

Towards 2050: Singapore's Digital- Industrial Future

Jurong Island as a Platform for Energy, Trust and Intelligence



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Singapore at an inflection point

Singapore operates the world's 6th largest refinery export hub and the 9th largest chemicals hub¹ - despite having no oil or gas reserves.

At the centre of this achievement is Jurong Island, home to over 100 global companies¹ and more than S\$60 billion² in accumulated investments. It underpins an Energy and Chemicals sector that employs over 27,000 workers¹ and generates more than S\$90 billion in value – a quarter of Singapore's manufacturing output³. Few advanced economies have achieved this level of industrial scale, concentration and resilience on such constrained land and resource foundations.

That success now marks a strategic junction. Today, digital infrastructure is becoming as essential as physical infrastructure, and the fundamentals that shaped the last era of industrial growth are being reshaped by global forces. Globally, countries are working towards 2050 net zero commitments while facing a sharp rise in electricity demand from AI-driven applications. By 2030, global electricity demand from data centres is projected to more than double to ~945 TWh – roughly equivalent to Japan's entire electricity consumption today⁴. The collision of a finite carbon budget and rising compute demand is exposing hard limits on how digital and industrial systems can scale.

¹ Ministry of Trade and Industry Singapore. (2025, November 24). Opening Address by Deputy Prime Minister and Minister for Trade and Industry Gan Kim Yong at the Jurong Island (JI) Anniversary Dinner. Retrieved from Ministry of Trade and Industry Singapore: <https://www.mti.gov.sg/newsroom/opening-address-by-deputy-prime-minister-and-minister-for-trade-and-industry-gan-kim-yong-at-the-jurong-island--ji--anniversary-dinner/>

² EDB Singapore. (2026). Energy & Chemicals. Retrieved from EDB Singapore: <https://www.edb.gov.sg/en/our-industries/energy-and-chemicals.html>

³ Department of Statistics Singapore. (2024). Total Output In Manufacturing By Industry. Retrieved from Department of Statistics Singapore: https://tablebuilder.singstat.gov.sg/table/TS/M354891?_sv_p_id=TAK17ESZKp4nE5iE

⁴ IEA (2025, April 10). AI is set to drive surging electricity demand from data centres while offering the potential to transform how the energy sector works. Retrieved from IEA: <https://www.iea.org/news/ai-is-set-to-drive-surging-electricity-demand-from-data-centres-while-offering-the-potential-to-transform-how-the-energy-sector-works>

What supported competitiveness in the industrial era will not determine success in the digital-industrial era. Future readiness now requires not more infrastructure, but a deliberate redesign for a low-carbon, AI-ready era. Singapore has begun addressing this challenge directly. In October 2025, it earmarked on Jurong Island close to 300 hectares for new energy systems, alongside ~20 hectares for the country's largest low-carbon, AI-ready data centre park, projected to host up to 700 MW of compute⁵.

This paper outlines the global forces reshaping digital infrastructure and introduces three mutually reinforcing pillars – circularity, data stewardship and national capability, to explore what the future of Jurong Island could look like. Together, these form a potential blueprint for Singapore and serve as a global reference point for the next industrial era.



Jurong Island reflects Singapore's approach to sustainable industry development. It brings energy-intensive operations like data centres into an established energy and chemicals ecosystem. This will allow companies to develop and access low-carbon technologies and sustainable solutions, to achieve both digital growth and decarbonisation goals.

Josephine Moh,
Senior Vice President and Head,
Energy & Renewables at EDB

Jurong Island's evolution from a traditional energy hub to a global innovation testbed demonstrates how strategic infrastructure can drive industrial transformation. With over 100 kilometres of integrated pipelines and 300 hectares dedicated to new energy solutions, the island enables companies to rapidly develop, test, and scale low-carbon technologies from pilot to commercial deployment.

