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Powering Data Centres

ARE INTEGRATED UTILITY PRECINCTS THE ANSWER?

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Foreword

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The data centre sector is entering a period of accelerated complexity. What were once manageable constraints around power and water are now defining factors, as hyperscale expansion converges with AI-driven demand, 2030 decarbonisation targets, rising capital discipline and heightened public scrutiny. The challenge has shifted from securing capacity at any cost to delivering infrastructure that is efficient, resilient and socially sustainable.

Across global markets, these pressures are becoming increasingly visible. Operators are competing for access to renewable energy, firm grid capacity, reliable water sources and development-ready land. Ultra-dense AI workloads are intensifying demand profiles and compressing infrastructure tolerances, while connection lead times continue to extend and utility constraints harden. Governments and communities are applying greater scrutiny to water use, emissions, heat rejection and land impacts, reshaping both approval pathways and the long-term viability of new developments. Without a more integrated response, data centres risk being perceived as competitors for scarce resources rather than contributors to broader economic and environmental outcomes.

> *We see the next phase of global data centre growth shaped by how effectively they integrate with surrounding energy, water and community systems.*

Yet these challenges also create a strategic opportunity. With coordinated planning and shared infrastructure, data centres can act as anchors for more resilient and sustainable systems, catalysing investment in renewable energy, recycled water and utility infrastructure that serves both industry and surrounding communities. An integrated precinct approach shifts the focus beyond standalone facilities and situates data centres within a wider framework of infrastructure planning that reduces delivery risk, improves system efficiency and enables cross-sector value.

Drawing on our experience across more than 100 hyperscale projects in Asia-Pacific and six decades of delivering complex, interdependent infrastructure, we see the next phase of global data centre growth defined by how effectively data centres are integrated with surrounding energy, water and community systems. The decisions being made today will determine whether markets merely keep pace with demand or establish a benchmark for resilient, future-ready digital infrastructure.

The Integrated Utility Precinct Model

STUART CASSIE
Director & APAC
Data Centre Lead

Ultra-dense AI deployments are driving sharp increases in power, cooling and water demand. Higher rack densities, more intensive cooling requirements and longer operating profiles are materially changing load characteristics, placing greater pressure on energy and water systems than traditional data centre designs were built to accommodate. Accelerating AI adoption alone is projected to add between 4.2 and 6.6 billion cubic metres of global water withdrawals by 2027, equivalent to four to six times Denmark's annual water use[1], increasing scrutiny on how new capacity is planned and supplied.

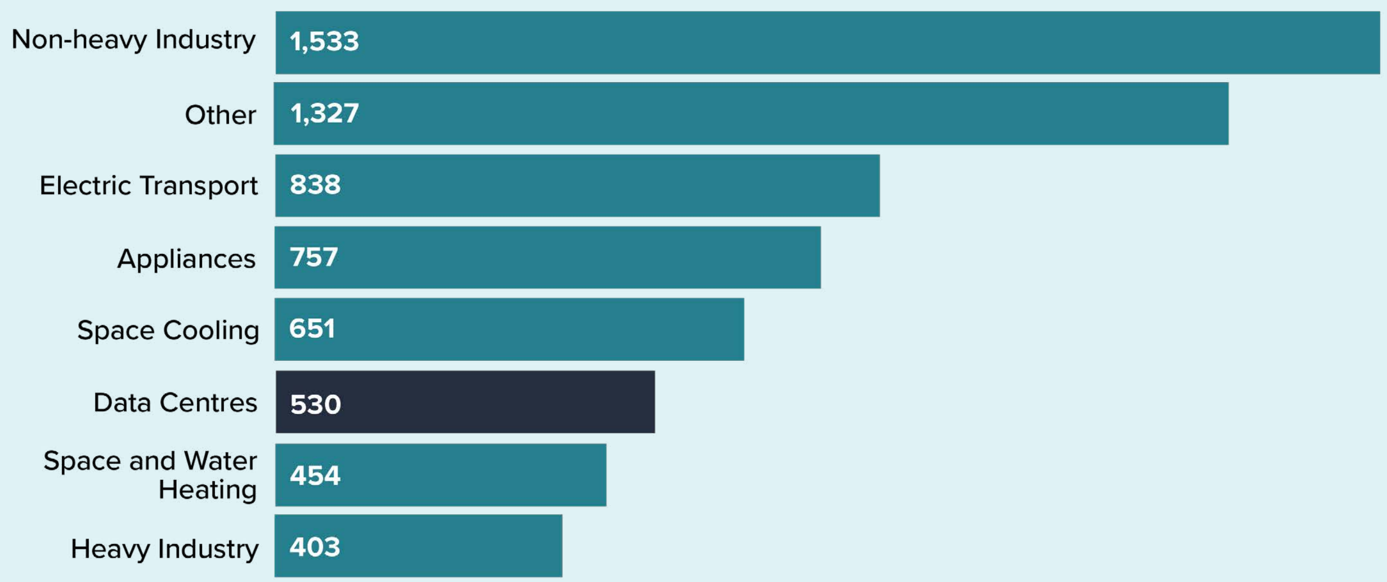
These changes are exposing limitations in the traditional standalone facility model. Approaches that rely on individual sites independently securing power, water and supporting infrastructure are becoming more exposed to longer connection timeframes, tighter planning conditions and increasing execution risk. Site-based solutions to redundancy and scalability are also under pressure as upstream network constraints become more pronounced.

