High Performance, Low Carbon

Designing the Next Generation of Sustainable Data Centres

KNAUF

Build on us.

Introduction

The data centre has become foundational infrastructure for the contemporary built environment, particularly given the expanding ecosystem of AI-driven applications. A 2025 report commissioned by the Clean Energy Finance Corporation (CEFC) and prepared by Baringa forecasts that data centres could account for up to 11% of Australia's total electricity consumption by 2035, up from approximately 1% today, with the sector projected to attract between $85 billion and $135 billion in investment and grow capacity fourfold within a decade.[1]

What distinguishes a data centre from almost every other building typology is the focus on operational performance. Where a commercial office is designed around human comfort, a data centre is designed around the continuous operation of server hardware. Thermal management, power delivery, security and redundancy are not secondary considerations; they define the brief.

The consequences for sustainability are significant. Cooling infrastructure alone can account for up to 40% of a facility's total energy consumption[2] and data centres operate at high load around the clock. Water consumption follows a similar pattern; evaporative cooling systems, widely used for their energy efficiency, can draw millions of litres annually from the public supply. Together, these demands place data centres among the most resource-intensive building types per square metre.

This paper is written for architects, interior designers and specifiers engaged in data centre projects in Australia. It examines the sustainability challenges specific to this building type, identifies the key design levers available to reduce environmental impact, and makes the case that material selection and design strategy are among the most practical and underutilised tools available to the project team.

"Thermal management, power delivery, security and redundancy are not secondary considerations; they define the brief."

Sustainability and data centres: Key challenges

Data centres are among the most carbon-intensive building types in the built environment, both at construction and across their operational lifetime. Mechanical, Electrical, and Plumbing (MEP) systems account for up to 60% of upfront embodied carbon in data centres, rising to approximately 90% of cumulative whole-of-life embodied carbon.[3] Structural elements carry additional carbon costs driven by heavy IT equipment and backup generation.

The operational carbon impact of these facilities is even more significant. Global electricity demand from data centres grew by 17% in 2025, far outpacing overall electricity demand growth of 3%, and the trajectory is steepening with AI adoption.[4] In Australia, AEMO estimates data centres consumed around 4 TWh in FY2025 (approximately 2.2% of total grid demand) with forecasts pointing to around 12 TWh by 2029–30 (equivalent to 6%).[5] Water consumption follows a similar curve, which is particularly concerning for Australian towns and cities that are likely to experience droughts.

The industry's response is gaining momentum, though Australia is still developing its framework relative to global peers. Many operators are underwriting renewable energy through power purchase agreements, and some are pursuing on-site generation and battery storage to reduce grid dependence. In addition, the GBCA has launched a Sustainable Data Centres program in partnership with Data Centres Australia, aimed at defining best-practice outcomes across design, construction and operation.[6] The program is intended to complement NABERS Energy for Data Centres, extending upstream into design-stage decisions, embodied carbon and broader ESG factors that operational benchmarking alone does not capture.[7]

Five ways data centres reduce environmental impact

Addressing the environmental impact of data centres requires action across multiple fronts. The most effective strategies target both the upfront carbon cost of construction and the ongoing resource demands of operation. The following summarises the primary areas where the sector is driving improvement.

Reducing embodied carbon through material specification
Specifying low-carbon materials, optimising design and pursuing adaptive reuse where feasible can collectively deliver significant reductions in a project's upfront carbon impact.

Improving operational efficiency through renewable energy integration
Pairing operational efficiency with renewable energy procurement through power purchase agreements or on-site generation is now standard practice for leading operators.

Waste heat recovery and precinct reuse
Every data centre generates substantial thermal output as a byproduct of continuous operation. Rather than rejecting this heat to the atmosphere, it can be redirected to adjacent facilities or urban energy networks. For example, at the 2024 Paris Olympics, surplus heat from Equinix data centres helped warm swimming pools.[8]

Water efficiency and recycled water systems
The Australian Government's expectations framework for data centre developers specifically calls for the use of non-potable water and circular water strategies, alongside transparent reporting of water usage and efficiency.[9]

Modular and prefabricated construction
Modular and prefabricated construction methods reduce on-site waste, improve quality control and support faster delivery. They also enable incremental capacity expansion without full-facility rebuilds. The latter is a relevant consideration given the pace at which AI infrastructure requirements are evolving.

High performance has a carbon cost

Data centres impose building performance requirements with no direct parallel in conventional commercial construction. The facility must operate continuously, maintain precise environmental conditions, and protect critical assets from physical and electronic threats. These demands shape every layer of the building and must be resolved alongside sustainability goals.

Key performance requirements include the following:

- Internal wall and ceiling systems must maintain structural and fire-resistance integrity under sustained thermal loads and potential flashover conditions.
- Compartmentalisation and penetration sealing must account for dense cable configurations and high-density racking.
- Security-sensitive and front-of-house areas may require ballistic-rated wall assemblies and blast-resistant glazing, particularly for government or financial sector tenants.

