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Global **Transmission** Report

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HITACHI

INDONESIA

ELECTRICITY GRID IN TRANSITION

CONTENTS

INTRODUCTION

1

Few countries face an energy challenge as consequential as Indonesia's. As the nation aims to accelerate economic growth from about 5% in 2025 to 8% by 2029[1], electricity supply must expand to support industrialisation, urbanisation, and a rapidly growing digital economy. PT PLN (Pesero), Indonesia's state-owned integrated electric power utility, forecasts an approximately 67% increase in total electricity consumption by 2034[2], highlighting the need for a comprehensive transformation of the country's power infrastructure.

That transformation must contend with three interrelated structural challenges: expanding generation capacity to meet rising demand, ensuring an affordable and reliable supply to sustain economic competitiveness, and reducing emissions in line with national targets and international climate commitments. How Southeast Asia's largest economy manages these priorities – and whether it can do so without further locking in carbon-intensive infrastructure – will determine the course of its energy policy and its prospects for sustainable growth.

Indonesia's electricity system remains heavily dependent on domestic coal, which accounts for approximately 54% of installed power capacity.[3] Abundant domestic reserves, a relatively young fleet of coal-fired power plants with long remaining operational lifetimes, and regulated price caps continue to incentivise its use.

While this dependence has historically provided energy security and cost stability, it increasingly poses environmental and economic risks. Continued reliance on coal drives up carbon emissions, undermining Indonesia's climate commitments. It also impacts access to international finance, trade, and global value chains, which are becoming more sensitive to the carbon intensity of energy systems. Ongoing fossil fuel subsidies and challenges in implementing the coal phase-down plan are likely to prolong this dependence and increase the eventual cost of transition.

Indonesia is well-positioned to accelerate its transition to a cleaner energy system. It holds one of the world's largest untapped renewable resource bases, including solar, geothermal and wind, with particularly strong potential across its eastern regions.

Falling technology costs are steadily strengthening the economic case for deployment, with solar and battery storage now becoming competitive with diesel and new coal across much of the archipelago. This opportunity is especially significant given that diesel generators continue to serve as the primary dispatchable source in many remote and islanded systems not interconnected with the main grid.

The government has begun to establish the policy architecture to guide this energy transition. Indonesia's updated National Energy Policy, *Kebijakan Energi Nasional* (KEN), released in October 2025, sets out a long-term roadmap for the energy system transformation. It targets an increase in the share of renewable energy in primary energy supply from about 14.7% in 2024[4] to 19-23% by 2030, rising further to 70-72% by 2060.[5] These targets are aligned with the government's commitment to achieve net-zero emissions by 2060.

To support this framework, PLN's latest electricity supply plan, *Rencana Usaha Penyediaan Tenaga Listrik (RUPTL) 2025-2034*[6], forecasts adding about 42.6 GW of renewable energy capacity – around 61% of total new capacity addition – by 2034, making it the greenest plan in the organisation's history. Complementing this domestic framework, the Just Energy Transition Partnership (JETP), an international funding initiative, aims to mobilise

Figure 1: Power Sector Plan, 2025-2034

Investment: USD188 billion		
New Capacity	**New Transmission**	**New Distribution**
Investment: USD131 billion NRE & Storage: 52.9 GW Fossil Fuel: 16.6 GW	Investment: USD24 billion Lines: 48,758 km Substation Capacity: 108 GVA	Investment: USD11 billion Lines: 198,998 km Substation Capacity: 18 GVA

Note: NRE – New and Renewable Energy (from resources such as solar, hydro, wind, geothermal, bioenergy, and nuclear). In addition to generation and transmission & distribution (T&D) investments, the total USD188 billion comprises USD5 billion for Smart Grid development and USD17 billion for PLN's expenses, such as interest and construction costs.
Source: RUPTL 2025-2034

about USD21.4 billion in public and private financing to accelerate Indonesia's energy transition.[7]

These frameworks confirm a strong political commitment, but translating their targets into timely investment will require overcoming institutional and structural barriers. Chief among these is policy fragmentation: renewable energy targets are not always harmonised with power sector investment plans, and coordination across multiple, sometimes overlapping, frameworks remains difficult. Fossil fuel subsidies further distort market signals, reducing the appeal of renewables for private investors. Progress will hinge on domestic policy reform, credible coal phase-down pathways, and timely access to financing and technology.

Infrastructure presents an equally significant limitation. Indonesia's electricity grid was built around centralised coal-fired power plants on its major islands – a configuration not designed for integrating variable renewable energy (VRE) or managing power flows across the archipelago's fragmented grids. While transmission and distribution (T&D) infrastructure has expanded in recent years, grid development has consistently lagged demand growth, raising concerns about system stability that will only intensify as the generation mix changes further.

Grids are now at the centre of power sector transformation. The energy transition demands more than expanding renewable energy deployment; it requires a stronger, more resilient, and highly digitalised grid. Expanding and modernising T&D infrastructure, improving interconnection between islands, adding flexibility, and accelerating digitalisation are essential to scale up renewables, manage a more distributed energy system, and meet growing demand reliably and affordably. Without these measures, generation targets will likely remain aspirational.

Recognising the urgency for a stronger grid, the latest RUPTL outlines a USD35 billion investment in T&D infrastructure[8] by 2034 to support the energy transition. The decisions taken now will carry long-term consequences. Technology and investment choices made in the next few years will determine the efficiency, resilience, and carbon intensity of Indonesia's power system, and with it, Indonesia's ability to remain competitive in an increasingly decarbonised global economy.

This report examines the current state of Indonesia's power sector, the systemic challenges impacting its energy transition, and the opportunities emerging within it – with special focus on the T&D infrastructure, which will be decisive in determining the speed and the extent of this transition. ■

ELECTRICITY SECTOR TRANSFORMATION: KEY DRIVERS OF CHANGE

2

Indonesia is projected to experience sustained growth in electricity demand over the coming decade, driven by robust economic expansion and industrial development. At the same time, policy commitments to reduce emissions are influencing the future generation mix. This chapter outlines the current structure of the electricity sector and the key drivers of change.

2.1 Economic Imperatives and Power Demand

Indonesia enters the second half of the 2020s pursuing one of the most ambitious development targets among major emerging economies. Behind its 8% growth ambition by 2029[1] lies a deeper transformation: Indonesia is transitioning from a commodity-exporting economy to one anchored in domestic manufacturing, digital services, and value-added industrial processing.