In many markets, incremental expansion of standalone facilities is proving insufficient to meet AI-era requirements. The issue is no longer scale alone, but how capacity is integrated with energy, water and enabling infrastructure to improve resilience, manage resource demand and reduce delivery risk.

1. Li, Yang, Islam and Ren (Link)

Data centre electricity demand is expected to more than double to 945 TWh by 2030, driving around one-tenth of global power demand growth.

IEA projections of electricity demand growth between 2024 and 2030, TWh



Source: International Energy Agency (IEA) (Link)

An integrated utility precinct model responds directly to this shift. Planning energy, water, cooling and enabling infrastructure at a district scale enables data centres to operate as part of broader utility systems rather than as isolated loads. This enables coordinated infrastructure investment, improves efficiency and supports more predictable delivery in constrained environments.

Such an integrated utility approach offers not only a viable alternative, but a solution that can deliver mutual benefits to:

Operators

- Reduced capital and operating costs through shared infrastructure and lower-cost financing.
- Added potential to generate revenue by exporting surplus renewable energy or recycled water to the grid or local users.

Communities & Neighbours

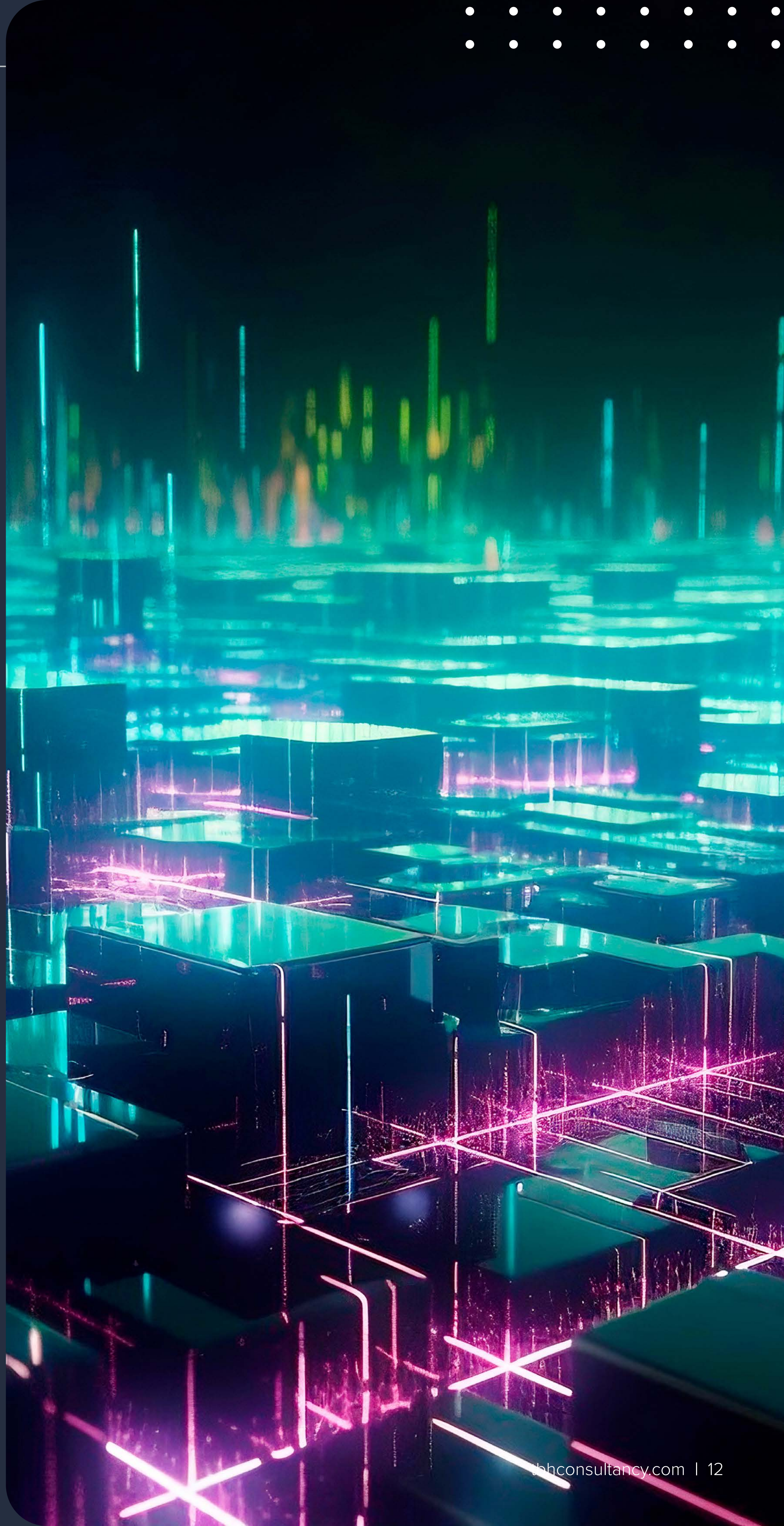
- Improved access to renewable energy, sustainable water supply, public amenities and digital infrastructure.
- Potential to harness waste heat as a resource.

Government

- Streamlined planning and approvals aligned with net-zero, circular economy and urban growth objectives.
- Reduced duplication of assets and reduced capital investment requirements.

Investors

- Stronger Environmental and Social Governance (ESG) performance, unlocking access to green finance and attracting premium tenants.
- More resilient and diversified revenue streams.



Core Elements