Battery rooms present the most complex design challenge. As operators shift from diesel backup toward lithium-ion energy storage systems to support renewable energy integration, the specification requirements for these spaces have intensified considerably. Lithium-ion batteries present a thermal runaway risk: an uncontrollable self-heating state that can exceed 300°C, producing toxic gases, smoke and fire. Conventional clean agent suppression systems are insufficient for this type of event because, while they reduce oxygen levels, the underlying chemical reaction continues regardless, and a fire that appears suppressed can re-ignite.

Battery rooms, therefore, require the following:

- Dedicated suppression strategies tailored to the installed battery chemistry.
- Early off-gas detection systems.
- Robust mechanical ventilation and explosion pressure relief.
- Structural compartmentalisation designed to contain, not just suppress, a runaway event.

The high-performance systems and materials needed to address these requirements typically carry significantly higher embodied carbon than standard commercial equivalents.

Addressing embodied carbon in data centre design

While the industry has made significant sustainability gains over the past decade, largely through improvements in operational efficiency, less attention has been paid to the environmental impact of building materials and construction itself.

Unlike operational carbon, which can be reduced incrementally over a building's life through efficiency upgrades and renewable energy procurement, embodied carbon is locked in at the point of construction and cannot be recovered. Addressing it early, through informed design and specification strategies, is one of the most impactful actions a design team can take.

Optimising design to reduce material impact

The most effective approach is proactive rather than reactive: design optimisation, beginning at the design stage and carried through every layer of the specification, allows the project team to reduce embodied carbon before it is committed. Design optimisation in practice means:

- Where possible, adapt existing infrastructure: reusing an existing building rather than constructing a new one can eliminate approximately 88% of the embodied carbon associated with a standard new build, according to industry reports.[10]
- Avoiding over-specification by aligning performance requirements with fit-for-purpose systems rather than defaulting to the highest-rated assembly.
- Rationalising structural grids and spatial layouts to reduce material quantities without compromising function.
- Selecting lightweight, high-performance systems that maintain required fire, acoustic and structural outcomes with less material mass.
- Designing for adaptability rather than obsolescence: buildings that can accommodate future IT loads without structural modification avoid carbon-intensive retrofits down the line.

Understanding data centre tier levels

Data centres are classified across four redundancy tiers: from Tier I (basic infrastructure with no redundancy) through to Tier IV (fully fault-tolerant with concurrent maintainability).[11] Each step up the tier scale introduces additional duplication of power paths, cooling infrastructure, distribution equipment and backup systems. This duplication is necessary where uptime obligations demand it, but it carries a direct and substantial embodied carbon cost.

Selecting the appropriate redundancy tier for the operational brief, rather than defaulting to the highest available, is a straightforward opportunity to reduce embodied carbon without compromising performance. Tier I and II configurations carry substantially less duplicated plant and infrastructure than Tier III or IV equivalents.

Material efficiency, circularity and dematerialisation

Interior wall and ceiling linings are among the most extensively applied systems in a data centre, and their cumulative embodied carbon impact is proportionally large. The key is selecting systems that balance durability with material efficiency; in high-demand environments, a system that degrades quickly and requires early replacement adds avoidable embodied carbon with every substitution cycle.

Circular design principles are also useful in this context. Designing for disassembly, specifying durable and recyclable systems, and planning for future retrofit rather than wholesale replacement are strategies that will grow in importance as whole-of-life carbon reporting requirements expand across the sector.

Multi-functional building systems that integrate fire resistance, acoustic separation, impact resistance and thermal performance into a single assembly reduce the need for additional layers and redundant materials. This “dematerialisation” approach, achieving equal or better performance with less, improves constructability, reduces on-site waste and aligns naturally with modular and prefabricated delivery methods.

Supply chain and verified life cycle data

Material selection in data centres should extend beyond product performance to account for whole-of-life carbon impacts, including manufacturing processes, transport distance and installation waste. Locally manufactured and responsibly sourced products reduce supply chain emissions and offer greater programme certainty.

Whole-of-life thinking should also inform how durability is weighted in the specification. A system with a lower upfront carbon footprint that requires replacement within ten years may carry a higher cumulative impact than a more robust alternative.

The role of sustainability certifications

Rating frameworks including Green Star, NABERS, LEED and BREEAM are increasingly shaping material and system selection in data centre projects. These tools incentivise low-carbon materials, responsible sourcing and lifecycle-based design. As client ESG requirements tighten, certification pathways are moving from optional to expected.

Low-carbon materials play a central role in achieving meaningful certification outcomes. Selecting systems with a verified Environmental Product Declaration (EPD), reduced Global Warming Potential (GWP), and responsible chain-of-custody sourcing directly contributes to credits across multiple rating categories. In data centres, where interior and structural systems are applied at significant scale, the aggregated impact of low-carbon material selection can be the difference between achieving a target sustainability rating and falling short.