This transition makes electricity supply a defining condition for national development. The sectors driving growth require far more power than the system currently produces. The adequacy, reliability, and carbon intensity of Indonesia's power system will therefore be decisive in determining whether the economic strategy delivers.

Three converging trends are driving the projected increase in electricity demand.

Industrial downstreaming (Hilirisasi): Indonesia is systematically reorienting its industrial composition away from raw ore exports toward domestic refining and processing. Nickel has emerged as the primary driver given its critical role in EV battery manufacturing and wider clean energy supply chains. Industrial parks, mainly located in Sulawesi and Kalimantan, are generating substantial baseload electricity demand in regions with historically limited grid infrastructure.

Digital economy expansion: Data centres, cloud infrastructure, and telecommunications networks are among the fastest-growing consumers. As these sectors expand, their share of overall electricity consumption is expected to rise significantly, mirroring trends already observed across other major Asian markets.

Urbanisation, rising incomes, and electrification: Growing urban populations and higher living standards are broadening electricity consumption. Moreover, the gradual adoption of electric vehicles will add a persistent, geographically dispersed load.

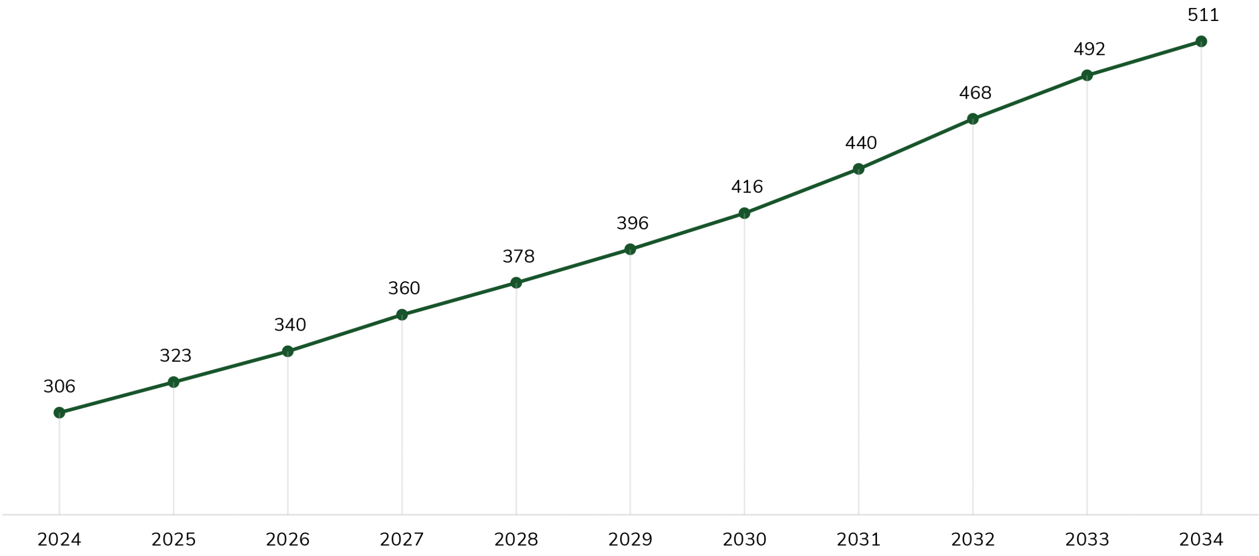
PLN projects that electricity consumption will grow by 36% between 2024 and 2030, and then grow an additional 23% by 2034[2], requiring the power sector to expand at a pace and scale it has never achieved.

These projections are not mere numbers; they define the baseline infrastructure needed to guide power sector investment and policy decisions.

2.2 Energy Transition Commitments

On its path to net-zero by 2060, Indonesia – under the Second Nationally Determined Contribution (NDC) – has committed to reducing greenhouse gas emissions by 31.89% by 2030 (compared to business-as-usual scenario in 2010), increasing to 43.2% with international support.[9]

Figure 2: Electricity Sales (TWh), 2024-2034



Source: Statistik PLN, 2024 and RUPTL 2025-2034

Decarbonising the power sector is essential to meeting these goals, as it accounts for 57.4% of the domestic coal consumption.[10] Despite plans to progressively replace coal with renewable energy, it is expected to remain the dominant source in the energy mix until mid-century.

The government's own projections reflect the complexity of this dependence. Domestic coal consumption is expected to remain high through the 2040s before declining materially in the 2050s. Coal's share of the primary energy mix is projected to increase slightly from about 40.4% in 2024[4] to 40.7-41.6% in 2030, and then decline to 28.9-31% in 2040 and further to 19.1-20.9% in 2050, by which point non-fossil energy sources are expected to contribute around 53-55%[5] of the mix.

However, a more proactive stance on coal retirement is emerging. The Ministry of Energy and Mineral Resources (MEMR) Regulation No. 10/2025, introduced in April 2025, establishes a roadmap for accelerating the decommissioning of existing coal-fired plants, signalling that net-zero is moving from ambition into active regulatory action.

Indonesia is making progress toward a cleaner energy mix, but the transition remains gradual. Effectively managing legacy coal obligations and aligning domestic planning frameworks with international climate goals will be critical. These actions will largely determine whether Indonesia's net-zero pathway remains credible on the international stage.

2.3 Coal Infrastructure Constraints

Indonesia's power system has approximately 100.7 GW of installed capacity and remains heavily reliant on fossil fuels, with coal accounting for 54% of the total capacity.[3] Renewables contribute around 14%[3] – primarily through geothermal and hydropower. Solar and wind are still at an early stage of deployment. This structure reflects decades of coal-based infrastructure investment, which provided affordable electricity but now constrains the transition to cleaner energy.

Much of the coal fleet is relatively young, with long technical lifetimes and binding contractual obligations with independent power producers (IPPs). Early retirement is therefore costly, and the pace of fleet turnover is partly determined by financial and contractual considerations that sit outside the direct control of energy policy.

Coal's persistence is not merely contractual; it is also economic. Indonesia is the world's largest exporter of thermal coal, and the sector provides significant employment and regional revenue. In parallel, the Hilirisasi strategy is generating large volumes of concentrated baseload demand in regions with underdeveloped grid infrastructures, creating conditions in which mine-mouth coal plants are viewed as the most practical near-term supply solution for energy-intensive industrial clusters. The RUPTL 2025-2034 accordingly proposes 6.3 GW of new coal capacity, primarily mine-mouth, to support grid reliability and industrial growth. This new thermal capacity continues to be commissioned under exemptions to the coal moratorium established by Presidential Regulation 112/2022.