01 Shared Water Infrastructure

- Centralised precinct-scale treatment plants processing stormwater, greywater and municipal wastewater
- Closed-loop circular economy design to minimise potable water demand
- Built-in redundancy to ensure continuity of supply in peak demand or drought periods

02 Integrated Renewable Energy Generation and Storage

- Shared microgrids linking on-site solar, wind and battery storage to serve both operators and surrounding communities
- Co-funded rooftop solar programs for nearby industrial and residential users
- Battery storage systems to stabilise peak demand and reduce grid stress

03 Waste Heat Reuse and District Heating

- Capture and reuse of residual heat for nearby housing, industrial processes or agricultural applications
- Potential for district heating and cooling networks in high-density residential zones adjacent to precincts

04 Community and Transport Integration

- Integrated EV charging infrastructure within precinct design to serve both data centre operators and the public
- Physical and digital connectivity enhancements for surrounding areas, improving regional integration

05 Circular Economy Integration

- Resource recovery and reuse strategies for materials, water and energy within the precinct
- Closed-loop systems reducing environmental footprint and enhancing resilience

06 Resilience and Redundancy

- Shared systems providing redundancy in both power and water supply
- Improved business continuity for operators and service reliability for communities

Planning Reform

Future state and local planning frameworks are expected to play a central role in enabling integrated utility precincts. Embedding provisions and incentives for shared power, water and cooling infrastructure would align new data centre projects with long-term regional utility strategies. This approach reduces duplication, supports more efficient approvals, and provides clearer guidance for both developers and communities.

