S&P Global
Ratings

Energy Transition

Asia-Pacific Faces An Uphill Climb To A Cleaner Future

April 26, 2022

Primary Credit Analyst

Abhishek Dangra
Singapore
+ 65 6216 1121
abhishek.dangra@spglobal.com

Parvathy Iyer
Melbourne
+ 61 3 9631 2034
parvathy.iyer@spglobal.com

Apple Li
Hong Kong
+ 852 2533 3512
apple.li@spglobal.com

Research Support

Vernice Tan
Singapore

This report does not constitute a rating action.

Contents

Country Specific Key Takeaways

Appendix

Overview

Key Takeaways

- Evolving energy policies, awaited technological developments and significant capital investments required over time may delay the energy transition for most Asia-Pacific power utilities. Company-specific factors will be credit drivers for the next one to three years.
- China and Indonesia's policy-led energy transition will contrast with private sector-led renewable investments in India and Australia. State government policies and incentives will play a bigger role in Australia whereas in India federal policies will lead the way.
- Massive capital expenditure into renewables will stretch the balance sheets of rated utilities and could cause downside rating pressure for companies that are slow to transition or that adopt more aggressive leverage.

Asia-Pacific's energy transition will be an uphill journey. One full of twists and turns--and that's just the beginning. By global standards, the region faces considerable roadblocks as it moves to renewable and stable forms of energy. The reliance on fossil fuel-based generation remains high (nearly 70%); and demand for power is growing, with significant investment needs.

India and China's reluctance to agree to "phase out" coal dilutes the multinational agreement at the 26th UN Climate Change Conference (COP26) in November 2021. Therein lies a huge sticking point: the high dependence on fossil fuels for power generation and employment. For the next two decades, the developing and growing economies in Asia-Pacific will account for 60% of growth in global power demand. There has been progress of sorts. COP26 elicited declarations of net-zero emissions targets from many countries, including China, India, Indonesia, Vietnam, and Australia. The stage may be set for action, but each country will reach the summit at its own pace. To get there will require enabling policies and a reprieve in the high cost of technological solutions.

'For the next two decades, the developing and growing economies in Asia-Pacific will account for 60% of growth in global power demand'

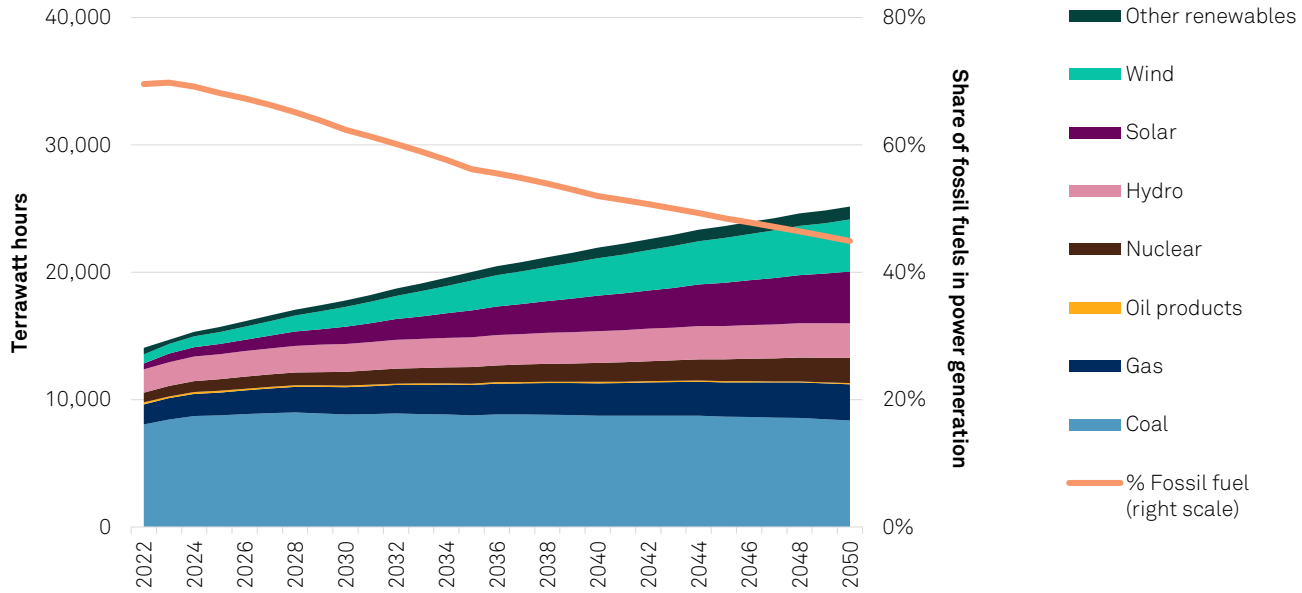
If the energy transition is to accelerate, we believe affordability, reliability and sustainability must converge. In many Asia-Pacific markets, dirtier fuels are cheaper, and many countries are lagging and more dependent on energy policies to gradually meet the global ambition of lower carbon emissions. In countries such as China and Indonesia, government policies will determine the energy transition whereas in India the private sector will take the lead because of the favorable economics for renewables. Short-term transition goals, particularly those of China and India, may face delays because of considerations around energy security and access to electricity.