The very industrial policies that are driving coal demand today are simultaneously increasing Indonesia's exposure to evolving international trade and regulatory risks. Emerging frameworks, including the European Union's Critical Raw Materials Act and carbon border adjustment mechanisms, are beginning to tie market access to supply chain emissions. Power sector decarbonisation is therefore not only a climate imperative but also a prerequisite for sustaining the export competitiveness of the industrial value chains that Indonesia's economic growth strategy is built around.

2.4 Renewable Energy Potential and the Grid Challenge

Indonesia possesses one of the world's largest and most diverse renewable energy resource bases. Its geography – a vast equatorial archipelago, along a highly active volcanic arc, and intersected by major river systems – supports the development of multiple complementary forms of low-carbon generation. The challenge lies in the pace and cost of developing these resources and delivering power reliably to demand centres.

Solar energy represents the largest single untapped resource in Indonesia, with the highest potential in West Kalimantan, South Sumatra, and East Kalimantan. Consistent equatorial solar irradiation makes utility-scale photovoltaics increasingly cost-competitive with conventional generation. Distributed and rooftop solar can serve demand without long-distance power lines, particularly for commercial, industrial, and urban residential sectors. Paired with storage, solar offers a viable decarbonisation pathway for a significant share of the electricity demand.

Geothermal energy is Indonesia's most distinctive renewable resource. Situated along a highly active volcanic arc, the country has an estimated 23 GW of largely untapped potential across Sumatra, Java, Bali, Nusa Tenggara, Kalimantan, Sulawesi, Maluku, and Papua.[11] Unlike solar or wind, geothermal provides firm, low-carbon baseload power. Development is capital-intensive with long lead times, but Indonesia's well-proven high-quality resources support a strong long-term investment case.

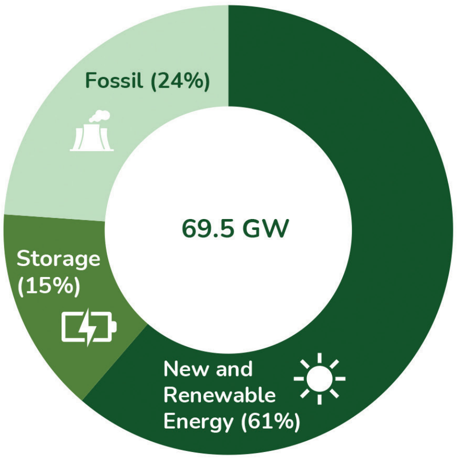
Hydropower potential is substantial in Sumatra, Kalimantan and Papua. Existing capacity already provides flexible and dispatchable generation, and further development could support clean baseload growth if transmission infrastructure keeps pace with resource development.

Wind energy is more geographically constrained, but several coastal and island locations, particularly in Southern Sulawesi, South Kalimantan and Java, show viable potential. Technological advances continue to improve project economics even in moderate-wind locations.

The RUPTL 2025-2034 operationalises Indonesia's renewable energy commitments through a decade-long infrastructure programme, proposing approximately 69.5 GW of new generation capacity, of which about 61% or 42.6 GW is designated as new and renewable.

The plan also calls for 10.3 GW of energy storage deployment, including pumped hydro and battery systems (BESS), to support grid stability and the integration of variable generation.

Figure 3: Installed Capacity Addition, 2025-2034



16.6 GW from fossil fuels, primarily natural gas

10.3 GW from energy storage systems

42.6 GW from new and renewable sources such as solar, hydro, wind, geothermal, bioenergy, and nuclear

New and Renewable Energy (42.6 GW)

- Solar PV (17.1 GW)
- Hydro (11.7 GW)
- Wind (7.2 GW)
- Geothermal (5.2 GW)
- Bioenergy (0.9 GW)
- Nuclear (0.5 GW)

Fossil Fuel (16.6 GW)

- Gas (10.3 GW)
- Coal (6.3 GW)

Storage (10.3 GW)

- Hydro Pumped Storage (6.0 GW)
- Battery (4.3 GW)

Source: Accelerated Renewable Energy Development (ARED) scenario under RUPTL 2025-2034

About 73% of the new capacity outlined in the RUPTL is expected to be developed and financed by private IPPs.[8] Financing delays have historically hindered the development of renewable energy projects, making access to commercial capital and effective de-risking mechanisms now critical for their successful implementation.

However, this ambitious plan faces a persistent challenge: the geographic distance between renewable resources and major demand centres. Solar in Kalimantan, geothermal in Sumatra and Sulawesi, and hydropower in remote river systems are all distant from the Java-Bali corridor, which is the largest consumption centre. Realising these resources at scale requires commensurate investment in transmission infrastructure, including the proposed "Super Grid" connecting the major islands. Financing, permitting, and construction timelines for this infrastructure, however, extend well beyond 2030, constraining which renewable projects can realistically advance in the near term, and determining the sequencing of the broader transition.

These structural constraints become even more pronounced in light of a recent government announcement. Beyond RUPTL's official solar pipeline, a direct presidential initiative introduced in mid-2025, aims to add an additional 100 GW[12] of solar capacity. This ambition signals a significant acceleration in renewable energy expansion and reinforces the central role of solar energy in Indonesia's long-term decarbonisation strategy.

Achieving this additional solar deployment will further intensify the grid challenges already outlined in RUPTL. It will require a faster and more extensive build-out of transmission infrastructure, alongside substantially greater investment in energy storage and advanced grid-balancing solutions, than currently envisioned under the Super Grid and broader grid modernisation programmes. ■

GRID INFRASTRUCTURE AND THE ARCHITECTURE OF INTEGRATION

3

The energy transition in Indonesia is as much a grid challenge as a generation challenge. Renewable resources are concentrated on the outer islands, far from the demand centres in Java. Without a grid capable of bridging this geographic divide and maintaining system flexibility, new clean energy cannot be delivered reliably to the industrial clusters and urban centres that will drive the next phase of Indonesia's economic development.

