Green Computing Breakthrough in a Hot and Humid Climate[1]

Exploring the Green and Low-Carbon Transition of the NTT Jakarta 3 Data Center in Indonesia

Abstract: Indonesia is the largest economy in Southeast Asia, and the rapid development of its digital economy has driven a surge in demand for digital infrastructure. In 2026, NTT DATA Group completed and began operating the NTT Jakarta 3 Data Center in the Bekasi–Cikarang industrial corridor east of Jakarta, making it one of the largest data centers in Indonesia. Facing a hot and humid tropical climate and Indonesia's coal-dominated power system, the data center has developed three core practices. First, systematic planning: it connects to the national grid through two power plants and redundant feeders, ensuring a reliable energy supply at the source. Second, technological innovation: it uses a cooling wall design and an N+1 water-cooling system that can handle the heat dissipation of high-density computing loads of 15 kW per rack, reducing cooling energy consumption by about 20% compared with conventional solutions while optimizing both water and electricity use. Third, energy efficiency upgrades combined with renewable energy: in line with NTT DATA's NET-ZERO Vision 2040, it is advancing data center decarbonization and laying out its future decarbonization pathway. This case offers a practical reference for developing countries with conventional power systems seeking to build highly energy-efficient data centers and decarbonize their entire supply chains.

Keywords: data center; green and low-carbon; tropical cooling; energy efficiency optimization; renewable energy

I. Background

Over the past decade, Indonesia's digital economy, including mobile networks, e-commerce, fintech and cloud services, has grown rapidly, driving a surge in demand for high-availability data center rack capacity in and around Jakarta. Indonesia's information and communication technology (ICT) market was valued at about USD 43.8 billion in 2024 and is projected to reach USD 164.1 billion by 2033[2]. Within this, the digital economy could grow two- to fourfold, with its contribution to gross domestic product (GDP) rising from about 4% to more than 18%[3]. However, these opportunities come with serious energy challenges. Data centers are among the most energy-intensive asset classes in

[1] Case provided by CCICED Special Policy Study on *Pathways to Advance Global Cooperation on Green Development*

[2] U.S. Department of Commerce. Indonesia Country Commercial Guide: Information and Telecommunications Technology [EB/OL]. (2025-11-17)[2026-08-07]. https://www.trade.gov/country-commercial-guides/indonesia-information-and-telecommunications-technology

[3] PT Telkom Indonesia. Deputy Minister of BUMN Supports Telkom Group's Optimistic Steps to Become the Biggest Player in the Data Center Business in the Region [EB/OL]. (2023-10-16)[2026-08-07]. https://www.telkom.co.id/sites/news-resources/en_US/news/deputy-minister-of-bumn-supports-telkomgroup's-optimistic-steps-to-become-the-biggest-player-in-the-data-center-business-in-the-region-2151; Business-Indonesia. AI to Shape Indonesia's Digital Economy as It Moves Toward USD 180 Billion [EB/OL]. (2025-11-27)[2026-08-07]. https://business-indonesia.org/news/ai-to-shape-indonesia-s-digital-economy-as-it-moves-toward-usd-180-billion-2030

commercial real estate. Balancing the growing demand for digital services with the need to cut carbon emissions has become a serious challenge for the country.

Indonesia's data center market has very strong prospects, with demand growing much faster than planned capacity. By 2030, Indonesia's planned data center capacity is projected to reach 3.56 GW, while demand may exceed 4.5 GW, leaving a capacity gap of about 1 GW[4]. Against this backdrop, the NTT Jakarta 3 Data Center (hereinafter "the data center"), announced in 2019, is one of the largest data centers in Indonesia and is expected to become a flagship project for aligning digital development with sustainable development in Indonesia.

The data center represents a total investment of about USD 500 million, with 18,000 m² of planned IT space and 45.6 MW of IT power capacity at full load. It provides colocation and cloud services that meet NTT's global Nexcenter standards, benchmarked against world-class levels of security, availability and energy efficiency[5]. The site avoids the congested urban core, and the industrial estate is served by a dedicated high-capacity substation of PT PLN (Persero), Indonesia's state-owned electricity company, capable of meeting the high power demands of AI computing. The data center's overall design has received LEED v4 Silver certification from the U.S. Green Building Council (USGBC)[6].