Over the next decade, the current disruption of global supply chains and sharp increases in energy prices will act as an incentive for a faster transition toward renewables.

By accelerating the energy transition, large Asia-Pacific countries will focus on weaning their economies off energy imports. The importance of coal will decline but remain relevant in the generation mix--that is, unless greener technologies become a cheaper and equally stable form of power or if financial aid from developed nations can help Asia-Pacific countries decarbonize faster. This also increases the region's dependence on technological and cost breakthroughs in carbon capture and green hydrogen.

Chart 1

Renewables Will Meet Growth While Coal Will Likely Remain In APAC's Power Mix



Source: S&P Global Commodity Insights, Global Integrated Energy Model March 2022 Reference Case.

A crucial part of the challenge will be a balancing act between keeping energy prices affordable for the end customer while incentivizing new technologies. In some cases, this means green energy solutions that are more expensive but stable and making dirtier fuel costlier. The energy policies of most Asia-Pacific countries incentivize renewables rather than penalize coal. Carbon policies in the region currently lack the teeth to bite into the cash flows of power utilities. However, we expect energy policies to evolve, and some markets such as China could undergo rapid change to enable their long-term policy direction.

Climate change and its impact on the environment is foremost in the mind of most banks and global investors. Environmental, social, and governance (ESG)-related risks and their impact on funding is visible in Europe and Australia. In Asia, it's a budding story. This is because local banks are the major financiers to the region's power sector, and they have varied mandates on ESG. Nonetheless, it is only a matter of years before this risk becomes prominent in Asian countries. Nearly 60% of Asia-Pacific power generators are exposed to environmental risk factors, worth about US$500 billion of rated debt.

We expect big investments in renewables from renewable generators pursuing growth and national power majors leading energy transition efforts. This will stretch their balance sheets. Meanwhile, evolving policies could create higher credit risks for unregulated power players, who may not be able to pass on the entire cost. The choice of business mix and financial leverage could have a big credit impact over the next few decades; the short-term credit effect over the next couple of years will likely be based on company-specific factors. If companies undertake more aggressive leverage but fail to keep pace with policy directions, it will put downward pressure on ratings.