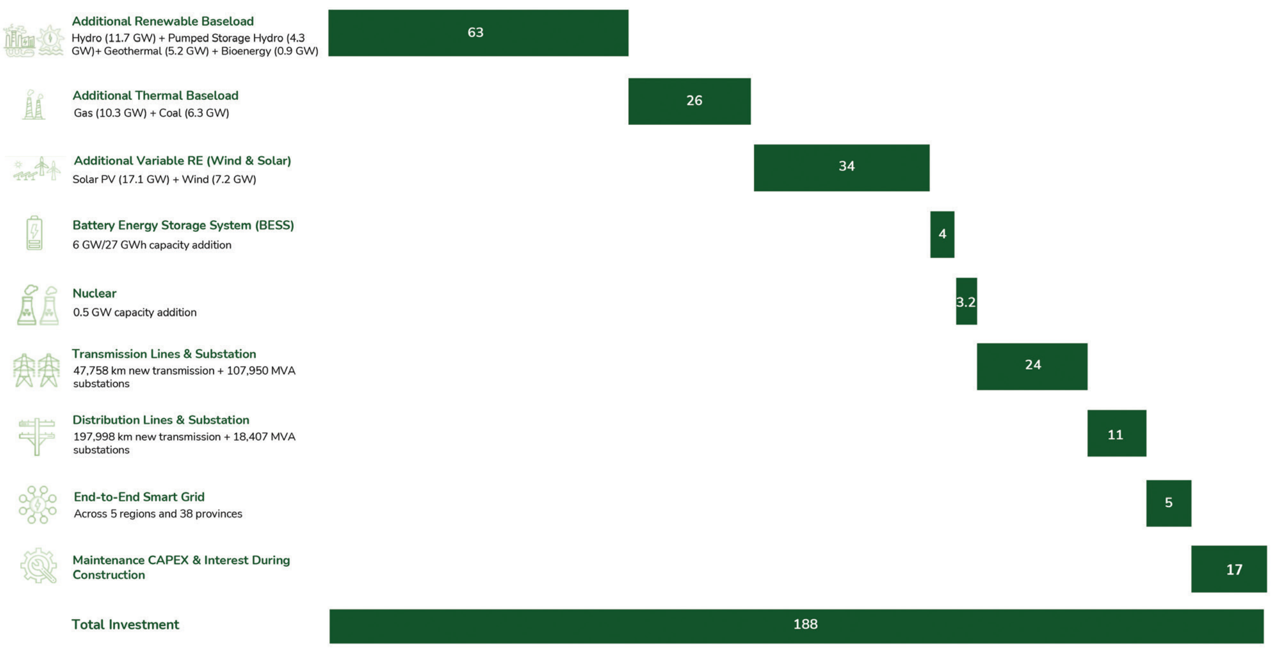
The generation targets set out in the RUPTL 2025-2034 will only be achieved if transmission and distribution networks are developed in parallel with – and in key areas ahead of – renewable deployment. Where grid expansion lags, the consequences are material: increased curtailment, underutilised assets, and delays in emissions reductions.

3.1 From Structural Constraints to Investment Priority

Indonesia's existing grid was designed for a centralised, dispatchable coal-dominated system. Its radial architecture, limited inter-island connectivity, and minimal storage capacity constrain its ability to integrate large shares of variable renewable energy.

The RUPTL 2025-2034 responds with a major investment push through a USD35 billion[8] T&D spending plan within a broader USD188 billion

Figure 4: Power Sector Investment Plan (USD billion), 2025-2034



Note: Total investment may differ from the sum of individual segment investments due to rounding differences.
Source: RUPTL 2025-2034

Figure 5: Transmission Network Capacity Plan, 2025-2034

Transmission Network Addition
47,757 km

Voltage	2024	2034	2025-2034 Addition
500 kV	7,718 km	14,171 km	6,453 km
500 kV DC	0 km	2,432 km	2,432 km
275 kV	4,640 km	10,695 km	6,055 km
150 kV	54,043 km	86,205 km	32,162 km
70 kV	6,153 km	6,808 km	655 km

Substation Capacity Addition
107,950 MVA

Voltage	2024	2034	2025-2034 Addition
500 kV	45,349 MVA	95,599 MVA	50,250 MVA
500 kV DC	0 km	6,000 MVA	6,000 MVA
275 kV	13,088 MVA	28,088 MVA	15,000 MVA
150 kV	117,270 MVA	152,990 MVA	35,720 MVA
70 kV	7,050 MVA	8,030 MVA	980 MVA

Note: 2024 data is actual installed line length and substation capacity. The 2034 data is projected installed line length and substation capacity.
Source: Statistik PLN, RUPTL 2025-2035

Five weaknesses define Indonesia's current power system constraints:

System losses: Combined transmission and distribution losses of approximately 8.55% exceed international benchmarks[15], representing both economic inefficiency and a barrier to renewable delivery.

Geographic mismatch: As mentioned before, demand is concentrated in Java, while the majority of renewable resources are located in Sumatra, Kalimantan, Sulawesi, and Nusa Tenggara. The transmission infrastructure to connect these regions remains insufficient. The RUPTL's Super Grid rationale is, in effect, an official acknowledgement of this mismatch.

Limited storage capacity: Planned additions of 10.3 GW of battery and pumped hydro storage reflect the scale of the current shortfall. Without adequate storage, high renewable energy penetration becomes a grid stability risk rather than an asset.

Underdeveloped smart grid infrastructure: Advanced metering, automated fault detection, and real-time load management remain limited, constraining operational flexibility.

Outdated regulatory framework: Grid codes and market rules are designed for dispatchable generation and do not adequately accommodate renewable energy variability, forecasting, or flexible dispatch.

electricity programme. This amount is needed to build 47,758 km of new transmission lines, 107,950 MVA of new transmission substation capacity, 197,998 km of new distribution lines, and 18,407 MVA of new distribution substation capacity.[13]

Financing represents the central execution risk. The state utility alone cannot shoulder this investment, highlighting the need for increased private sector participation. At the same time, the JETP has identified 340 priority transmission projects,[14] offering an internationally endorsed pipeline capable of attracting concessional and blended finance from multilateral development banks and bilateral partners.

3.2 Connecting the Archipelago: The Super Grid Vision

Indonesia's archipelagic geography requires a transmission system capable of moving electricity across long distances and between islands. The Green Enabling Super Grid (GESG), a central pillar of the RUPTL 2025-2034, transforms this challenging reality into a coordinated infrastructure programme.

