Harnessing Artificial Intelligence for Energy Transition in the Asia-Pacific

Generated using *Claude AI Sonnet 4* on *1 October 2025* and compiled by APCTT

Note

This article was generated using Artificial Intelligence as a value-added contribution to the Asia-Pacific Tech Monitor's special issue on "Harnessing Artificial Intelligence for Energy Transition." This experiment demonstrates the potential applications of AI in knowledge synthesis and technical writing within the context of our thematic focus. The use of AI for this article is purely experimental and educational in nature. APCTT does not endorse, promote, or have any affiliation with any specific AI company, platform, or service provider.

Abstract

Artificial intelligence is reshaping how the Asia Pacific generates, manages, and uses electricity. Record renewable additions are raising the bar for short-term forecasting, grid flexibility, and asset reliability, just as AI driven data centre demand grows rapidly. Across the Asia Pacific, AI is transitioning from pilots to operations in wind and solar self-forecasting, distribution-level digital twins, and demand response. Governments are pairing these advances with major grid investments and regional power market cooperation. Realizing AI benefits at scale will require digital-ready grids, open data, model governance, and workforce capabilities to ensure AI accelerates rather than complicates the path to net zero.

Introduction

Global renewable power expanded by a record 585 GW in 2024, taking cumulative capacity to 4,448 GW; renewables accounted for over ninety percent of net additions (IRENA, 2025). Those headline numbers translate into a day-to-day operations challenge: system operators must forecast weather-driven output and balance variability across grids that were not originally designed for such dynamism. In parallel, the International Energy Agency projects global data centre electricity uses to more than double to around 945 TWh by 2030, with AI workloads the most significant driver (IEA, 2025a). Asia Pacific, already a major share of global energy demand, sits at the nexus of these trends, with implications for reliability, affordability, and decarbonization (Energy Institute, 2025).

Where AI is delivering value

Short-term forecasting for variable renewables

Australia has operationalized participant self-forecasting, allowing wind and solar farms to submit machine learning based five-minute forecasts to the market operator. Evidence from the Australian Renewable Energy Agency trial and the Australian Energy Market Operator shows self-forecasts can reduce generation forecast error and improve dispatch outcomes relative to legacy baselines (ARENA, 2021; AEMO, 2024). The mechanism matters: when forecasts are tied to incentives and integrated into operational tools, model accuracy and system value improve, especially during ramps and cloud transients that defeat simple persistence models.

Distribution level visibility and planning

Singapore Energy Market Authority and SP Group are building a nation-scale Grid Digital Twin, an integrated asset twin and network twin using real time and historical data to assess the health of grid assets and the impact of new connections (EMA, 2021; SP Group, 2023). A digital twin provides the scaffolding for AI applications: probabilistic hosting capacity for rooftop PV, dynamic thermal ratings on feeders, and predictive maintenance that prioritises field crews where risk is highest. While quantified system wide benefits will accumulate over time, the architectural shift is clear: data liquidity plus physics informed models create space for AI to assist planners and system controllers.

Demand response and resource aggregation

Japan's framework for virtual power plants and demand response, underpinned by technical and cybersecurity guidance from the Ministry of Economy, Trade and Industry (METI), enables AI driven coordination of distributed resources. As AI and data centre loads rise, flexible demand becomes a hedge against local constraints and peak pricing, complementing grid reinforcement (METI, 2023; Reuters, 2024). For Asia Pacific neighbours, Japan's approach illustrates how policy plumbing standards, telemetry, and settlement is as important as the algorithms.

Aligning new digital loads with clean power

Malaysia has committed RM 43 billion, approximately 10.1 billion US dollars, to upgrade its national grid, with leaders explicitly citing the role of AI and battery storage in improving flexibility for growing demand, including data centre clusters. The investment aims to speed renewable integration while meeting the reliability expectations of digital industries (Reuters, 2025; The Edge Malaysia, 2025). Experience from mature data centre markets suggests siting clusters near clean supply and storage, procuring twenty-four by seven carbon-free electricity, and minimising power usage effectiveness with AI optimised cooling are emerging good practices (IEA, 2025a).