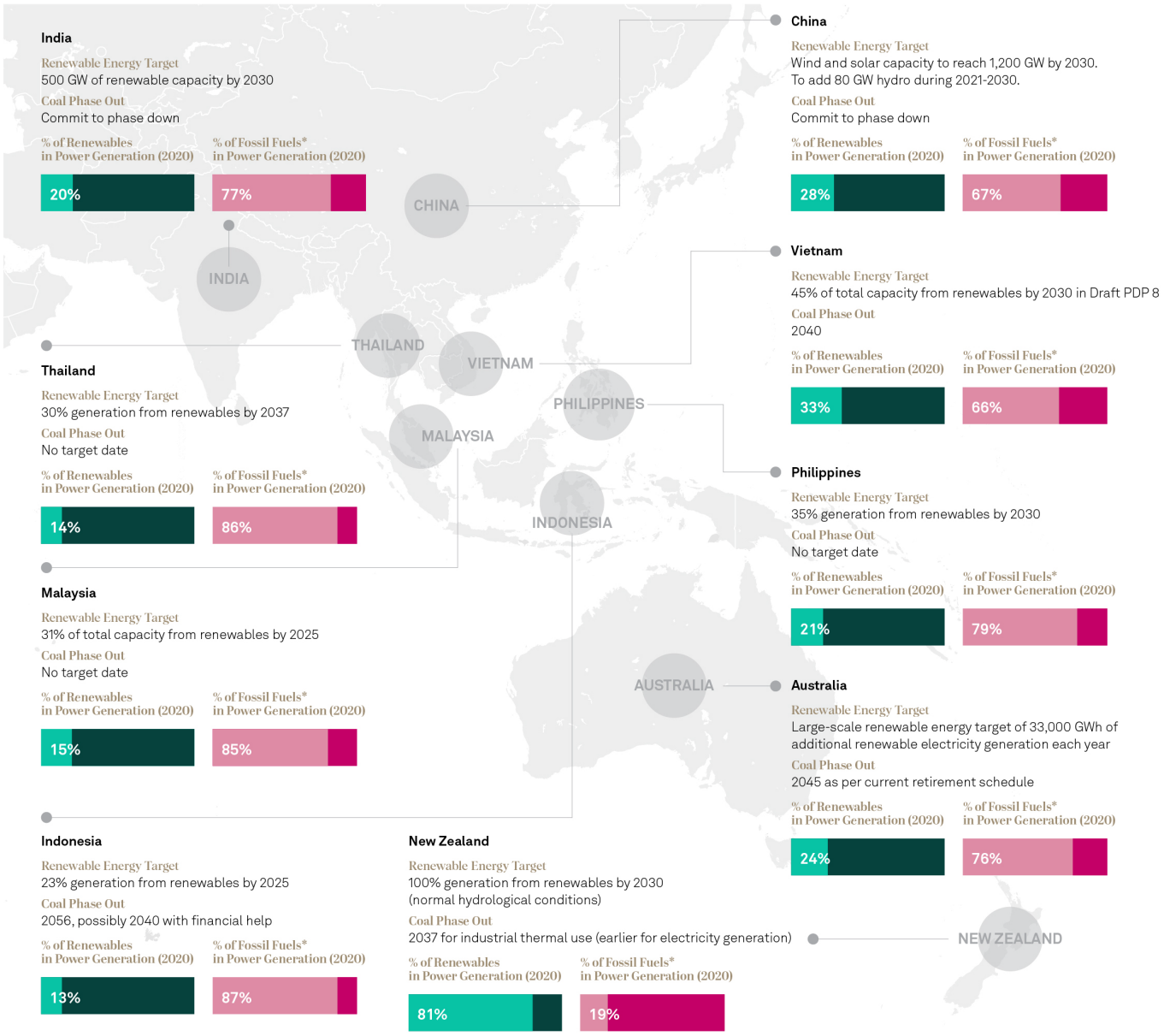
'Evolving policies could create higher credit risks for unregulated power players, who may not be able to pass on the entire cost'

Meeting Policy Goals Requires Versatile And Progressive Energy Policies

China's policy-led targets for energy transition and significant growth opportunities in India will drive heavy capital expenditure (capex) investments. Renewable players will pursue growth while fossil fuel power majors will target energy transition. In Australia, state government policies and incentives will guide renewable growth, while federal policies remain obscure.

Many Asia-Pacific countries have set ambitious energy targets given their current overdependence on fossil fuels; and policies are still evolving. Some have yet to announce a timeline to phase out coal. Sudden policy turns such as those in Vietnam can result in stranded assets while in countries such as Indonesia, a lack of detailed plans suggests the achievability of policy targets will require continual monitoring.