Yeo Siok Leng,
Director,
Energy and Chemicals,
JTC



⁵ EDB Singapore (2025, October 27). Jurong Island celebrates 25 years with new focus on powering the future of low carbon innovation in Energy and Chemicals. Retrieved from EDB Singapore: <https://www.edb.gov.sg/en/about-edb/media-releases-publications/jurong-island-marks-twenty-five-years-of-low-carbon-innovation.html>



Global forces reshaping digital infrastructure

Singapore's transition mirrors a broad global realignment. Across advanced economies, governments are confronting the same set of constraints – tightening land availability, rising renewable energy demands and the growing urgency around data security. This section examines the global forces reshaping digital infrastructure and uses them to frame a long-term vision for how Jurong Island could evolve in response.

2.1 LAND SCARCITY AS A STRUCTURAL CONSTRAINT

Data centres are among the most land-intensive uses within dense urban and industrial environments. In Singapore, where developable land is exceptionally scarce and new greenfield development is tightly controlled, strong demand has translated into persistently tight capacity. As a result, land availability has become a defining factor shaping both the cost and feasibility of data centre development.

This reality forces policymakers to consider not only how much land digital infrastructure occupies, but also where it belongs and how effectively it advances national objectives. It also signals that future digital-industrial districts may require new spatial models that use land more efficiently, a direction that could shape Jurong Island's vision in 2050.

Globally, the issue isn't ambition – it's headroom. Digital infrastructure is hitting hard limits that are redefining what 'viable' looks like.



Michael Goh,
VP & GM (EMEA and APAC) at
Iron Mountain

2.2 ENERGY AND CARBON LIMITS UNDER AI-SCALE DEMAND

The rapid growth of data centre electricity demand is exerting increasing pressure on electricity systems. AI-scale power density is outpacing grid headroom while decarbonisation standards tighten. The IEA projects that AI-optimised data centre demand will more than quadruple by 2030⁴. Local grids in many regions are struggling to keep pace with this shift, turning energy availability and grid capacity into structural constraints for digital growth.

Yet even as energy constraints tighten, digital infrastructure plays a growing role in the global energy transition. Data centres can serve as offtakers for low-carbon generation, helping to underwrite new capacity, anchor PPAs and accelerate the deployment of cleaner power systems. In this way, digital infrastructure sits on both sides of the environmental equation: intensifying near-term pressure while enabling decarbonisation. These tensions contribute to Jurong Island's 2050 vision, which explores clean energy systems and circularity.

Reaching Net Zero by 2050 requires more than just consuming clean power – it requires building entirely new energy economies. Singapore is unparalleled in offering the reliable environment needed to make this leap, and the transformation of Jurong Island is proof of that smart, clean energy future.



Martijn Van Wijngaarden,
Director of Global Energy Solutions at
Iron Mountain

2.3 DATA SECURITY AS THE FOUNDATION FOR AI ADOPTION

Digital infrastructure underpins key industries and national security. Yet confidence in how AI should be governed, tested and deployed is lagging its technical acceleration, creating a widening gap between capability and trust in an increasingly complex and uncertain operating environment.

As AI shifts from prompt-based tools to agentic, enterprise-grade systems, the cost of failure rises sharply. Cyberattacks, misconfiguration, silent data corruption and opaque model behaviour now carry national-level consequences.

Securing data today demands far more than cybersecurity. It requires clarity over data locality, physical security, verifiable chain-of-custody and the ability to understand decisions over long time horizons. Most existing infrastructure was built for speed, not stewardship. Jurong Island's 2050 architecture responds to this need through a layered model of Protection, Persistence and Preservation, proposed in this paper as a way to think about how data infrastructure can be engineered for endurance, governance and long-term confidence.





Towards 2050: the Jurong Island ecosystem

Against this backdrop of global constraints, Jurong Island offers Singapore a unique platform to redesign for the next industrial era – not only for data centres, but also for manufacturing and innovation.