Country snapshots

Australia: Australian Energy Market Operator (AEMO) has formalized participant self-forecasting pathways and continues to publish forecasting accuracy and improvement roadmaps, reflecting how machine learning is moving from trials to day-to-day system operations. The lesson for the region is to build the market interface for AI, including data specifications, submission windows, and validation alongside the models (AEMO, 2024).

Singapore: The Grid Digital Twin supports faster and safer interconnections and better asset management, creating a platform for AI to scale responsibly from predicting asset failures to evaluating scenarios for electric vehicle charging and distributed storage (EMA, 2021; Channel NewsAsia, 2021).

Japan: Facing surging data centre loads, Tokyo Electric Power Company (TEPCO) plans to invest 470 billion yen, approximately 3.25 billion US dollars, by fiscal year 2027 to expand its power grid. In parallel, virtual power plant and demand response guidelines enable aggregated flexibility to complement physical upgrades, an approach that spreads risk between infrastructure and software (Reuters, 2024).

Malaysia: The government's 43-billion-ringgit grid modernization program aims to add capacity for renewable integration and anticipated AI driven demand, with public statements pointing to AI and storage as enabling technologies (The Edge Malaysia, 2025; Reuters, 2025).

Regional cooperation and technology transfer

Interconnection and market integration can spread variability, lower balancing costs, and amplify AI value by enlarging balancing areas and data pools. The ASEAN Power Grid initiative envisions integrated operation and cross-border power trade by 2045, supported by multilateral partners such as the Asian Development Bank (ADB, 2025). Recent analyses argue that modern grids, including new transmission corridors and digital backbones, are the unlock for clean energy investment in Southeast Asia. One estimate peg the regional transmission need at around 100 billion US dollars by 2045 (Ember, 2025; Eco Business, 2025). For AI practitioners, this implies prioritising tools that support regional scheduling, congestion forecasting, and probabilistic reserve sharing as interties expand.

Policy and market priorities

Invest in digital-ready grids. AI value is limited by the availability, latency, and quality of telemetry. Advanced metering infrastructure, phasor measurement units, distributed energy resource telemetry, and cyber-secure data exchanges are prerequisites (IEA, 2025b). Regulators can unlock innovation by standardising data formats and enabling third-party access where appropriate, like open data models that catalysed forecasting advances in Australia.

Model assurance and open data. Because AI can inform dispatch, interconnection, and protection settings, operators should require documentation, continuous monitoring, fallback modes, and robustness testing. Japan resource aggregator guidance and Australia knowledge sharing from the short-term forecasting trial offer practical starting points (METI, 2023; ARENA, 2021).

Align digital growth with clean power. Data centre clusters should be co-sited with renewables and storage, pursue round the clock carbon free electricity procurement, and drive power usage effectiveness toward best-in-class levels via AI optimised thermal controls. The IEA outlook highlights why AI related processing is a major contributor to rising electricity use this decade (IEA, 2025a).

Finance and skills. Regional energy reviews point to capacity gaps in data engineering, power systems analytics, and cybersecurity within utilities and regulators' skills that determine whether AI pilots scale into operational practice (Energy Institute, 2025). Multilateral programmes linked to the ASEAN Power Grid and national grid upgrades can embed training and knowledge transfer into capital projects.

Outlook

Over the next five years, three trends will define AI's contribution to the Asia Pacific transition. First operationalisation: more markets will emulate Australia's self-forecasting model, allowing AI to participate in dispatch relevant processes. Second granularity: distribution level visibility via digital twins will bring AI closer to grid edge assets, including behind-the-meter solar, electric vehicle charging, and heat pumps. Third integration: regional interconnectors and cross border trade under the ASEAN Power Grid will expand the canvas on which AI can optimise flows. Each step requires governance covering data rights, security, model auditability, and equitable access so smaller utilities and emerging markets benefit alongside digital hubs. Done well, AI will help the region integrate more renewables faster and more reliably, turning software intelligence into real world system flexibility.