Asia-Pacific Renewable Energy Targets

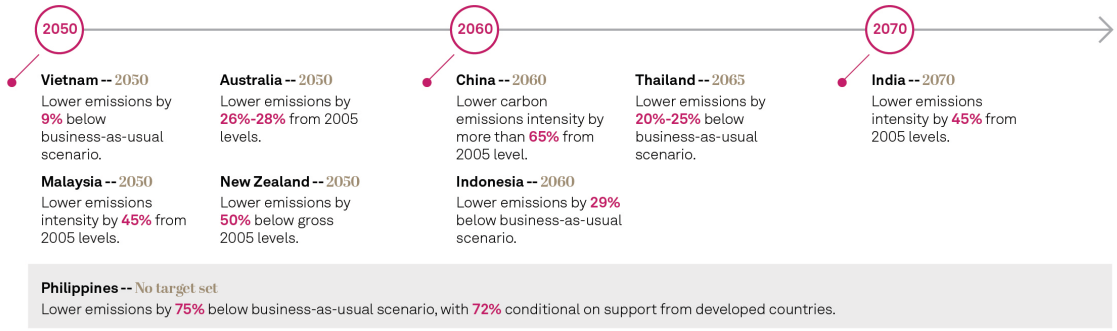


*Includes coal, natural gas and oil. Source: BP Statistical Review of World Energy 2021, Philippines Department of Energy, New Zealand Ministry of Business, Innovation & Employment, S&P Global Commodity Insights.

Net Zero Doesn't Mean Coal Is Out

Asia-Pacific's net-zero targets place high reliance on technological developments and feasible solutions for reducing and capturing emissions. In developing economies, the rising power demand and high dependence on fossil fuels create additional strains for Asia-Pacific countries relative to Europe. Coal generation will likely remain in the mix for most Asia-Pacific countries even by their net-zero target date. For China, nuclear power will also play an important role in achieving its targets.

Asia-Pacific Net Zero Targets And 2030 Emissions Commitments



Source: S&P Global Commodity Insights, S&P Global Ratings.

At Least Five Years Before Carbon Policies Have Any Bite

The transition faces delay because in most Asia-Pacific countries carbon policies are nascent. In India and Australia, carbon policies are lacking; in Indonesia, proposed carbon taxes are low; and in China they apply only narrowly. The delay in widening the scope of coverage consequently lessens the trading interest. And low carbon prices fail to disincentivize fossil fuel players. We expect carbon taxes to increase, but we doubt most Asia-Pacific countries will achieve a fully functional carbon trading market covering all key sectors before the end of the decade. In our view, many utilities will be able to pass-through additional costs under regulatory or contractual frameworks. Merchant players unable to pass on increasing carbon costs will face credit pressures.

Table 1

National Carbon Policies Still On The Drawing Board

	Carbon ETS	Carbon Tax
China	ETS in 2021, to expand from power generators to other industrial sectors	None established
India	None established	None established
Indonesia	Under consideration; plans for a fully operational carbon market in 2025	To begin in July 2022* at US$2.1/mt CO2 equivalent for coal-fired generators
Vietnam	Under consideration; pilot carbon exchange to start in 2025	None established
Thailand	Under consideration; voluntary emissions reduction system since 2015	None established
Philippines	Under consideration	None established
Malaysia	Under consideration; plans to introduce in phases from end-2022	Under consideration as part of 12th Malaysian Plan
Australia	None established	None established
New Zealand	Implemented in 2008	ETS in force

ETS--Emissions trading system. *Postponed from April 2022 to cushion impact of rising energy prices on consumers. Source: S&P Global Commodity Insights, S&P Global Ratings.

Energy Security And Affordability Could Slow The Pace Of Energy Transition

Access to affordable electricity will trump long-term energy transition goals. We acknowledge short-term actions focused on energy security and affordability might appear to delay energy transition. For instance, China has made energy security a primary goal. It has shown its willingness to increase generation from coal temporarily for the next 12-24 months, thereby deviating from a recent focus on containing emissions. India's customs duty levy on solar equipment and raw materials also aims to improve energy security. But it could accelerate energy transition after three to five years by improving the manufacturing ecosystem. Indonesia remains focused on electricity affordability because of the knock-on effect on its economy--that's assuming tariffs in its power plans remain flat until the end of the decade. Australia is focused on energy security to meet peak demand and avoid grid instability until networks can support the growing decentralized renewables projects.