Today, the Energy and Chemicals cluster on Jurong Island is already evolving. Companies are moving into specialty chemicals and biofuels which have a lower carbon footprint than traditional refineries and crackers. At the same time, new low-carbon technology initiatives are also emerging – the A*STAR's ISCE² for example, will provide a national test bedding facility for companies to test and validate emerging low-carbon technology under industrial conditions⁶. Together, these developments signal Jurong Island's shift to a more sustainable global hub.

As these shifts deepen, the ecosystem will continue to evolve towards the long-term vision that follows.

By 2050, Jurong Island could become a global blueprint for decarbonising complex industries while supporting high-density compute within tight land and carbon limits. What was once a dense, emissions-intensive zone transforms into a clean, resilient and innovative ecosystem which reinforces national priorities.

This evolution, which requires coordinated transition over decades, is not defined by a single technology, but by three mutually reinforcing attributes:

- **Circularity:** Designing shared energy and asset systems that reduce emissions while sustaining AI-scale growth.
- **Data:** Ensuring critical data can be preserved, recovered and trusted over decades.
- **National Capability:** Anchoring high-value, non-offshorable roles where infrastructure, governance and risk converge.

⁶ EDB Singapore. (2025, November 17). How Singapore's Jurong Island is powering the future of low-carbon innovation in Energy and Chemicals. Retrieved from EDB Singapore: <https://www.edb.gov.sg/en/business-insights/insights/how-singapores-jurong-island-is-powering-the-future-of-low-carbon-innovation-in-energy-and-chemicals.html>