Co-Location of Critical Systems

For integrated precincts to function in a meaningful way, critical systems must be physically co-located. Renewable energy generation, storage, water treatment and digital infrastructure need to be planned as interconnected assets rather than separate projects. This will enable surplus electricity or treated water to flow back into local grids and communities, creating mutual benefits that extend beyond the data centre sector.

Public–Private Investment Models

Delivering shared infrastructure at scale will require joint investment models involving operators, government agencies and utilities. A coordinated approach will enable the delivery of large-scale assets, minimising delays and cost barriers, while also improving utilisation and ensuring benefits are distributed across multiple stakeholders.

Pathways to Implementation

Pathways to Implementation

Effective Management of Delivery Interfaces

Such interdependent delivery also introduces a high degree of interface risk. The timing of each element, including renewable generation, transmission links, water treatment and data centre readiness must align precisely. A delay in one component risks creating stranded capacity in another, which undermines investment certainty. Forward planning, coordinated procurement and sophisticated project management and controls are therefore central to reducing delivery risk and ensuring that precincts achieve their intended outcomes and return on investment.

Incentives for Early Movers

Targeted incentives can encourage early adoption of precinct-based approaches. These could include preferential access to green finance, targeted grant programs, zoning advantages and accelerated approvals for developments that align with precinct integration principles. Recognition programs could also highlight and reward facilities that achieve exceptional levels of community integration and operational efficiency, further raising industry benchmarks.

Performance Metrics Beyond Power Usage Effectiveness

While Power Usage Effectiveness (PUE) remains a core efficiency benchmark, the focus will need to shift toward broader indicators at the precinct level. Metrics covering water reuse, renewable generation, waste-heat utilisation and community energy supply can provide a more comprehensive view of sustainability. Transparent reporting of these outcomes is expected to become an increasingly important factor in securing approvals, financing and community support.

Regional Applications

Growing pressure on electricity networks, water systems and land availability is prompting a shift in how data centres are planned and integrated into their surrounding environments. Emerging regulatory adjustments around water sourcing, cooling technologies and power access are helping to manage near-term pressures, but stop short of enabling data centres to operate as shared infrastructure that delivers broader community benefits.

In markets facing water scarcity, grid constraints or concentrated industrial activity, an integrated precinct approach offers a more coordinated pathway for growth. District-scale planning can enable data centres to anchor shared energy and water systems, reduce competition for essential resources and support the emergence of new industrial zones or communities where conventional utility networks are limited. This model is adaptable to both mature and emerging markets and can be tailored to regional resource conditions.

Malaysia

Malaysia's data centre market is expanding rapidly, with Johor, Selangor and Penang emerging as key hubs serving Singapore and the wider region. This growth is occurring against increasing scrutiny of water consumption, particularly in Johor where large facilities draw on constrained municipal supplies. In response, the state has announced a halt on approvals for Tier 1 and Tier 2 developments and requires all new facilities to use reclaimed water.

In Johor, hyperscale operator AirTrunk has partnered with Johor Special Water (JSW), the state-owned industrial and bulk water supplier, to develop a large-scale recycled water supply for its data centre campuses. The initiative involves the joint development of treatment and delivery infrastructure to produce non-potable water for cooling, reducing reliance on municipal potable systems. This collaboration reflects a broader shift toward coordinated, precinct-scale utility planning in response to growing data centre demand and increasing pressure on regional water resources.

Application

An integrated utility precinct model would:

- Establish shared reclaimed-water loops serving data centres and adjacent industries;
- Reduce reliance on potable supply by shifting cooling to fully recycled sources;
- Enable states to pre-plan utility-ready industrial districts rather than assessing projects individually;
- Support new industrial clusters in areas where conventional water and power networks are constrained.