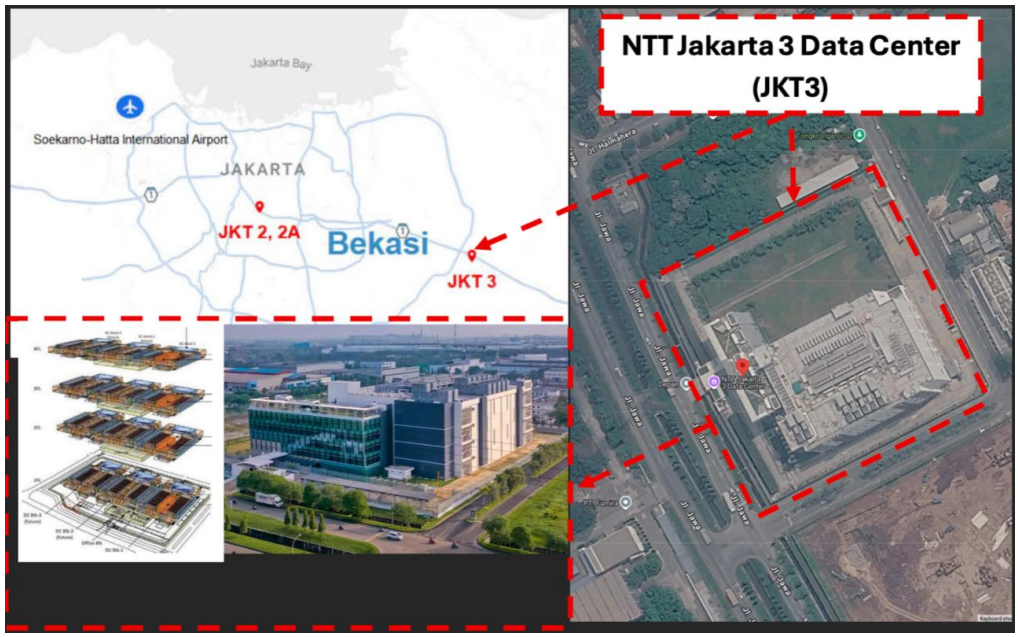


Figure 1. NTT Jakarta 3 location and building rendering[7]

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[4] Arizton Advisory & Intelligence. Indonesia Data Center Market - Investment Analysis & Growth Opportunities 2025-2030 [EB/OL]. (2025-04)[2026-08-07]. https://www.arizton.com/market-reports/indonesia-data-center-market-analysis-2025; Jan Yong. Indonesia Expects 1GW Data Center Shortfall by 2030: Report [EB/OL]. (2026-05-06)[2026-08-07]. https://w.media/indonesia-expects-1gw-data-center-shortfall-by-2030-report/

[5] NTT Global Data Centers. Jakarta Data Center Brochure [EB/OL]. [2026-08-09]. https://services.global.ntt/en-us/pdf-viewer/e24e4eed-04db-445d-aed4-cc65724e0eda

[6] NTT Global Data Centers. Jakarta 3 Data Center Datasheet [EB/OL]. [2026-08-09]. https://services.global.ntt/en-US/pdf-viewer/5BC7B7C8-27BB-4636-ACC7-7266C110559E

[7] DataCenterMap. GDC - Jakarta 3 Data Center [EB/OL]. [2026-08-09]. https://www.datacentermap.com/indonesia/jakarta/ntt-jakarta-3/; NTT Global Data Centers. Jakarta 3 Data Center [EB/OL]. [2026-08-09]. https://services.global.ntt/en-us/services-and-products/global-data-centers/global-locations/asia-pacific/jakarta-3-data-center