3.1 DATA CENTRES AS ENABLERS OF CIRCULAR, LOW-CARBON GROWTH

THE FUTURE OF JURONG ISLAND Integrated Cold Energy Ecosystem

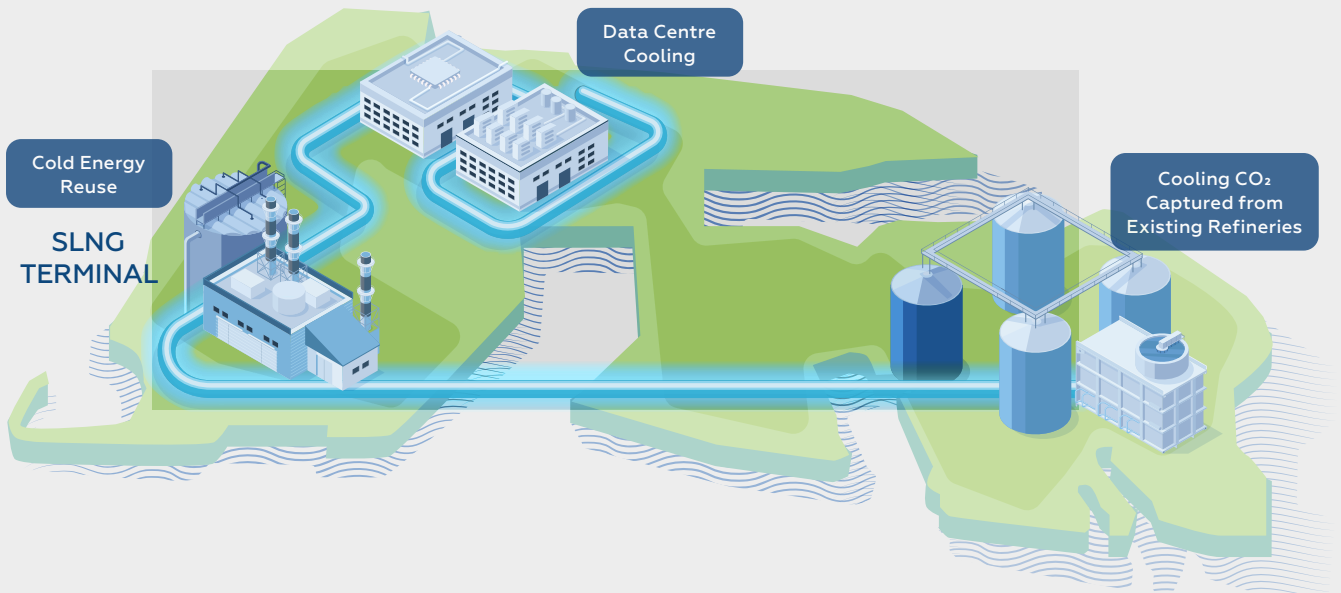


Figure 1 – Visual of a Circular Jurong Island

As Jurong Island looks toward 2050, circularity becomes central to how a constrained industrial system can remain competitive and resilient over decades. The following sections build on the Jurong Island Circular Economy (JICE) study⁷ and explore three illustrative examples of how circularity can be applied as Jurong Island evolves.

The cold energy released from LNG regasification can be efficiently utilised for data centre cooling, cold storage for pharmaceuticals and food, and CO₂ liquefaction for carbon capture - making Jurong Island a strategic hub for a high impact circular economy.



Leong Wei Hung,
CEO of Singapore LNG Corporation
(SLNG)

⁷ JTC. (2021, August 19). 51 companies including Chevron, ExxonMobil and Shell jointly support industry-first circular economy study by JTC to optimise resource use as Jurong Island transforms into a sustainable energy and chemicals park. Retrieved from JTC: <https://www.jtc.gov.sg/about-jtc/news-and-stories/press-releases/51-companies-jointly-support-industry-first-circular-economy-study-by-jtc-to-optimise-resource-use>

From Fossil Fuels to Low-Carbon Fuels

The future Jurong Island draws on a coordinated suite of low-carbon energy pathways. Hydrogen, ammonia and biomethane provide firm, resilient power for industrial loads and AI-class compute. This shift is already taking shape on Jurong Island, with partnerships such as the Aster-Air Liquide MOU to produce low-carbon hydrogen⁸ and Keppel’s ammonia pathfinder project for power generation and bunkering⁶. Together, these fuels phase out the island’s carbon-intensive identity and establish a foundation for the future.

From Waste to Resource

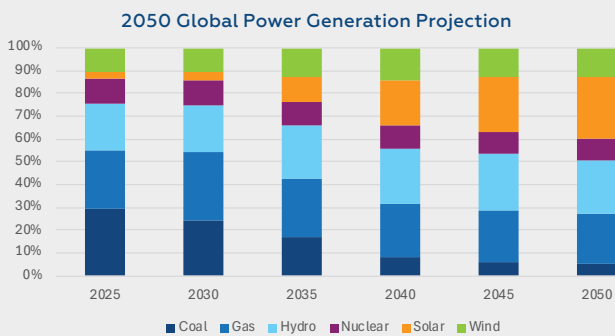


Figure 2 – Baringa’s 2050 Climate Base Case highlighting renewable transition

Baringa’s Climate Base Case⁹ indicates that even as economies reduce coal reliance, gas would continue to play a critical role by providing reliable, dispatchable power that supports grid stability while renewable capacity continues to scale. In 2050, Jurong Island could be one of the few places turning this transition dynamic into an advantage.

LNG arriving at the Singapore LNG Corporation’s (SLNG) terminal at -161°C is warmed to -20°C using sea water, in the regasification process. This vast temperature differential or “cold energy” becomes one of the island’s most strategic assets.

For data centres, the chilled sea water provides a stable, low-carbon cooling source that reduces electricity demand and supports higher-density compute. At the same time, the same infrastructure releases enough cold energy to support carbon management efforts by petrochemical operators on the island, who harness it to liquify CO_2 captured from production processes for utilisation in other industries, locally or overseas, or sequestration. In this way, digital and industrial systems draw from a common utility backbone, with efficiencies in one reinforcing sustainability outcomes in the other.