'Access to electricity at an affordable price will trump long-term energy transition goals'

Grid Stability And Technological Developments Will Demand Large Capex

The lack of integrated energy plans obscures the amount of base-load power needed to replace fossil fuels; while high growth in renewables can result in grid instability and curtailment risks--a reduction in the amount of energy delivered by a generator to the grid. A forecast drop in technology costs and solutions for round-the-clock green power are critical to achieving policy targets, which assume significant replacement of fossil fuel-driven base-load power. Technological and cost breakthroughs will create inflection points for energy transition. Heavy investments into the grid, smart metering, and strengthening will become part of the cost equation in the energy affordability and transition costs.

'Technological and cost breakthroughs will create inflection points for energy transition'

Power grid: Increasing the proportion of renewables in the energy mix will expose the generators to the risk of higher curtailment due to the intermittent nature of renewable power. Vietnam's fast growth of renewables in past two years has led to an appreciable increase in curtailment risk, while Indonesia needs significant investments to strengthen its grid. Renewables, particularly in resource-rich regions, also impose a demand-and-supply imbalance on the grid, requiring further strengthening of the transmission and distribution network. This can expose the renewable power generators to the risk of losing cash flows, especially in the absence of an adequate grid balancing mechanism and development of storage solutions. Countries with smart grids and integrated networks--such as Australia and China--can achieve grid stability through network investments whereas countries such as India and Indonesia will rely more heavily on battery and storage solutions to balance demand. Yet, Storage solutions will also be critical in all Asia-Pacific countries to efficiently meet demand--under all conditions--without creating redundancies in the network.

Technology: Pumped hydro and improvement in battery storage solutions will drive energy transition toward the end of the decade. Pumped hydro is emerging as the most obvious candidate to provide storage solutions due to its proven nature and the lack of economical alternatives. Batteries providing one-to-two-hour storage are currently only able to help balance peak demand. Cost competitive carbon-capture technologies and green hydrogen breakthroughs will be closely watched as Asia-Pacific is likely to remain reliant on coal for the next few decades. In China, the development of power storage and carbon-capture technologies will accelerate over the next decade. Green hydrogen could play a bigger role if cost breakthroughs are achieved by the early to mid-2030s. For instance, industrial hydrogen supporting manufacturing or clean hydrogen for certain industries, including commercial and residential use. In Australia, the private sector is keen to progress this through grants from state governments or allied bodies such as the Clean Energy Council, but projects remain only at pilot stage. China and India also have plans to scale up green hydrogen, but such plans won't make a meaningful impact until the beginning of next decade.

Will Growth And Transition Capex Cause Bumps In Credit Quality?

Massive capex investments into renewables will stretch the financials of rated utilities, resulting in downside rating pressure for companies that adopt more aggressive leverage. For increasingly competitive markets, the cash flow stability of regulated fossil fuel majors may weaken during the growth stage of renewables. In large markets (such as China, Australia, India), we expect good regulatory support and continuity for regulated network businesses.

ESG-related risks are increasing for Asia-Pacific power utilities, and we expect this will intensify over the next few years. We see emerging trends of international capital market players turning cautious on fossil fuel-based generators. This is despite strong cash flow visibility with assured regulated returns and relatively lower leverage compared with fast-growing renewable operators. Emerging trends include the use of green bonds; transition funding with ambitious renewable capacity targets; and alternative funding channels with segregated fossil fuel and renewable capacity. For example, the four Australian major banks have varied positions on funding of coal and fossil fuel-related assets. All are reluctant to fund new projects; some are willing to support existing assets with a clear target to reducing debt; and some are not expected to fund this.

ESG factors and strong green credentials are increasingly important for renewables players. Such credentials provide them with an increasing pool of long-term domestic bank funding, frequent access to international dollar bond markets, and continuing equity investments with support from large institutional investors. Currently, we haven't observed significantly higher cost of capital for fossil fuel-based players. However, we expect increasing differentiation in funding costs for fossil fuel generators and renewable players over the next three to five years.