Saudi Arabia

Saudi Arabia is experiencing one of the world's most rapid expansions in digital infrastructure, driven by giga-projects, AI investment and national diversification initiatives under Vision 2030. These developments are unfolding in an environment shaped by arid climate conditions, high cooling requirements and fast-growing industrial demand, elevating the importance of reliable non-potable water sources and efficient utility planning. The Kingdom's extensive desalination capability and track record in large-scale infrastructure delivery provide a strong foundation for more coordinated, precinct-based development models.

National initiatives such as HUMAIN, aligned with Vision 2030's digital and AI ambitions, highlight the growing emphasis on energy-efficient computing, advanced cooling strategies and alignment with renewable-energy targets. Together, these priorities reinforce the case for precinct-level approaches that optimise both water and power resources for high-intensity digital infrastructure.

Application

An integrated utility precinct approach could:

- Coordinate desalination, recycled water and non-potable cooling into a unified system that supports digital-infrastructure growth while reducing pressure on municipal potable supplies;
- Underpin investment in shared wastewater-treatment facilities, expanding the supply of recycled, industrial-grade water for both data centres and adjacent industries;
- Extend recycled-water and energy infrastructure to neighbouring industrial areas, improving overall network efficiency;
- Co-locate renewables and storage using available land, supporting more flexible and secure power-supply arrangements;
- Enable new industrial clusters or remote development areas where extending traditional utility infrastructure would be cost-prohibitive.

United States

AI-related load growth is placing significant pressure on U.S. electricity and water systems, particularly in regions such as Arizona, Texas and Nevada, where long interconnection queues coincide with water scarcity. Many data centre hubs face restrictions on groundwater extraction and increasing scrutiny over evaporative cooling, prompting operators to adopt reclaimed-water systems or water-free cooling technologies. Interest in Small Modular Reactors (SMRs) and other forms of dedicated firm generation is accelerating, driven by the need for carbon-free, round-the-clock power independent of congested transmission networks.

In Arizona, Microsoft's Goodyear campus was initially designed to incorporate water-based cooling, but municipal wastewater systems lacked capacity for the associated discharge volumes, prompting a revised agreement in which Microsoft is contributing to the expansion of the city's 157th Avenue Wastewater Treatment Plant to secure long-term non-potable supply. Later phases of the project will use air-cooled designs, further reducing dependence on municipal water systems.

Application

An integrated utility precinct model would strengthen the viability and system value of these developments by:

- Co-locating SMRs, renewable generation and large-scale batteries to provide firm, round-the-clock power independent of congested transmission networks;
- Using data centres as stable baseload consumers to underwrite shared investment in new generation, recycled-water systems and supporting utility infrastructure;
- Creating district-scale non-potable water networks that reduce reliance on strained municipal supplies and support adjacent industrial users;
- Reducing reliance on major transmission upgrades through coordinated microgrid design and on-site firming capacity;
- Enabling new industrial districts or community hubs in regions where conventional utility extensions are too costly or slow to deliver.

Australia

Australia's emerging digital-infrastructure corridors are developing within an environment characterised by variable renewable generation, long transmission distances and localised water constraints. These conditions are particularly evident in Western Australia and the Northern Territory, where significant load growth is expected across mining, defence, hydrogen and digital infrastructure. In many regions, land availability is not the limiting factor; the sequencing and capacity of power and water infrastructure determines where large-scale data centre investment can be supported.

In the Northern Territory, SunCable's Australia-Asia PowerLink (AAPowerLink) proposes a multi-gigawatt solar and storage precinct north of Tennant Creek, designed to supply large industrial loads alongside potential hyperscale data centre developments. Its configuration – combining co-located generation, long-duration storage and transmission infrastructure – would provide a practical model for supporting digital-infrastructure growth in areas where traditional network extensions are not viable.

Application

An integrated utility precinct approach could:

- Co-develop renewable generation, storage and firming capacity with data centre loads, improving supply reliability in regions where transmission upgrades are lengthy or economically marginal;
- Enable precinct-scale recycled-water systems that reduce dependence on potable supplies and support co-located industrial users;
- Provide shared utility corridors for power and water, creating conditions for new manufacturing activity or emerging industries to cluster around anchor data centre assets;
- Support the establishment of new regional communities or industrial districts in locations where extending traditional utility networks is not feasible.