This cold energy is further integrated with cold energy battery technology developed by Professor Alessandro Romagnoli and his research group at Nanyang Technological University (NTU) to store thermal capacity and smooth cooling demand across the estate.

Examples of these efforts are already in motion, such as the JTC and Keppel partnership that studies the thermal network systems to minimise energy use for cooling energy-intensive facilities such as data centres⁸. Together, these initiatives unlock practical pathways for cross-industry energy efficiency and support a cleaner, more efficient Jurong Island.

Industrial circularity is achieved when energy streams are reused and optimised across sectors through a multi-energy systems approach. Jurong Island demonstrates how thermodynamic integration at estate scale can deliver sustainability, resilience and long-term economic value.



Prof. Alessandro Romagnoli
Nanyang Technological University, Singapore

⁸ JTC. (2025, November 24). Jurong Island celebrates 25 years with new industry partnerships to accelerate low-carbon innovation. Retrieved from JTC: <https://www.jtc.gov.sg/about-jtc/news-and-stories/press-releases/jurong-island-celebrates-25-years-with-new-industry-partnerships-to-accelerate-low-carbon-innovation>

⁹ Baringa. (2023). Climate Base Case Analysis. Retrieved from Baringa: <https://www.baringa.com/en/insights/climate-change-sustainability/climate-risk/climate-base-case-analysis/>

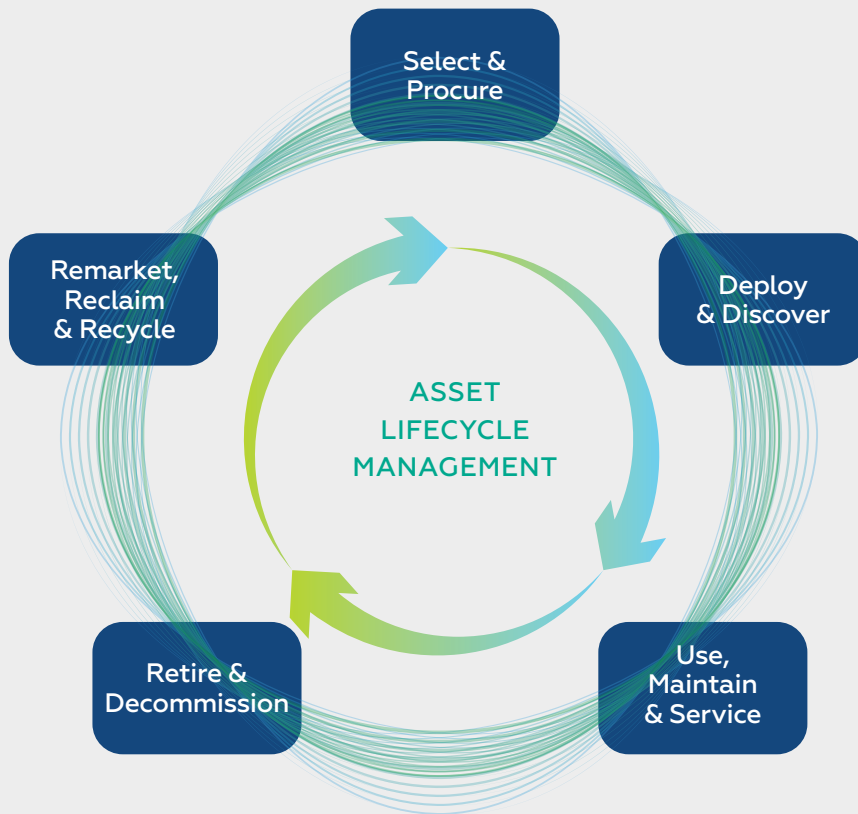


Figure 3 – New economic value can be generated from end-of-life digital equipment

From Landfill to Economic Value

In 2050, Jurong Island could anchor one of Asia’s most advanced digital asset lifecycle ecosystems, transforming what was once treated as end-of-life waste into a strategic resource.