High Voltage Direct Current (HVDC) technology forms the backbone of the Super Grid. Its deployment represents a first for Indonesia and a step-change in its transmission capability. The GESG comprises approximately 8,918 km of new transmission lines, including three new ±500 kV HVDC lines totalling 3,664 km (two of which are under investigation). The Sulawesi backbone accounts for the largest share of GESG's additions at 4,018 km, followed by the Sumba–Bali–Java (1,394 km) and the Sumatra–Java links (1,174 km).[16]

The Super Grid will be developed in phases, prioritising commercially viable and system-critical corridors first, while deferring more capital-intensive interconnections to a later stage.

The Sumatra–Java interconnection, targeted for completion in 2031, is the most consequential near-term milestone and a key test of Indonesia's implementation capacity.

However, the interconnections with the greatest impact on decarbonisation – particularly Java–Kalimantan and Kalimantan–Sulawesi – are scheduled for 2040 and beyond. This means the Super Grid's potential to shift Indonesia's generation mix remains a long-horizon ambition. Thus, timely delivery of the initial interconnections will be critical to sustaining momentum and enabling near-term renewable integration.

3.3 Cross-Border Interconnection and Regional Market

Indonesia's energy transition creates opportunities beyond its own borders. Under the ASEAN Power Grid (APG) framework, the country is well positioned to participate in – and over time help expand – regional electricity trade, leveraging its substantial untapped renewable resources.

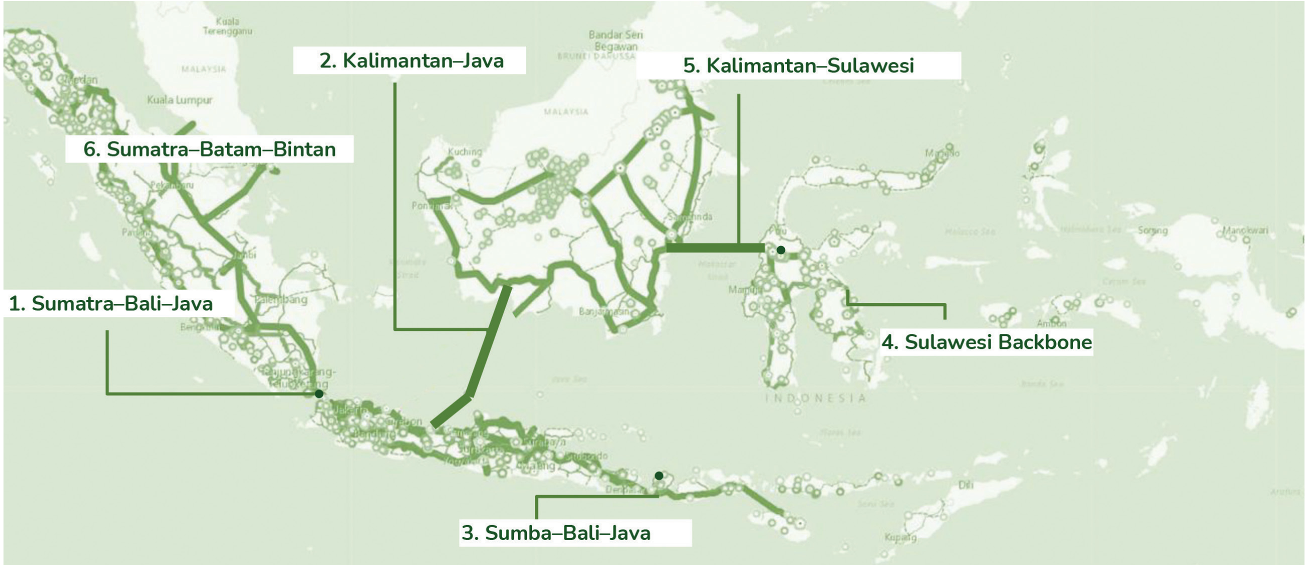
Four bilateral interconnection projects are currently advancing and constitute key components of the envisioned APG.

Sumatra, Indonesia–Singapore (Target: 2040): The proposed interconnection will have a planned capacity of 1.2 GW.[17] It will consist of a 260 km (including approximately 100 km subsea cables), ±250 kV HVDC link connecting Paranap substation in Sumatra, Indonesia to Singapore.[18]

It may be noted that, in May 2025, Singapore Energy Interconnections (SGEI) – a government-established entity responsible for developing cross-border power links – and Singa Renewables, a joint venture between TotalEnergies and Royal Golden Eagle, signed a Memorandum of Understanding (MoU) to develop a subsea interconnector. This project aims to supply low-carbon electricity from Indonesia to Singapore.[19]

Singapore plans to import about 6 GW of low-carbon electricity from the region by 2035[20], with Indonesia serving as a key partner. As of October 2025, the Energy Market Authority (EMA) of Singapore has granted conditional licenses to

Figure 6: Indonesia's Green Enabling Super Grid



Planned Domestic Interconnectors

1. Sumatra–Java	2. Kalimantan–Java
500 kV HVDC | 1,174 km | 2.6 GW | 2031 To channel Sumatra's 14.5 GW potential (7.3 GW geothermal and 7.1 GW hydro) to Java demand centres	**500 kV HVDC | 1,096 km | 2040** To supply surplus renewable energy from Kalimantan to meet Java's electricity needs
3. Sumba–Bali–Java	**4. Sulawesi Backbone**
500 kV HVDC | 1,394 km | 2 GW | > 2040 To transmit up to 2 GW of solar power from Sumba to meet electricity demand in Java	**275 kV | 4,018 km | 5.7 GW | 2026-2031** To transfer up to 5.7 GW of central Sulawesi hydropower to major demand centres
5. Kalimantan–Sulawesi	**6. Sumatra–Batam–Bintan**
680 km | Beyond 2040 Feasibility & financial viability studies under assessment	**275 kV | 556 km | 2031-2033** To deliver power to digital/data centre demand in Batam and Bintan

Note: The HVDC option for Kalimantan–Java and Sumba–Bali–Java is still under investigation.
Source: RUPTL 2025-2034

six Indonesian projects totalling 3 GW (including 1 GW allocated to Singa Renewables), along with conditional approval for another 400 MW project. This demonstrates strong interest from international consortia in supplying large scale renewable energy from Indonesia to Singapore.

Perawang, Sumatra, Indonesia–Peninsular Malaysia (Target: 2035): This proposed interconnection is a 234 km HVDC link with a planned capacity of 2 GW[17], connecting Perawang in Indonesia to Telok Gong in Malaysia. It will be developed jointly with Malaysia's Tenaga Nasional Berhad (TNB).