'Massive capex investments into renewables will stretch the financials of rated utilities, resulting in downside rating pressure for companies that adopt more aggressive leverage'

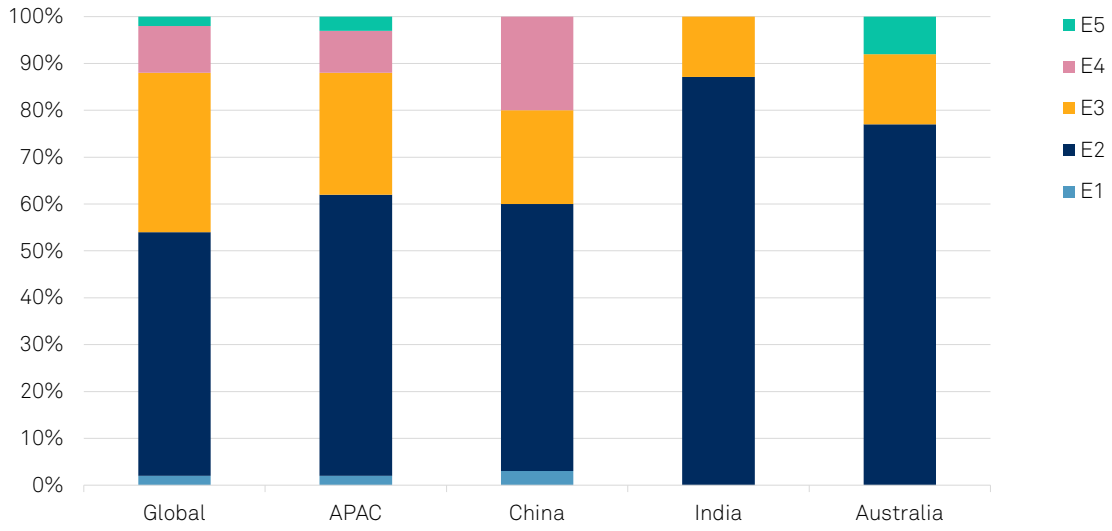
Impact Of ESG Factors On The Credit Quality Of Power Utilities

Nearly 60% of Asia-Pacific power generators are exposed to environmental risk factors (with an environmental risk credit indicator of E-3 or higher, indicating some negative consideration in credit ratings). This counts for about US$500 billion of rated debt. Climate transition risk is the key ESG risk for fossil fuel-based generators in Japan, China, and Hong Kong. More than 85% of utility networks (e.g., transmission and distribution companies) have only indirect exposure to environmental risk factors. On a combined basis, about 40% of Asia-Pacific power utilities are exposed to environmental risk factors.

'Nearly 60% of Asia-Pacific power generators are exposed to environmental risk factors'

Chart 2

Regulatory Support And Renewables Moderate APAC's Exposure To Environmental Risks



Includes power generators and utility networks. Source: S&P Global Ratings.

For two rated issuers, Tepco Holdings, Japan's largest regulated utility company, and EnergyAustralia, environmental factors are a very negative consideration (E-5) in our credit rating analysis.

- The Fukushima No.1 nuclear power plant accident in 2011 caused unprecedented environmental concerns across Japan, and the burden on Tepco itself is immense. Strongly backed by the Japanese government and industry, the company has agreed to contribute ¥8 trillion to the decommissioning project over the next 30-40 years. Even though the company has dramatically changed its management and business operations, we think it will carry this burden for a long time. The company has considerable risk of litigation related to the accident and has huge off-balance-sheet liabilities, although it has steadily stabilized operations and earnings since the accident.
- EnergyAustralia will remain more exposed to climate transition risk over the next decade because of its predominantly coal- and gas-oriented generation base (54% coal, 30% gas) as well as costs associated with the scheduled retirement of the Yallourn coal plant in 2028. Exposure to flooding and end-of-life asset retirement costs and associated waste management also increase environmental risks.

