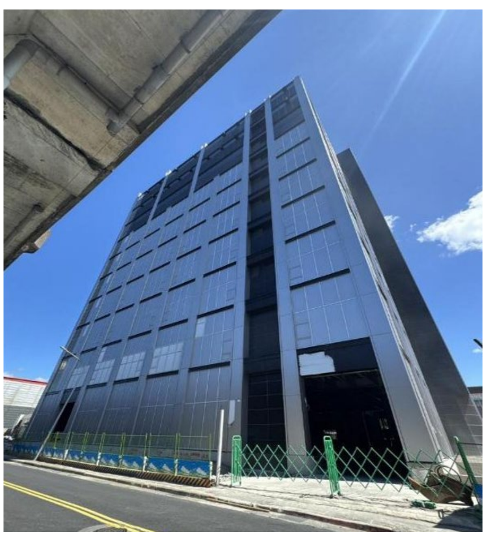
Data centres are not one-size-fits-all – geography, weather, energy supply, and local regulation all influence the viability and attractiveness of solutions in each location.

In **Europe**, renewable power generation options for data centres tend to be more extensive than in other regions. The reason for this is both geography (hydropower availability in the Nordics, for example) and the relatively higher cost of natural gas, which makes gas turbines a less attractive solution. Sustainability ambitions and increasingly constrained power systems are also pushing regulators to introduce reporting requirements and heat re-use minimums for new data centres. For example, the EU Energy Efficiency Directive (EED) will require data centres to report energy and water usage data and require larger campuses to re-use some heat. Germany has already put heat re-use requirements into place, and Ireland has proposed a policy requiring data centres to bring their own generation and storage. Investors in Europe may find alpha opportunities in *policy-pulled solutions* such as heat re-use, software for energy efficiency and sustainability tracking, and renewable power generation solutions.

The picture in the **US** is very different. At the federal level, support for renewable energy generation is being rolled back. Natural gas prices are much lower, meaning that developers are more likely to turn to gas than to renewables for power generation in the short term. US-based hyperscalers are, however, investing in medium and long-term generation options such as SMRs. Hyperscalers are also piloting sustainable technologies in self-owned environments before rolling them out globally. Regulation-backed solutions like heat re-use and sustainability tracking may not scale as easily in the US. But other power generation, energy efficiency, and embodied emissions-targeting solutions will benefit from the many large, AI-focused data centres being built in the US by hyperscalers who still prioritise environmental ambition. US investors can explore *hyperscaler and AI-driven opportunities*, including equipment upgrades and construction-focused solutions.

Markets outside of North America and Europe remain underserved. This can present a major opportunity for both tech investors and investors in developers and projects. Despite generating 70% of global GDP, geographies including APAC, the Middle East, and South America account for only 30% of global data centre capacity.[29] Provision per million internet users is starkly lower in Asia: 13MW in Japan and just 1MW in Thailand, versus 40MW in the US.[30] With young, digitally engaged, and growing populations, demand for data storage is accelerating rapidly across **Asia** and driving opportunities for sustainable data centre growth.

Investing in sustainable **Asian** data centres and related technologies requires deep local knowledge and a nuanced approach to sustainability, informed by energy mix and specific market dynamics. For instance, in Singapore, land scarcity and the tropical climate pose challenges for low-PUE designs. In archipelagic countries like the Philippines and Indonesia, site selection must carefully account for fragmented utility access and localised resource availability, with cooling systems designed for their warmer and more humid climates. Conversely, higher irradiation across Asia delivers solar plants with higher energy yields per unit area than a comparable solar plant in Europe. In fact, up to a third of ASEAN data centres could be powered by solar and wind.[31] The prevalence of colocation deployments across the wider Asia Pacific region further shapes the viability of sustainable innovations. Operators of retail colocation environments – who typically bear the energy costs – are more incentivised to invest in efficient systems that can improve margins and meet evolving customer expectations. Dynamics vary country-to-country, but in general, investors can pursue *capacity-gap opportunities* in underserved markets and drive solutions that favour efficiency upgrades, water-smart cooling, and renewable power where geography allows.



actis

Image sources: Actis

A recent urban data centre project developed by **Actis** in Taiwan is designed to navigate complex urban siting and power constraints and bring 23MW of capacity to the heart of Taipei. A thorough sustainability strategy brought together renewable power supply and a water-cooling system with rainwater harvesting to identify potential savings of up to 60 million kWh of electricity and 218,000 m^3 of water per year compared to more traditional designs.[32] Green landscaping at the site has the potential to create shade, reduce heat island effects, purify the air, and reduce noise pollution.