Current studies indicate a nominal voltage of ±500 kV, although an alternative ±250 kV configuration is also under consideration.[21]

Malinau, Kalimantan, Indonesia–Sabah, Malaysia (Target: 2035): This proposed interconnection has a planned capacity of 200 MW[17], connecting Malinau in Kalimantan, Indonesia, to Kalabakan in Sabah, Malaysia. The project will be developed in collaboration with Sabah Electricity Sdn Bhd (SESB). A detailed feasibility study for this project is currently underway.[22]

Sarawak, Malaysia–West Kalimantan, Indonesia Expansion (Target: 2040): Building on the existing interconnection commissioned in 2015 between Mambong in Sarawak and Bengkayang in West Kalimantan, this project aims to expand transmission capacity by an additional 600 MW, raising the total capacity from 230 MW to 830 MW.[23]

These proposed interconnectors serve multiple strategic objectives. They diversify revenue streams, attract foreign investment into domestic renewable generation, and strengthen the policy and regulatory framework for regional trade. Simultaneously, within the APG framework, these projects illustrate a broader shift toward regional interconnection and a growing interest in leveraging Indonesia's renewable energy potential. As such, they provide a complementary pathway to the domestic Super Grid, linking Indonesia's energy transition with wider regional market integration.

While these bilateral initiatives demonstrate increasing commercial and technical readiness, corresponding regulatory measures have also evolved to support cross-border electricity flows. Government Regulation No. 40/2025 (GR 40/2025) replaces the previous National Energy Policy (GR 79/2014) and introduces, for the first time, explicit provisions for electricity export and import through PLN or a government-appointed entity. This provides long needed regulatory clarity while maintaining the priority of domestic supply security. Although the overarching Electricity Law remains unchanged, GR 40/2025 establishes the policy conditions necessary for Indonesia to participate in regional power markets and optimise the use of surplus renewable capacity within a controlled and security-aligned framework.

Taken together, these developments mark a strategic shift in Indonesia's regional energy stance. As cross-border projects advance and renewable capacity expands, Indonesia's ability to exchange power with neighbouring systems will strengthen system flexibility, enhance resilience, and create new economic opportunities across the ASEAN market.

3.4 Grid Modernisation: Smart Infrastructure and System Flexibility

The expansion of renewable energy requires a modern grid capable of real-time monitoring, automated control, and predictive system management. Modernising the grid is a key operational priority for achieving the energy transition ambition.

The RUPTL 2025-2034 sets out a four-layer programme for PLN, requiring an estimated USD5 billion in investment[24], to enable comprehensive grid modernisation.

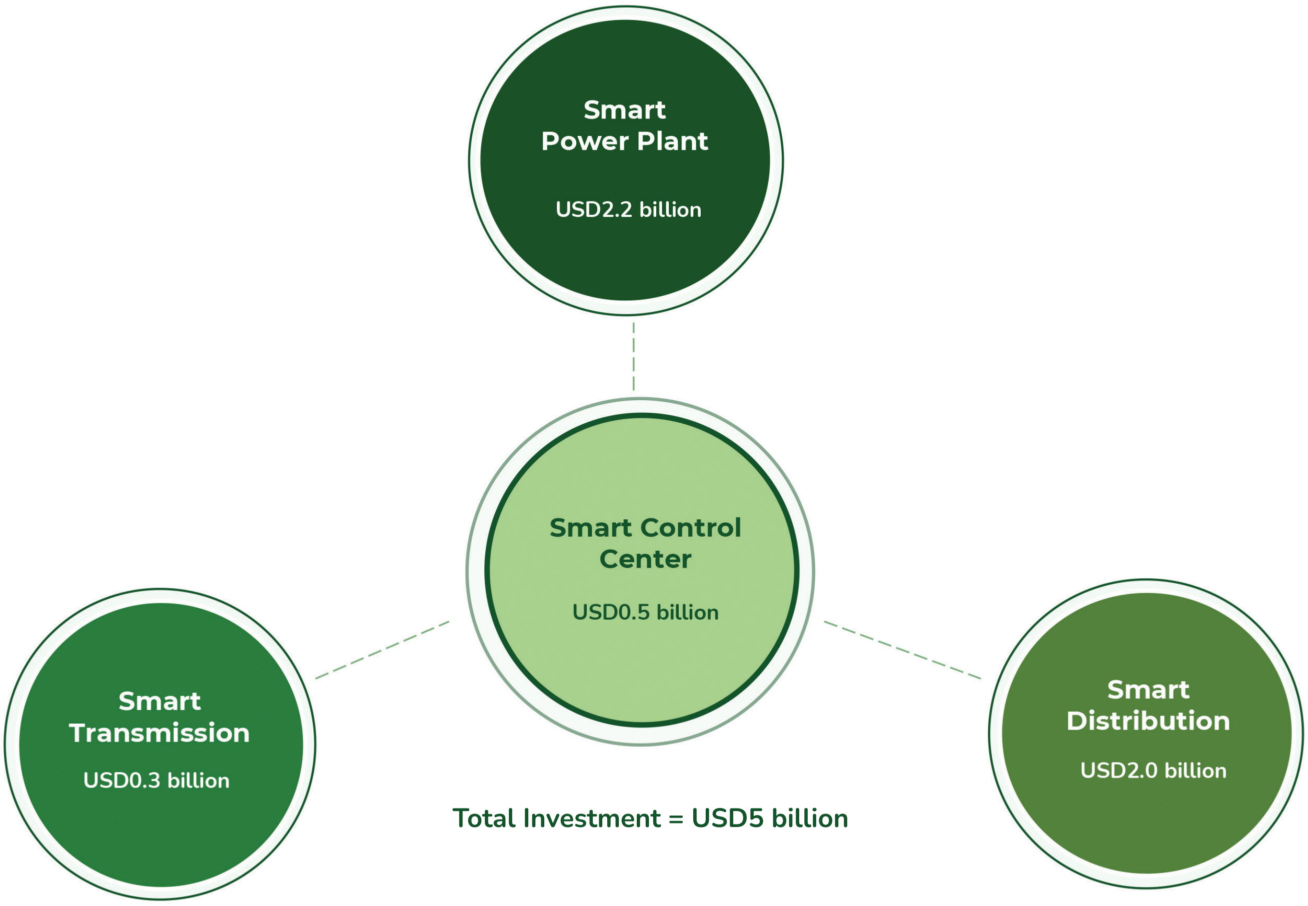
Smart Transmission that goes beyond basic line extensions to include HVDC networks for long-distance and back-to-back power transfer, Flexible AC Transmission Systems (FACTS), dynamic voltage and system strength support technologies such as synchronous condensers, Static VAR Compensators (SVC) and Static Synchronous Compensators (STATCOM). Modern converter-based compensation systems, such as enhanced STATCOM, can also provide inertial response and oscillation damping capabilities, thereby improving stability in weak or islanded grids with high shares of inverter-based renewable generation. These assets must be complemented by coordinated network control technologies, including wide-area monitoring and real-time power flow optimisation, to enable the secure integration of large scale variable renewable energy.