Environmental factors are a negative consideration (E-4) in our credit rating analysis on State Power Investment Corp State Power Investment Corp. Ltd., China Huaneng Group Co. Ltd., China Huadian Corp. Ltd., Huaneng Power International Inc., China Resources Power Holdings Co. Ltd., Guangdong Energy Group Co. Ltd. and PT Cikarang Listrindo Tbk as these companies have sizable exposure to fossil fuel-based power plants. China's decarbonization initiatives could lead to lower utilization hours, margins and increase the risk of additional costs to improve efficiency and need for carbon trading to meet carbon emissions quotas.

Environmental factors are a moderately negative consideration (E-3) in our credit rating analysis of fossil fuel-based generators and LNG-focused Japanese utility networks. Similarly, unregulated fossil fuel-based generators still in the process of transitioning with lower diversification into renewables in countries like Australia, Thailand, India, Hong Kong could face higher cash flow volatility and capex burden for transition.

We believe fossil fuel-based generators with strong regulatory mechanisms and framework (like in India), pure-play renewable players and utility networks in the region are not exposed to significant environmental risks (E-2). Pure-play renewable players with good operating performance in China and India benefit from stronger credit positioning (E-1), while environmental factors have a neutral impact on other renewable generators with weaker operating performance (like in India) or New Zealand-based renewable generators with some hydrology risks.

Related Research

- India Renewables: Growth Trumps Deleveraging, April 2022
- Industry Top Trends 2022 Asia-Pacific Utilities, Jan. 26, 2022
- Energy Transition In Asia-Pacific: A Marathon, Not a Sprint, April 19, 2021
- ESG Credit Indicator Definitions And Application, Oct. 13, 2021

Editor

Lex Hall

Digital Designer

Halie Mustow

S&P Global
Ratings

Australia

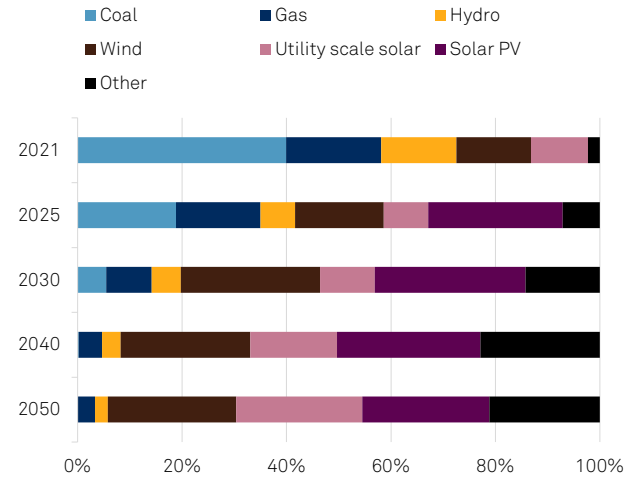
States Take Leadership In Energy Transition As Federal Policies Dither

Primary Credit Analyst: **Parvathy Iyer**
Research Support: **Ambrose Beaney**

Key Takeaways

- Obscure energy policies at the federal level could cause inefficiency and mean Australia is left behind in the energy transition.
- Addressing the lag in the massive network augmentation will require better coordination of renewable investments across states.
- Delays in setting targets for electric vehicles (EVs) and investment in technology will affect future market design.

NEM Capacity Evolution Till 2050 (Step Change Scenario)



Source: Australian Energy Regulator (AER), Australian Energy Market Operator (AEMO). Other includes Utility Scale Storage and Distributed Storage. NEM--National Electricity Market.