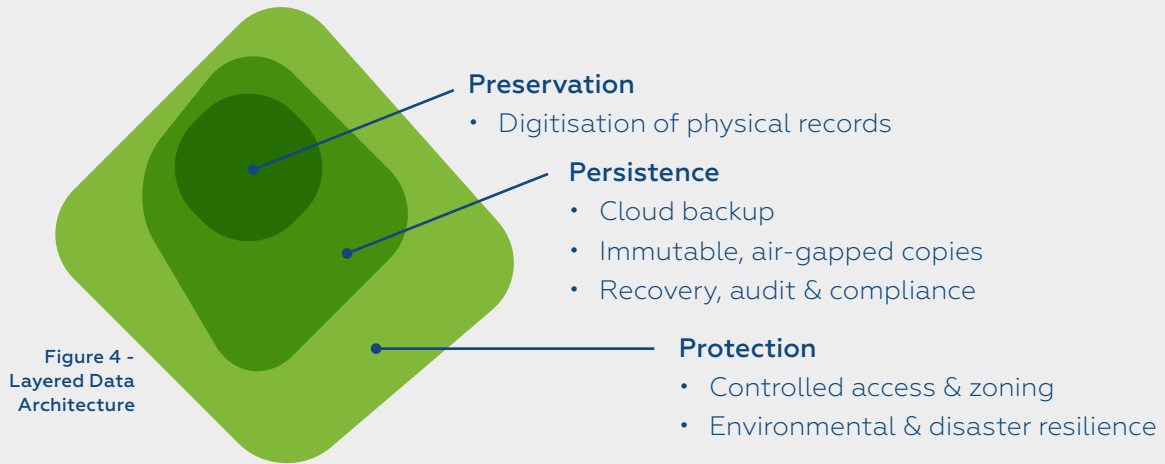
Decommissioned materials are recovered rather than discarded, and refurbished components circulate seamlessly through regional supply chains as part of the island’s established operating model. This creates new revenue streams, reduces import dependencies and reinforces Singapore’s standing as Asia’s hub for circular economy services. In this future, circularity is no longer a sustainability measure; it is a pillar of economic strength, technological leadership and regional competitiveness.

The future of IT hardware is circular - driving resilience and value across global supply chains. As the #1 ALM provider in North America and #2 worldwide, we see a \$30 billion opportunity across Asia Pacific. Singapore’s Jurong Island is the gateway to what we believe will become Asia’s first fully integrated IT asset lifecycle ecosystem.



Ming Yow,
Regional VP and MD Commercial (APAC) at Iron Mountain

3.2 AI SECURITY AND THE CRITICAL PLAYERS TO SAFEGUARD DATA



Singapore has already laid important foundations for a trusted digital economy through initiatives under the Smart Nation, alongside frameworks such as the Cybersecurity Act 2018 and the Model AI Governance Framework. These initiatives accelerate digitisation and aim to enhance cyber resilience and confidence in AI.

Building on these, Jurong Island in 2050 can see data centres evolving from compliance-based operators into leaders that actively shape how national digital and AI priorities are implemented.

The role is grounded in three principles, forming the foundation built not for peak performance alone, but for confidence over decades:

- **Preservation:** Keeping yesterday's data relevant for tomorrow's decisions
- **Persistence:** Continuity through disruption, not best effort recovery
- **Protection:** Securing high-value digital and AI assets through design

Preservation: Keeping Yesterday's Data Relevant for Tomorrow's Decisions



Figure 5 – Iron Mountain supported The GRAMMY Museum with physical and digital storage for its one-of-a-kind archive¹⁹

By 2050, Jurong Island could serve as Asia's data vault, where physical records are digitised, standardised and governed in ways that preserve their integrity while increasing its usefulness. Digitised information becomes durable, searchable and interoperable – forming baselines for analytics, automation and AI training. For organisations, this unlocks tangible financial value through better insights, faster innovation and more responsible AI adoption.