Smart Distribution that transforms the grid from a conventional Distribution Network Operator (DNO) to a modern Distribution System Operator (DSO), enhancing five core capabilities – operability, reliability, quality, efficiency, and flexibility. This transformation is driven by distribution automation, enabling the transition from passively operated networks to actively managed systems. Key enabling technologies include advanced monitoring and control platforms such as SCADA, automated feeder switching and fault isolation (self-healing), and Advanced Metering Infrastructure (AMI) for enhanced system visibility. Together, these capabilities support the reliable integration of distributed energy resources (DERs), including distribution-connected BESS, while improving network operability, resilience and flexibility in increasingly decentralised power systems.

Smart power plants that embed digital technologies directly into generation assets, including flexible generation controls, Automatic Generation Control (AGC), Power System Stabilisers (PSS), Digital Twin capability for predictive maintenance and reliability analysis, and Internet of Things (IoT) integration for isolated power systems, enabling generation assets to actively support grid stability rather than simply produce power.

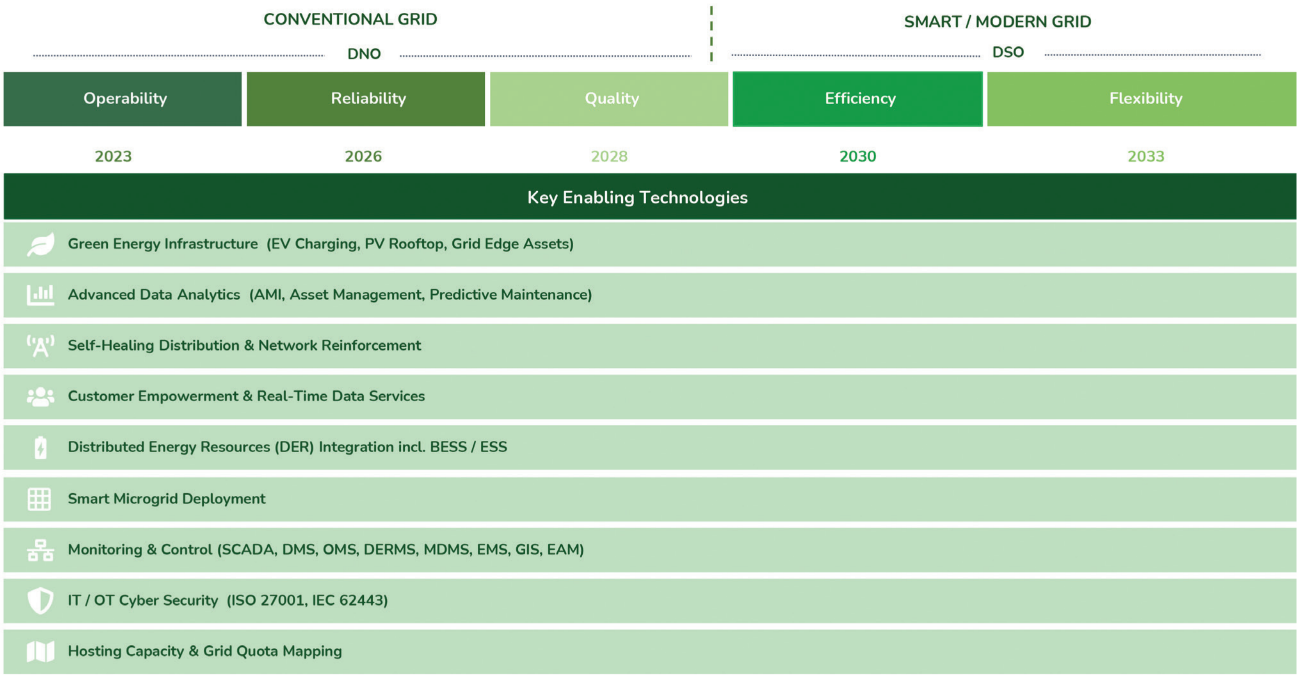
Smart Control forms the core, integrating all transmission and distribution layers through a coordinated and cyber-resilient control architecture. This digital operational backbone supports secure real-time monitoring, distributed system coordination, dispatch optimisation, and resilient network operation across increasingly decentralised power systems.

Figure 7: PLN's Proposed Smart Grid Investment Plan



Note: Smart transmission investment does not include HVDC-related investments.
Source: RUPTL 2025-2034

Figure 8: Grid Modernisation Roadmap



Note: Adapted from RUPTL 2025-2034.
Source: Global Transmission Report

RUPTL 2025-2034 includes the development of Smart Control Centres on the islands of Sumatra, Kalimantan, and Sulawesi, each designed to operate as a regional hub. These centres will be interconnected with a National Control Centre in Java, enabling centralised oversight and system-wide coordination. This integrated architecture is a critical component of the GESG vision, allowing PLN to efficiently manage increasingly decentralised and variable renewable power flows.

The rollout of this unified smart control system is planned for 2026-2027, coinciding with the early phases of the Super Grid and the broader grid modernisation roadmap.

RUPTL 2025-2034 explicitly includes capacity building for grid operations personnel, recognising that hardware alone cannot function effectively without the skilled human infrastructure to operate it.

However, it should be noted that the technology plan by itself is insufficient without accompanying policy and commercial reforms to make investments viable and projects executable. Currently, grid infrastructure, renewable generation, and market design are planned separately, creating institutional inefficiencies.

Indonesia needs a fully integrated planning framework that co-optimises generation, transmission, and system flexibility as a single, coordinated system. Without this approach, grid expansion risks remaining reactive rather than anticipatory. ■

PRIVATE SECTOR PARTICIPATION IN TRANSMISSION

4

Indonesia's energy transition imposes substantial demands on grid expansion and modernisation at a scale that public financing alone cannot meet. Mobilising private capital is therefore essential to delivering net-zero commitments.