Conclusion

AI is not a silver bullet, but it has become a system enabler where infrastructure and institutions are ready. In the Asia Pacific, where renewable additions are breaking records and AI era loads are rising, the practical path is clear. Invest in digital ready grids, publish data and require model assurance, align data centre growth with clean power, and expand regional cooperation so software driven efficiencies compound hardware investments. The result can be a cleaner, more reliable, and more competitive power system for a digitally powered economy (IRENA, 2025; IEA, 2025a).

References

- Asian Development Bank (ADB). "ASEAN Power Grid Overview." Accessed October 8, 2025. https://www.adb.org/where-we-work/southeast-asia/asean-power-grid.
- Australian Energy Market Operator (AEMO). "Participant Forecasting." Accessed October 8, 2025. https://www.aemo.com.au/energy-systems/electricity/national-electricity-market-nem/nem-forecasting-and-planning/operational-forecasting/solar-and-wind-energy-forecasting/participant-forecasting.
- Australian Renewable Energy Agency (ARENA). "Short Term Forecasting Trial: Summary of Key Insights." Accessed October 8, 2025. https://arena.gov.au/knowledge-bank/short-term-forecasting-trial-summary-of-key-insights/.
- Channel NewsAsia. Vanessa Lim. "New 'Digital Twin' for National Power Grid to Better Manage Electricity Supply." Accessed October 8, 2025. https://www.channelnewsasia.com/singapore/new-digital-twin-national-power-grid-manage-electricity-supply-2271356.
- Eco-Business. "ASEAN Power Grid Needs at Least 100 Billion US Dollars to Build Transmission Lines by 2045: ADB." Accessed October 8, 2025. https://www.eco-business.com/news/asean-power-grid-needs-at-least-us100-billion-to-build-transmission-lines-adb/.
-
- Energy Market Authority (EMA). "Singapore's First Digital Twin for National Power Grid." *Media Release.* Accessed October 8, 2025. https://www.ema.gov.sg/news-events/news/media-releases/2021/singapores-first-digital-twin-for-national-power-grid.
- Energy Market Authority of Singapore (EMA). "Leveraging Digital Solutions to Future-Proof Singapore's Energy Grid." *Media Release,* October 24, 2023. Accessed October 8, 2025. https://www.ema.gov.sg/news-events/news/media-releases/2023/leveraging-digital-solutions-to-future-proof-singapore-energy-grid.
- Energy Institute. *Statistical Review of World Energy,* 74th ed. London: Energy Institute, 2025. https://www.energyinst.org/statistical-review.
- Ember. *Wired for Profit: How Power Companies in ASEAN Are Cashing In on the Energy Transition.* London: Ember, 2025. https://ember-energy.org/app/uploads/2025/05/Report-Wired-for-profit-ASEAN-PDF.pdf.
- International Energy Agency (IEA). "Energy Demand from AI." *Energy and AI.* Accessed October 8, 2025. https://www.iea.org/reports/energy-and-ai/energy-demand-from-ai.
- International Renewable Energy Agency (IRENA). *Renewable Capacity Statistics 2025.* Accessed October 8, 2025. https://www.irena.org/Publications/2025/Mar/Renewable-capacity-statistics-2025.
- Reuters. "TEPCO to Invest $3.25 Billion in Power Grid for AI Demands, Nikkei Reports." *Reuters,* August 29, 2024. https://www.reuters.com/business/energy/tepco-invest-325-bln-power-grid-ai-demands-nikkei-reports-2024-08-29/.
- Reuters. "Malaysia PM Says $10 Billion Committed to National Grid Upgrade." *Reuters,* June 16, 2025. https://www.reuters.com/markets/commodities/malaysia-pm-says-10-bln-committed-national-grid-upgrade-2025-06-16/.
- The Edge Malaysia. "Malaysia to Spend 43 Billion Ringgit on Grid Upgrades to Support Clean Energy and AI." June 16, 2025. https://theedgemalaysia.com/node/759102