Preservation, therefore, is not simply about storage; it is about keeping institutional knowledge intact and usable as technologies, datasets and systems evolve.

¹⁹ Iron Mountain. (2024, December 18). The GRAMMY Museum®. Retrieved from Iron Mountain: <https://resources.ironmountain.com/case-studies/t/the-grammy-museum>

Persistence: Continuity Through Disruption, not Best Effort Recovery

The world's most valuable resource is no longer oil, but data, according to the Economist¹¹. By 2050, data on Jurong Island could sit in immutable, air-gapped and verifiable recovery environments, making restoration a built-in capability rather than a best effort attempt.

The need is clear – ransomware affects most large organisations. According to a 2024 Sophos survey, 94% of organisations hit by ransomware reported attempts by cybercriminals to compromise their backups¹². In an AI-driven economy, such loss erodes not only data, but the foundation for analytics, automation and AI enabled innovation.

Persistence addresses this fragility by shifting focus from preventing disruption to ensuring recovery; keeping essential datasets intact, accessible and verifiable even under severe disruptions.

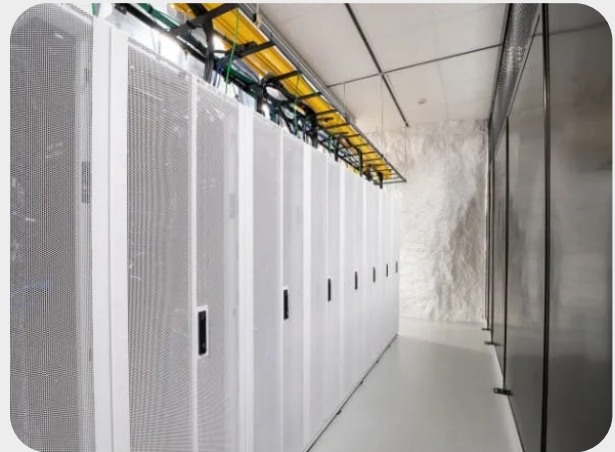


Figure 6 – Underground lake surrounding Iron Mountain's underground data centre at Western Pennsylvania¹³

Protection: Securing High-Value Digital and AI Assets Through Design

As countries reexamine how to secure critical digital infrastructure and preserve scarce surface land, some have begun exploring unconventional approaches including underground data centres. Geological separation materially reduces exposure to surface-level disruption, including extreme weather, electromagnetic disturbance and physical interference. In this sense, security is achieved passively through design, rather than continual escalation of perimeter defences or reactive intervention.

Figure 7 – Photo of Iron Mountain's underground data centre at Western Pennsylvania¹³



95% of the Fortune 1000 companies come to us to unlock the value from what's already within reach - from preserving Reuters' at-risk tapes from its global news bureaus to enabling AI training at biotech firms through digitisation of pathology slides.

Eric Goh,
Commercial Director (EMEA & APAC) at
Iron Mountain



¹¹ The Economist. (2017, May 6). The world's most valuable resource is no longer oil, but data. Retrieved from the Economist: <https://www.economist.com/leaders/2017/05/06/the-worlds-most-valuable-resource-is-no-longer-oil-but-data>

¹² Sophos. (2024, March). The Impact Of Compromised Backups On Ransomware Outcomes. Retrieved from Sophos: <https://assets.sophos.com/X24WTUEQ/at/539j6fwcmx6wk6whnhxc47/sophos-the-impact-of-compromised-backups-on-ransomware-outcomes-wp.pdf>

¹³ Iron Mountain. (2026). Retrieved from Iron Mountain: <https://www.ironmountain.com/data-centers/locations/pennsylvania-data-center>

3.3 THE MULTIPLIER FOR ECONOMIC IMPACT

By 2050, Jurong Island could become a centre of high-skill, non-offshorable roles, extending beyond the 27,000 jobs anchored by today's Energy and Chemicals cluster. As industries decarbonise and AI becomes embedded in operations, capability growth emerges across three fronts: direct, indirect and ecosystem jobs.