Singapore

Singapore remains one of Asia's most constrained data centre markets. A nationwide moratorium on new approvals was introduced in 2019 in response to concerns around energy intensity, land scarcity and carbon emissions. Although lifted in 2022, new developments must now meet significantly higher performance thresholds, including leading-edge PUE and WUE, elevated operating temperatures and strong alignment with national decarbonisation pathways. These constraints, combined with fixed land availability, are sharpening focus on district-level infrastructure and shared-resource models as a means of supporting future capacity growth.

Within this environment, Microsoft's SG2 incorporates rainwater harvesting and non-potable water for cooling, reducing reliance on potable supply in a dense urban setting. More broadly, Singapore's data centre sector is increasingly linked to national exploration of alternative clean-firm energy options, including assessment of advanced nuclear technologies such as Small Modular Reactors (SMRs), reflecting a coordinated approach to energy and water infrastructure for high-intensity users.

Application

An integrated utility precinct approach could:

- Pool non-potable water sourcing and treatment across multi-tenant clusters, reducing potable demand and supporting higher-density development;
- Coordinate renewable-energy procurement, firming and thermal-storage systems at district scale;
- Enable shared heat-recovery networks that redirect waste heat to nearby commercial or industrial users;
- Maximise limited land by concentrating high-efficiency data centres within planned industrial or redevelopment zones.

Japan

Japan's data centre market is undergoing accelerated expansion, particularly in Tokyo and Osaka, driven by AI workloads and cloud-region build-outs. These hubs face structural constraints: limited industrial-zoned land, long lead times for grid reinforcement, and dependence on regional water networks that must also service dense urban populations. Operators are increasingly looking to secondary regions such as Chiba, Saitama and Hokkaido, where renewable availability, land affordability and proximity to subsea cable routes provide alternative pathways for growth.

In Hokkaido, SAKURA Internet's Ishikari Data Center Campus leverages cold-climate conditions, abundant hydro and wind resources and proximity to industrial land parcels that support phased precinct-scale expansion. The campus has progressively integrated shared energy and cooling infrastructure optimised for cold climates, positioning it as a notably energy-efficient hyperscale development within Japan's data centre landscape.

Application

An integrated utility precinct approach in Japan would:

- Enable coordinated renewable-energy procurement, storage and cooling across multi-operator zones in secondary regions such as Hokkaido and Chiba;
- Reduce pressure on the Tokyo-Osaka grid corridor by co-locating new growth with high-capacity renewable generation;
- Support precinct-scale water reuse and air-side cooling strategies tailored to regional climate advantages;
- Create the foundation for new industrial districts anchored by digital infrastructure in areas where land and utilities are more readily expandable.

Thailand

Thailand is emerging as a major data centre growth market in Southeast Asia, supported by cloud infrastructure investment and regional expansion by AWS, Huawei and Google. The bulk of new development is concentrated in Bangkok's eastern and northern industrial corridors, where estate-scale power and water infrastructure has historically supported large manufacturing users. These zones are now experiencing rising competition for power capacity, limited substation headroom and increasing sensitivity around water availability during dry-season periods.

Recent hyperscale expansion, including ST Telemedia Global Data Centres' Bangkok campus developments, is increasing the concentration of high-density facilities within these utility corridors. Delivered as multi-building clusters with integrated power infrastructure, high-efficiency cooling and pathways for renewable-energy procurement, these campuses enable operators to scale while remaining within established network and land-use constraints.

Application

A precinct-scale model in Thailand would:

- Integrate data centre electricity and cooling requirements with established industrial-estate utilities, reducing duplication of infrastructure;
- Enable centralised recycled-water systems in regions affected by seasonal scarcity;
- Support clustering of hyperscale facilities near transmission staging points in the Eastern Economic Corridor (EEC);
- Align with national plans to expand high-tech industrial zones where power, water, logistics and digital infrastructure are planned in coordination.