Building data centres for the future with Knauf

The data centres being designed and built today will define a significant share of Australia's energy and carbon trajectory for decades to come. As the sector matures and sustainability frameworks tighten, architects and designers who understand how to navigate the intersection of performance, compliance and embodied carbon will be best positioned to deliver facilities that meet both the operational demands of clients and the environmental expectations of regulators and communities.

Material innovation is central to this shift. The transition away from single-purpose, high-carbon assemblies toward multi-functional systems that consolidate fire, acoustic, impact and moisture performance into a single product is already underway, and its implications for data centre specification are significant.

Knauf's portfolio directly addresses the performance complexity of these buildings. Multistop™ ONE combines fire, water, mould, sound and impact resistance in a single board, is GECA certified and holds Climate Active Carbon Neutral certification. This multi-functional plasterboard solution is a practical specification choice for data halls, circulation spaces and ancillary environments where multiple performance demands must be met efficiently.

Fiberock® Aqua-Tough™ drywall delivers fire resistance of up to two hours in wall systems, is classified as non-combustible and offers very high impact resistance. These performance properties are directly relevant to battery rooms, plant areas and high-security zones. Its paperless, homogenous core also resists moisture and mould, making it a durable long-term solution in the demanding thermal and humidity conditions where premature material degradation carries a high maintenance and carbon cost.

Knauf's insulation products similarly support whole-of-life thermal performance and contribute to Green Star credits through responsibly sourced, low-embodied-carbon formulations. Knauf has committed to reaching net-zero carbon by 2045 and publishes verified EPD data for its Australian-manufactured products. This level of transparency provides third-party carbon evidence that specifiers increasingly need for rating tool compliance and client ESG reporting.

As a trusted supplier to major Australian data centre operators, including NextDC, Knauf brings both global sustainability leadership and local manufacturing capability to projects where performance and carbon reduction must be resolved together.

"In data centres, where interior and structural systems are applied at significant scale, the aggregated impact of low-carbon material selection can be the difference between achieving a target sustainability rating and falling short."

References

[1] Clean Energy Finance Corporation. "Data centre boom to reshape Australia's energy future: CEFC – Baringa report." CEFC. https://www.cefc.com.au/media/media-release/data-centre-boom-to-reshape-australia-s-energy-future-cefc-baringa-report (accessed 29 April 2026).

[2] AIRAH. "Report forecasts skyrocketing energy use in Australian data centres." HVAC&R News. https://hvacrnews.com.au/news/report-forecasts-skyrocketing-energy-use-in-australian-data-centres (accessed 29 April 2026).

[3] Barnstone, Alexi. "The Next Frontier: Reducing Embodied Carbon in Data Centre Development." MECLA. https://mecla.org.au/wp-content/uploads/2026/04/MECLA-Report-on-Reducing-Embodied-Carbon-in-Data-Centre-Delivery.pdf (accessed 29 April 2026).

[4] International Energy Agency. "Data centre electricity use surged in 2025, even with tightening bottlenecks driving a scramble for solutions." IEA. https://www.iea.org/news/data-centre-electricity-use-surged-in-2025-even-with-tightening-bottlenecks-driving-a-scramble-for-solutions (accessed 29 April 2026).

[5] Australian Energy Market Operator. "AEMO's updated forecasting methodology targets rapidly growing electricity loads, following industry consultation." AEMO. https://www.aemo.com.au/newsroom/news-updates/aemos-updated-forecasting-methodology-targets-rapidly-growing-electricity-loads (accessed 29 April 2026).

[6] Green Building Council of Australia. "GBCA launches Sustainable Data Centres program." GBCA. https://new.gbca.org.au/news/gbca-media-releases/gbca-launches-sustainable-data-centres-program (accessed 29 April 2026).

[7] Dux, Simon. "GBCA partners with Data Centres Australia on sustainability framework." w-media. https://w.media/gbca-partners-with-data-centres-australia-on-sustainability-framework (accessed 29 April 2026).

[8] Colloide. "Harnessing Data Centre Waste Heat for District Heating Networks." Colloide. https://colloide.com/harnessing-data-centre-waste-heat-for-district-heating-networks (accessed 29 April 2026).

[9] Australian Government. "Expectations of data centres and AI infrastructure developers." Department of Industry, Science and Resources. https://www.industry.gov.au/publications/expectations-data-centres-and-ai-infrastructure-developers (accessed 29 April 2026).

[10] Bidinger, Mark. "Addressing the Hidden Challenge of Embodied Carbon in Data Centers." Schnieder Electric. https://blog.se.com/datacenter/2022/05/13/addressing-hidden-challenge-embodied-carbon-data-centers (accessed 29 April 2026).

[11] Uptime Institute. "Tier Classification System." Uptime Institute. https://uptimeinstitute.com/tiers (accessed 29 April 2026).

All information provided correct as of June 2026