Table 1. NTT Jakarta 3 key technical parameters

Key Parameter	Details
Facility Location	MM2100 Industrial Town, Jl. Jawa No. 31, Gandamekar, Cikarang Barat, 17530, West Java
Total IT Space	18,000 m² (up to 7,800 racks at full build-out)
Total IT Load Capacity	45.6 MW (15.2 MW/building)
Power Supply Architecture & Redundancy	Two power supplies via fully independent physical routes: – Dedicated power circuit for data center IT equipment – Separate power circuit for air-conditioning, security and communications equipment
UPS and Backup Generation	N+1 uninterruptible power supply (UPS), avoiding downtime from single-equipment failure N+1 diesel generator backup power system
Cooling System	N+1 water-cooling system with NTT's proprietary cooling wall modules
Rack Density	Up to 15 kW per rack for high-density computing; standard provision of 6 kVA or more per rack Up to 7,800 racks at full capacity
Physical Security	24/7 on-site security, biometric access control, anti-tailgating system, PIN verification, 3-meter anti-climb perimeter fence
Certifications	USGBC LEED v4 Silver, ISO 27001, Threat and Vulnerability Risk Assessment (TVRA), Uptime Institute Tier III TCDD, PCI-DSS, Tier IV-ready, Renewable Energy Certificates (RECs)

Source: NTT official website

II. Key Measures

(1) Systematic planning to avoid energy risks at the source

To address an unstable power supply, the data center's power system is designed with an N+1 redundant architecture and is supplied by two power plants over two fully independent routes, ensuring uninterrupted power. Its power sources include the PLN grid, which is dominated by coal-fired generation supplemented by natural gas and hydropower, with the share of installed renewable capacity rising slowly, in line with Indonesia's national plan for power sector decarbonization[8]. Assuming optimal operating conditions in 2025 and a power usage effectiveness (PUE) of 1.3 (benchmarked against the upper limit in China's green data center standards), the campus's total annual electricity consumption is estimated at about 512 GWh[9]. Given this scale of energy use, the data center's energy efficiency measures and future decarbonization pathway will have a material impact on Indonesia's overall carbon emissions. Every improvement in cooling efficiency, power distribution, server utilization and operational PUE can significantly reduce the facility's overall electricity consumption and, in turn, the carbon emissions generated by Indonesia's coal-dominated power system. Building on its robust power infrastructure and redundant design, the project can also pilot various renewable energy procurement options in the future.

(2) Technological innovation to tackle the energy burden of tropical cooling

The biggest operational and environmental challenge for data centers in Southeast Asia is managing heat dissipation from high-density computing equipment in a hot and humid tropical

[8] DC Hub. NTT DATA's Global Data Centers Division NTT Jakarta 3 Data Center (JKT3) [EB/OL]. [2026-08-07]. https://dchub.cloud/facilities/ntt-data-s-global-data-centers-division-ntt-jakarta-3-data-center-jkt3-bf025829

[9] Anonymous. A Long Road Ahead: A Review of the State of Knowledge of the Environmental Effects of Digitization [EB/OL]. [2026-08-09]. https://shs.hal.science/halshs-05219705v1/file/adpr2025bp-environmental-impact-digitalization.pdf

climate. Conventional raised-floor air-cooling systems rely on delivering large volumes of cold air, which wastes a great deal of cooling energy in hot and humid conditions. High ambient temperatures shorten the hours available for free air cooling, and high humidity requires careful design to prevent condensation on equipment[10]. To address this, the data center uses a proprietary cooling wall system and an advanced water-cooling architecture, effectively overcoming the low energy efficiency of conventional cooling solutions.

Cooling is a core focus of the data center's design. The cooling wall solution developed by NTT Group combines low energy consumption with low cost and can support high-density computing loads of about 15 kW per rack. The project's entire water-cooling system uses an N+1 redundant architecture, with at least one backup unit for both the chillers and the indirect evaporative cooling equipment. This meets Tier IV-ready high-reliability standards and suits the tropical climate of the Asia-Pacific region.