Direct Job Creation Tied to Governance and Custodianship

As Singapore evolves to be a premier global AI hub, the roles within data centres will expand beyond traditional operator roles. Data centre operators start to develop teams specialising in roles such as data governance and cybersecurity. These roles cannot be outsourced because their risks and responsibilities are inseparable from the infrastructure itself.

Indirect Job Creation from Industries that Follow Credibility

The concentration of governance and custodianship capabilities further strengthens Singapore's institutional credibility. Governance intensive workflows and regional leadership functions increasingly locate themselves in Singapore where continuity, defensibility and assurance are structurally embedded.

The migration of organisations in turn supports a wide range of professional and technical services, such as consulting and data migration specialists. What begins as a clustering of operational teams matures into a broader migration of roles; a shift driven not by incentives, but by the advantages of operating from a stable, high confidence environment.

Jurong Island's transformation is a regional pathfinder for "low-carbon compute". Its integrated model of low-carbon fuels and circular energy systems provides the necessary backbone for sustainable AI development, which will generate many interesting financing opportunities for banks.

Mike Ng,
Group Chief Sustainability Officer,
OCBC



Ecosystem Job Creation: An Economy Built Around Data-Driven Activities


Beyond direct and indirect employment, a broader ecosystem emerges. The concentration of data and compute infrastructure creates favourable conditions for data-driven activities. Companies start to develop AI models and advanced analytics, supporting roles such as data scientists, AI engineers and product developers. While such activities are not restricted to the location of data storage, the proximity of data, infrastructure and enterprises strengthens Singapore's position as a hub for data-driven innovation.

This is where the true multiplier effect appears. Each role embedded within the island's digital fabric generates several more roles. The result is a self-reinforcing ecosystem tuned to the needs of organisations operating in highly regulated, data-intensive sectors.

Industrial ecosystems work best when every resource is connected – energy, data and infrastructure. The opportunity lies in turning these flows into intelligent systems that continuously optimise efficiency and sustainability.

Ernst Westendorp,
CCO, Flo Energy





A blueprint for the next industrial century

Jurong Island has always been a place where Singapore tests what the future of industry can look like. But today, the island stands at a far larger turning point – one shared by advanced economies worldwide. As demand for compute accelerates, as decarbonisation narrows the margin for error, and as data becomes a core economic input, the question facing nations is no longer how to expand infrastructure, but how to redesign it.

Across this white paper, a pattern emerges. Jurong Island does not treat land, energy, carbon and data as separate challenges to be solved independently. It treats them as a single design space, a system where circularity, stewardship and capability reinforce one another over decades. This is what distinguishes Jurong Island: the willingness to address global constraints structurally, not incrementally.



The result is an industrial ecosystem built for endurance:

- A circular and clean energy integrated system strengthens resilience while improving environmental quality.
- A sovereign enclave that protects, preserves and governs the region's most sensitive information.
- A platform for intelligence that attracts high-skill, non-offshorable jobs and anchors decision-making roles for global firms.

In combining these elements, Jurong Island becomes more than an industrial estate. It becomes a national capability.

For countries grappling with the same pressures, Jurong Island offers a reference point for what is possible. It shows how constrained economies can lead, not follow.

Singapore has long been the first to build what others only begin to imagine. With Jurong Island's next chapter, it sets the terms for the world's next industrial paradigm and offers a blueprint for nations designing infrastructure for the years ahead.

The industries of the future will require a more innovative, system-level approach – connecting energy, digital infrastructure, carbon and capital into one coherent platform. Singapore is demonstrating what that future looks like. The next step is to translate this vision into investable pathways that can reshape industrial ecosystems worldwide.



Darren Yong,
Partner at Baringa



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