PLN currently operates as the sole transmission operator and dominant off-taker. While this structure facilitates system coordination, it concentrates financial risks arising from coal IPP obligations, subsidised tariffs, and the capital intensity of grid expansion. In response, the government has begun signalling greater openness to private participation to alleviate these constraints and mobilise additional investment.

4.1 Regulatory and Legislative Challenges

The proposed New and Renewable Energy Bill or Rancangan Undang-Undang Energi Baru dan Energi Terbarukan (RUU EBET), which has been under deliberation since 2021, represents the most consequential regulatory development affecting private participation in transmission. Its central, unresolved provision concerns the Joint Utilisation of Transmission Networks or Pemanfaatan Bersama Jaringan Transmisi (PBJT), commonly referred to as power wheeling, which would allow private companies to supply electricity directly to consumers via existing infrastructure.

However, in early 2025, media reports indicated that the government reaffirmed its intention to keep PLN as the primary regulator of the electricity market, while ruling out the immediate rollout of a full power wheeling scheme.

If implemented, power wheeling could significantly transform Indonesia's single-buyer market structure, though the proposal continues to be debated. This reform carries particular relevance given the scale of corporate demand for renewable energy. More than 130 RE100-affiliated companies operate in Indonesia,[25] however, access to clean electricity remains constrained under the current system. Progress has been impeded by Constitutional Court Ruling No. 39/PUU-XXI/2023, which reaffirmed the requirement for an integrated, state-controlled electricity system and raised concerns regarding market liberalisation. This has led to legal uncertainty around private participation in transmission.

The policy framework faces another inconsistency. As mentioned before, RUPTL forecasts that approximately 73% of new generation capacity will be delivered by IPPs.[8] In the absence of mechanisms such as power wheeling, these producers remain dependent on PLN as the sole off-taker, dampening investment incentives.

4.2 Initiatives to Attract Private Capital

In parallel with ongoing legislative discussions, the government has taken several initiatives to attract private and international investment into transmission infrastructure.

In February 2025, the government established Danantara, Indonesia's new sovereign wealth fund, to manage and optimise state-owned assets in support of the country's industrialisation and economic growth. Since its inception, Danantara has prioritised renewable energy and aims to advance Indonesia's clean energy transition.[26]

As part of this effort, Danantara has signed MoUs with several institutions, including the Japan Bank for International Cooperation (JBIC), to support a digitally connected green economy, focusing on renewable energy, electricity transmission, and water and wastewater management.[27]

Meanwhile, the Transmission Finance Joint Team, established under the Joint Office for Energy Transition, is tasked with identifying financing gaps, reviewing regulatory frameworks, and developing bankable investment models. These efforts draw on international experience from markets such as Singapore, India, Australia, and Egypt, where varying degrees of private participation in transmission have been implemented.[28]

The Transmission Finance Joint Team is currently evaluating the following alternative transmission financing options on PLN's request:[28]

1. Corporate Finance (BAU): Standard corporate loan to PLN
2. Deferred Payment: Payment made after project completion
3. Public-Private Partnership (PPP): Shared ownership or service provision with the private sector
4. Leasing (Build-Lease-Transfer): The private sector builds and finances, then leases back
5. Asset-Backed Securities: Investment backed by revenue-generating assets
6. Financial Ownership: Off-balance sheet JV with blended finance or BAU options
7. Public Service Agency: Government entity develops and owns transmission projects
8. Investment Trust: Pooled funds from investors for transmission projects

A joint roadmap issued in December 2025 by the Energy Transition Partnership and the Coordinating Ministry for Economic Affairs outlines measures to strengthen the investment environment, encompassing tariff adjustments, streamlined tender processes, prioritisation of transmission development near renewable energy clusters, and enhanced project bankability through targeted policy support.

The Energy Transition and Green Economy Task Force, established under CMEA Decree No. 141/2025, coordinates cross-sectoral implementation of Indonesia's net-zero strategy. Operating in collaboration with the JETP Secretariat, the Task Force monitors 13 high-priority projects spanning renewable energy, transmission, energy efficiency, and electrification.[14]

4.3 Local Content Requirements

Reforms to Local Content Requirements (LCRs) represent a complementary step toward improving investment conditions. Historically, LCR policies constrained procurement of specialised equipment, particularly for advanced grid technologies where domestic manufacturing capacity is limited.

Recent regulatory changes introduce greater flexibility. MEMR Decree No. 191/2024 streamlines LCR thresholds by applying a single project-level requirement, while allowing lower thresholds for technologies with limited domestic supply. Transmission infrastructure LCRs now range from 38-66%, while substation requirements range from 12-77%. MEMR Regulation No. 11/2024 provides exemptions for projects with at least 50% financing from multilateral development banks or international financial institutions.[29] The LCR reforms improve procurement efficiency and enhance the attractiveness of transmission projects to international investors.

Private sector participation in Indonesia's transmission sector is both an operational necessity and an acknowledged strategic priority. Recent policy signals, institutional reforms, and regulatory adjustments reflect a gradual shift toward a more enabling environment. Translating this momentum into tangible investment, however, will require clearly defined legal frameworks, bankable project structures, and sustained alignment between national policy objectives and market mechanisms. ■

CONCLUSION

5

Indonesia's economic progress and energy transition increasingly depend on the power sector's ability to deliver on policy objectives. The country's development goals – accelerating growth, expanding industrial value chains, and meeting climate commitments – are closely interlinked and require a power system that is cleaner, more reliable, and better integrated.

Indonesia has abundant renewable resources, but they are geographically distant from major demand centres, and transmission infrastructure has not kept pace with generation plans. Without proactive grid expansion, renewable deployment risks falling behind targets. Near-term investment in transmission and distribution is therefore as consequential as any generation decision for achieving the country's energy transition objectives.

Mobilising private capital at the necessary scale is equally critical. Investment requirements exceed public financing capacity, and while recent regulatory reforms signal progress toward a more enabling environment, clarity on private participation in transmission will be essential to strengthen investor confidence.

The transition's complexity should not be underestimated. Ongoing thermal capacity additions, gradual coal phase-down schedules, and differing timelines and incentives from external financiers create competing pressures.

Indonesia nonetheless retains important advantages. Its resource endowment, established planning frameworks, and growing international support provide a strong foundation. The country can also draw on the experience of other Asian economies while adapting solutions to its domestic institutional and geographic context. If managed effectively, this transition can become one of Indonesia's most important enablers of sustainable growth and energy security. ■

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