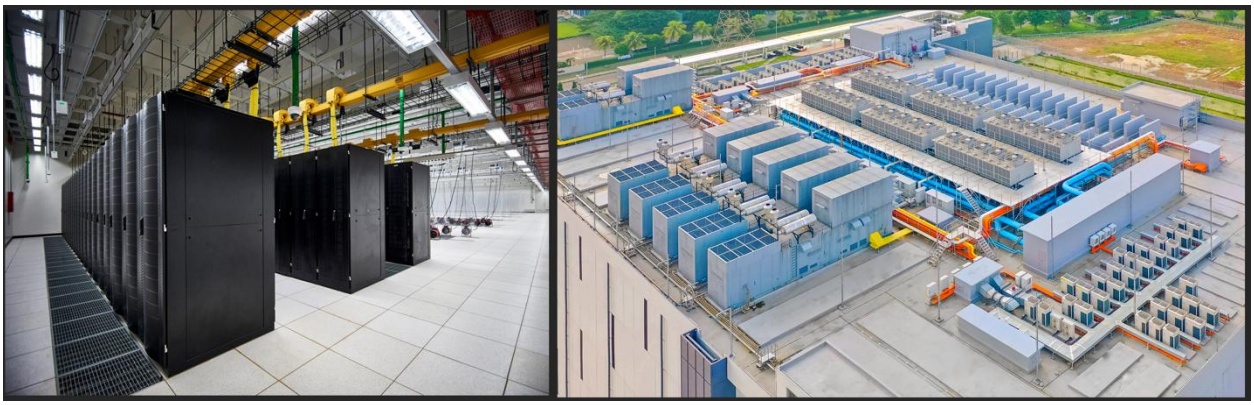


Figure 2. Data hall racks and rooftop cooling system at NTT Jakarta 3

Source: NTT[11]

(3) Combining energy efficiency upgrades with renewable energy to chart a future decarbonization pathway

Given Indonesia's coal-based energy resources, the data center initially relies mainly on improving building energy efficiency to reduce emissions. Measures include adopting advanced cooling systems, expanding capacity in modular phases to avoid redundant installed capacity, using high-efficiency uninterruptible power supply (UPS) and power distribution systems, and continuously optimizing operating temperatures and airflow in the data halls.

From an energy efficiency perspective, the combination of the cooling wall and the N+1 water-cooling system is the project's core advantage. In tropical data centers, cooling accounts for 37–45% of total non-IT energy consumption, and engineering designs that optimize heat-transfer efficiency and enable precise temperature control can substantially lower PUE[12].

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[10] University of Hawai'i at Mānoa. Rising Heat, Humidity Threatens Cheaper AI Data Center Cooling Methods [EB/OL]. (2026-07-13)[2026-08-09]. https://www.hawaii.edu/news/2026/07/13/ai-data-center-cooling/; Ertürk M, Keçebaş A. Cooling Degree Hour-Based Optimization of Air-Side Free and Partial Free Cooling Strategies for Mediterranean Buildings [J/OL]. International Journal of Refrigeration, 2025, 178: 227-242. [2026-08-09]. https://www.sciencedirect.com/science/article/abs/pii/S0140700725002580

[11] NTT Ltd. NTT Launches Hyperscale Data Center in Jakarta, Indonesia [EB/OL]. (2022-04-04)[2026-08-09]. https://pressat.co.uk/releases/ntt-launches-hyperscale-data-center-in-jakarta-indonesia-a6a9ebedcb5f45147ec233bc595cebb9/

[12] National Research Foundation Singapore, i3 Solutions Group. Green Data Centre Technology Roadmap [EB/OL]. [2026-08-09]. https://www.nccs.gov.sg/files/docs/default-source/default-document-library/green-data-centre-technology-roadmap.pdf; Ulya Z. Data Center Cooling in Indonesia: Addressing Tropical Climate Challenges and

Table 2. NTT Group global environmental performance indicators

Environmental Performance Indicator	Value
Global Annual Average PUE (IT load utilization ≥ 20%)	1.38 (calculated for IT load utilization ≥ 20%)
Global Annual Average Water Usage Effectiveness (WUE)	0.72 L/kWh (standard data halls); 1.42 L/kWh (evaporative-cooled data halls)
High-Density Cooling Capacity	Up to 15 kW per rack for high-performance computing loads
Global Renewable Electricity Share (FY24)	60%, up 18% from FY23
Absolute GHG Emissions Reduction (FY24 vs. FY21 baseline)	28% absolute reduction from the FY21 baseline
Contracted Waste Heat Recovery Projects	11 MW of waste heat recovery capacity

Source: NTT official website

In the long term, the data center follows NTT DATA Group's NET-ZERO Vision 2040, which aims to achieve carbon neutrality for operational Scope 1 and Scope 2 emissions by 2030, carbon neutrality across all of the group's business operations by 2035, and net-zero emissions across the entire supply chain by 2040.