India

India is one of the world's fastest-growing data centre markets, with major campuses under development in Mumbai, Chennai, Noida, Hyderabad and Navi Mumbai. Growth is being driven by new submarine cable landings, state-level incentive policies and accelerating AI demand. These hubs operate within resource environments shaped by seasonal water availability, summer stress on state electricity networks and increasing competition for suitable urban land.

In Navi Mumbai, large hyperscale developments by operators such as AdaniConneX, NTT and Reliance are prompting more coordinated utility planning. Multiple campuses connect to common 220 kV transmission substations developed by the state transmission utility, MSETCL, supported by high-voltage corridors designed to accommodate concentrated digital-infrastructure loads. Municipal authorities are also expanding access to tertiary-treated wastewater to reduce reliance on potable supply. Hyderabad is advancing similar measures, with long-term treated sewage effluent agreements and growing interest in integrated renewable and firming solutions to support high-density deployments.

Application

India's market conditions create strong applicability for integrated precincts that:

- Combine firm and renewable power procurement with shared substation and storage infrastructure;
- Develop non-potable water loops drawing on tertiary-treated municipal supply to reduce dependency on freshwater during peak-demand seasons;
- Align digital-infrastructure clustering with planned industrial corridors such as the Delhi–Mumbai Industrial Corridor (DMIC);
- Support new industrial ecosystems in tier-2/3 cities where utility networks are more expandable than in saturated city areas.

Indonesia

Indonesia is becoming a major expansion market for hyperscale and cloud providers, driven by domestic digital demand, new subsea cable landings and rapid development in Jakarta, Batam and Surabaya. Utility conditions vary widely across the country: Java faces increasing pressure on grid capacity and urban water systems, while outer-island locations offer greater land availability but require coordinated investment in power and water infrastructure. Indonesia's extensive geothermal resources and growing solar pipeline are also prompting interest in aligning data centre development with emerging clean-energy generation, rather than concentrating growth solely in already-constrained urban corridors.

In Batam's Nongsa Digital Park, data centre developments by operators such as Princeton Digital Group (PDG) and Keppel are progressing within a master-planned digital estate, where infrastructure coordination and sustainability measures are being explored at scale. In Greater Jakarta, hyperscale projects by PDG and NTT in the Bekasi-Cikarang corridor are increasingly structured around dedicated power infrastructure, access to non-potable water sources and alignment with Indonesia's expanding clean-energy supply, providing early elements of a precinct-style delivery model.

Application

An integrated utility precinct model in Indonesia would:

- Combine geothermal, solar and potential cross-border renewable supply into coordinated campus-level energy systems;
- Reduce reliance on local raw-water extraction by developing shared tertiary-treatment facilities serving both data centres and manufacturing estates;
- Create scalable digital-industrial districts in Batam and Cikarang where land availability aligns with multi-operator infrastructure planning;
- Strengthen long-term investment certainty in regions where standalone projects face water, grid and permitting constraints.

Conclusion and Strategic Outlook

The growth of digital infrastructure is placing increasing pressure on power networks, water systems and land availability across global markets. Many regions are already experiencing constraints that influence the pace and location of new development, and these pressures are likely to intensify as AI-driven demand continues to scale. Traditional, site-specific approaches are becoming less viable in environments where utilities are stretched and expansion pathways are uncertain.

Integrated utility precincts provide a framework for addressing these conditions. District-scale planning enables data centres to operate within shared energy and water systems, supporting investment in firm and renewable power, expanding access to recycled water and improving the efficiency of surrounding industrial uses. Where applied in the right locations, this model can also create opportunities for new development areas that would otherwise be limited by existing utility capacity.

Realising these benefits will depend on policy settings and investment structures that accommodate shared infrastructure and longer-term planning horizons. Regions that integrate precinct-scale thinking into their digital infrastructure strategies will be better equipped to manage resource constraints, reduce delivery risk and support sustained industry growth.

With the right planning frameworks and collaborative delivery models, integrated utility precincts can help shape a more resilient and sustainable foundation for the next generation of global data centre development.

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