Conclusion: Choosing the Right Investment Pathway

The data centre sector is at an inflection point: indispensable to the digital economy, yet facing growing scrutiny for its power, water, and carbon footprint. Sustainability is becoming a determinant of competitiveness and long-term asset value.

This whitepaper has aimed to outline the growing landscape of sustainable data centre solutions, enabling investors to identify the most promising opportunities for their portfolios. We have also shown that each sustainable solution comes with its own set of risks, regional variations, and uncertainties. Investors can navigate a set of strategic options to map their path forward:

- **Shape or follow:** Decide where to lead by shaping early standards (e.g., around heat re-use, low-carbon construction) and where to wait for hyperscalers or regulators to set the pace.
- **Portfolio balance:** Determine the right balance of yield vs. growth in portfolios, looking to Europe for stable returns under clear policy frameworks, the US for scale with some technology risk, or Asia for rapid expansion.
- **Role in the ecosystem:** Choose how to partner with utilities, developers, operators, municipalities, and technology providers to bring value beyond direct capital investments.
- **Decode hyperscaler intent:** Unpack what hyperscalers truly want and anticipate how their choices will steer the solution landscape to pinpoint the technologies that will benefit.
- **Adjust based on scenario planning:** Stress-test portfolio allocations, exploring how geopolitical and demand shifts may impact the performance of sustainable solutions. For example, investors can test a base case of incremental efficiency gains, policy-driven improvements, and gradually growing grid strain against an *accelerated AI case* of acute grid bottlenecks and rapidly shifting operational needs.

The pace of compute demand ensures that data centre build-out will continue to drive capital. The real question is whether that expansion reinforces old risks or accelerates the transition to a more sustainable digital economy. Investors who get smart now, build conviction in solutions, and develop expertise in this evolving space will be best positioned to capture alpha and play a decisive role in shaping the sector's future.

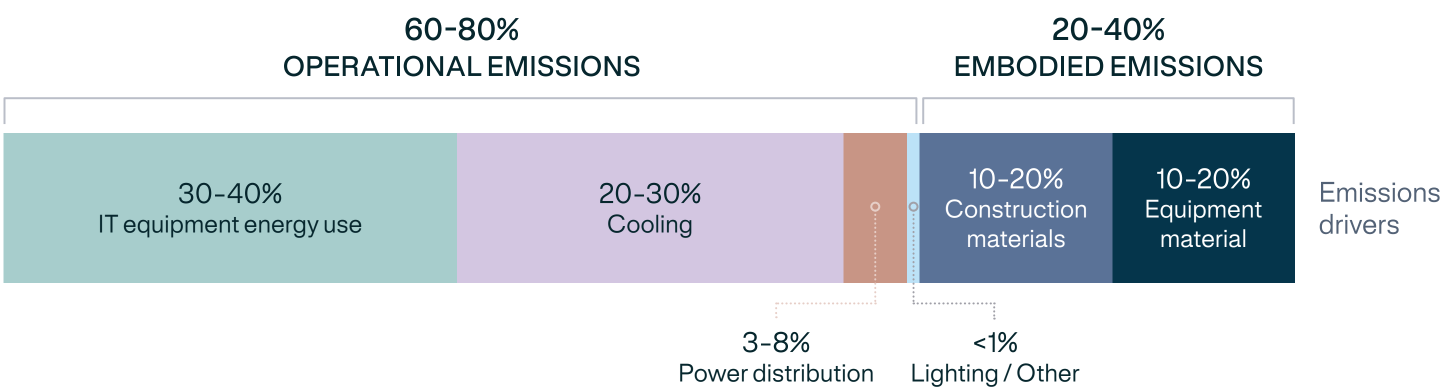
Appendix

ADDITIONAL CONTEXT ON SUSTAINABILITY IN DATA CENTRES

Data centre sustainability is a complex topic, but it can be understood on the following dimensions:

1. Lifecycle emissions: operational emissions from running a data centre and embodied emissions of construction and equipment materials. The split of operational and embodied emissions in a data centre depends on location and thus the carbon intensity of the energy supply. In a fossil-heavy US grid, the split might be 70/30 operational vs. embodied, while a data centre in Norway may see 90% of lifecycle emissions coming from embodied sources[33] – with fewer total emissions overall. **Lifecycle emissions are not consistently tracked or reported today** – in a 2024 survey, only 36% of respondents tracked scope 1 emissions, 27% tracked scope 2, and 18% tracked scope 3.[34]
2. Power usage: **Power Usage Effectiveness (PUE)** is the most widely used metric for tracking sustainability and indicates how efficiently a data centre uses energy.
3. Efficiency of water use: Water use is core to sustainability as large data centres can consume the same water per day as a town of 10,000 to 50,000 people.[35] **Water Usage Effectiveness (WUE)** measures how efficient a data centre's use of water resources is compared to the energy consumption of its IT equipment.
4. Other sustainability metrics: Complicating sustainability measurements are the wide variety of additional metrics used and the current fragmentation of industry standards. PUE and WUE remain dominant as reference metrics, but do not capture the full picture. Metrics like **renewable energy consumption** trends or **emissions and water use per MWh or unit of compute** offer richer insights but are inconsistently tracked and reported.

Despite complications in metrics and tracking, investors can roughly assess the sustainability impact of a given solution by looking at how much of the "pie" of emissions drivers it can address, as well as by understanding how much it helps to improve water use efficiency. While the split of emissions drivers varies widely, an average breakdown is as follows:[36]



About the Contributing Firms

For further discussion of the topics raised in this whitepaper, interested parties can connect with Systemiq's lead author, Amy Paterson, and General Atlantic's lead author, Cornelia Gomez. Additional contributors include Mattia Romani, Peter Hulshof, Sarah Chung, Michael Kast, and Isha Patel for Systemiq; Federico Apestegui, Sonia John, and Ade Okuwoga for BeyondNetZero, and James Magor and Michael Lau for Actis.

Systemiq is a systems change company that works with businesses, policymakers, investors, and civil society organisations to reimagine and reshape the systems that sit at the heart of society - energy, nature and food, materials, built-environment, and finance - to accelerate the shift to a more sustainable and inclusive economy. Founded in 2016, Systemiq is a certified B Corp, and has offices in Brazil, France, Germany, Indonesia, the Netherlands, the UK, and the USA. Find out more at www.systemiq.earth or via LinkedIn.

General Atlantic is a leading global investor with over four decades of experience providing capital and strategic support to more than 830 companies throughout its history. Founded in 1980, General Atlantic continues to be a dedicated partner to visionary founders and investors seeking to build dynamic businesses and create long-term value. The firm leverages its patient capital, operational expertise, and global platform to support a diversified investment platform spanning Growth Equity, Credit, Climate, and Infrastructure strategies. General Atlantic manages approximately $114 billion in assets under management, inclusive of all strategies, as of June 30, 2025, with more than 900 professionals in 20 countries across five regions. For more information on General Atlantic, please visit: www.generalatlantic.com.

BeyondNetZero is the climate growth equity fund of General Atlantic that invests in growth companies delivering innovative climate solutions that have the potential to meet and exceed net-zero emissions targets, with a focus on decarbonization, energy efficiency, resource conservation, and emissions management.

Actis is the Sustainable Infrastructure platform of General Atlantic and invests in structural themes that support long-term, equitable growth in defensive, critical infrastructure across energy transition, digitalization transition, and supply chain transformation. For more information on Actis, please visit www.act.is.

GRESB is a leading benchmark for sustainable real estate and infrastructure investments across the world, serving 150 financial institutions and investors worldwide. Established in 2009, our comprehensive and complementary datasets cover thousands of real assets investments, including real estate portfolios, infrastructure funds, and infrastructure assets through the annual GRESB assessments, collectively valued at USD 9 trillion. Our Asset Impact database includes indicators of 65,000+ companies and 300,000+ physical assets—representing +75% of global greenhouse gas emissions across 13 of the most carbon-intensive sectors. For more information, please visit www.gresb.com.

SDCL was established in 2007 and has a proven track record of financing and developing clean energy, energy efficiency, and decentralised energy infrastructure projects in the UK, Continental Europe, North America, and Asia. SDCL is headquartered in London and has an AUM of over $2.5 billion. The group and its investment vehicles also operate worldwide from offices in New York, Greenwich, Dublin, Hong Kong, and Singapore. SDCL is authorised and regulated in the UK by the Financial Conduct Authority. SDCL's Founder and CEO is Jonathan Maxwell, whose book, 'The Edge: how competition for resources is pushing the world, and its climate, to the brink, and what we can do about it' was published in 2023.

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