In addition, as Indonesia's policy framework continues to improve, the data center is now in a position to adopt a range of green power procurement options, including green tariffs, renewable energy certificates (RECs) and corporate power purchase agreements (PPAs). As a flagship data center, the project has strong incentives to integrate sustainability standards into procurement and engineering design by selecting low-carbon building materials and high-efficiency equipment and applying life-cycle management and circular economy models.

On supply chain decarbonization, the data center uses low-carbon building materials and selects IT and electrical equipment manufactured with more energy-efficient processes, while strengthening downstream management mechanisms such as tenant hardware management, asset life-cycle planning and circular economy operations. As a flagship data center in Indonesia, the project fully applies sustainability standards in procurement and design, cutting carbon emissions and increasing its capacity to use renewable energy by lowering PUE, adopting AI-based cooling and adding battery energy storage.

III. Lessons Learned

Under the dual constraints of a hot and humid tropical climate and a carbon-intensive power system, the NTT Jakarta 3 Data Center has charted a viable path for the green and low-carbon transition of hyperscale data centers in developing countries through technological innovation, life-cycle management, green power procurement and international cooperation. Its experience offers useful lessons for the sustainable development of data centers in hot and humid regions with carbon-intensive grids. Going forward, countries can cooperate on green data center standards, high-efficiency cooling technologies and renewable energy grid integration to jointly advance the low-carbon transition of data centers worldwide.

(1) Technological innovation is key to overcoming local challenges

Innovative Technology [EB/OL]. (2025-09-25)[2026-08-09]. https://nusantara-academy.com/data-center-cooling-in-indonesia-addressing-tropical-climate-challenges-and-innovative-technology/

The operational reliability and energy efficiency of data centers depend heavily on efficient heat dissipation and precise control of temperature and humidity. Indonesia's hot and humid climate has driven the adoption of innovative technologies such as the cooling wall, showing that local natural conditions are not insurmountable barriers and can instead act as catalysts for technological innovation. In similar markets, liquid-cooling or high-density air-cooling architectures should be planned for at the early stages of a project, which is more cost-effective and environmentally beneficial than retrofitting older data halls later. Technological innovation not only solves local challenges but also builds core competitiveness, supporting the long-term sustainable operation of a project.

(2) Sustainability must span the entire life cycle

Data centers are not the end of the industrial chain but key nodes in a carbon-intensive global supply chain. Their carbon emissions come not only from operations; a larger share comes from supply chain stages such as building construction and equipment manufacturing. The experience of NTT Jakarta 3 shows that sustainability assessment should not be limited to PUE but should incorporate full life-cycle assessment. Every step matters, from choosing low-carbon building materials and efficient IT equipment, to making supply chain emissions visible, to adopting circular economy models after assets are retired. Data center operators should use their influence to drive a green transition across the entire industrial chain, moving from individual projects to industry-wide transformation.

(3) Green power use remains key to reducing data center emissions

Renewable energy certificates (RECs) can help decarbonize the grid as a whole and play an irreplaceable role, but they have inherent long-term limitations. The REC mechanism introduced by PLN allows operators such as NTT to quickly offset their Scope 2 emissions, but it cannot change the fact that coal remains the grid's main source of generation. In the future, deep and systemic decarbonization will require vigorous promotion of direct corporate PPAs and power wheeling mechanisms, shifting to green power procurement models that deliver additional emissions reductions. For example, companies can contract directly with new solar, wind or geothermal power plants dedicated to supplying their own facilities, achieving genuine replacement of fossil energy. In addition, operators should participate actively in national grid reform as capital investors to achieve truly sustainable operations.