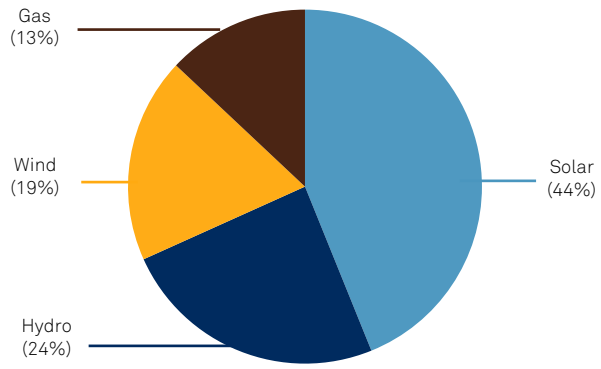
Policy	Target
Net Zero	2050
2030 Emissions Commitment	26%-28% reduction on 2005 levels
Peak Emissions*	2028
Renewable Energy (Large Scale)	Additional 33,000 GWh per year through 2030
Renewable Energy Target (By States)	By 2030: – 50% in Victoria, Queensland, Northern Territory – 100% South Australia, Australian Capital Territory – 200% Tasmania (as net exporter) – 60% New South Wales
Carbon Tax Or ETS	None established
Coal Phase-Out	2045 as per current retirement schedule
Electric Vehicles Penetration	No federal target

*S&P Global Commodity Insights, Global Integrated Energy Model March 2022 Reference Case.

Obscure Federal Energy Policies Increase Uncertainty Of The Market Design Post-2025

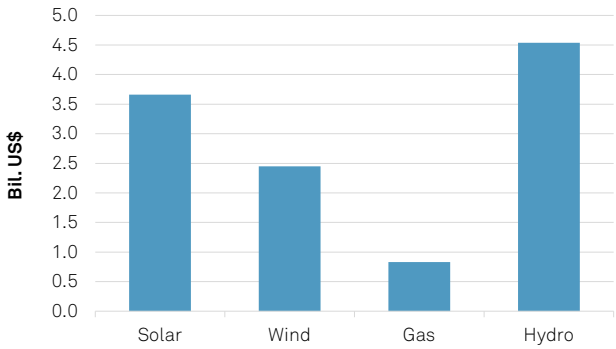
- Federal direction remains unclear and confusing.
- States are leading renewable energy policies with clear targets and the creation of renewable energy zones. Since 2017, several state incentives have contributed to a rapid rise in renewables in Australia. These include rooftop solar/home battery, low cost of solar and wind technology, corporate power purchase agreements (PPA) and ESG-related risk to coal-fired generators. Renewables now contribute about 32% of total generation; double that of 2017. Planned investments of about 9 gigawatts (GW) in renewable power to 2026 (see the NEM Capacity Additions chart below) have spurred the review of several market rules and design post-2025.
- However, lagging network enhancement is the main risk in supporting renewable projects. Over the past two years, this lag has led to the curtailment of new projects. The market operator expects about 10,000km of transmission lines to be built over the next decade. Better coordination of renewable projects and storage across states can increase the efficiency of investments. The regulatory framework remains supportive, but the scale and cost of the buildout will partially offset the benefits of the low cost of renewables to consumers.
- Curtailment risk and volatile electricity prices are affecting financing for some renewables projects. Some states are examining alternative mechanisms to support new projects until they become operational and secure PPAs.
- ESG-related risks and a decline in profitability will increasingly make coal-fired plants less reliable and hasten their closure unless there are incentives for an orderly exit. Poor returns on capital will deter the use of capital expenditure (capex) to maintain reliability. Adding to credit risks are a shrinking investor base and the higher cost of refinancing coal plant debt because of ESG concerns. The market operator anticipates coal-fired capacity will fall to as low as 5 GW by 2033 (see the chart NEM Capacity Evolution Till 2050, down to 25% of current levels). However, this will depend on the pace of network augmentation.
- The electrification of transport (20% of current emission levels) is a key pillar for Australia's target of net zero by 2050 (from 2005 levels). Electrification together with other forms of low-cost renewable technology are forecast to reduce emissions by 85% by 2050. The remaining 15% is expected to come from technology breakthroughs over the next two decades. Considering the limited policies on EVs and associated infrastructure, we expect possible delays in the first 10 years.
- Some states are considering the long-term use of gas in the energy mix. This will depend on the factors discussed above, as well as the use of hydrogen and when it will become economical. We believe gas will remain an important fuel in the economy at least until the 2040s, although its use may plateau gradually until then.

NEM Capacity Additions Of 9 GW Over 2021-2026



Source: AEMO, committed and anticipated additions; excludes Rooftop Solar.

NEM Capital Investments Of US$11.5 Billion Till 2026 (Generation Only)

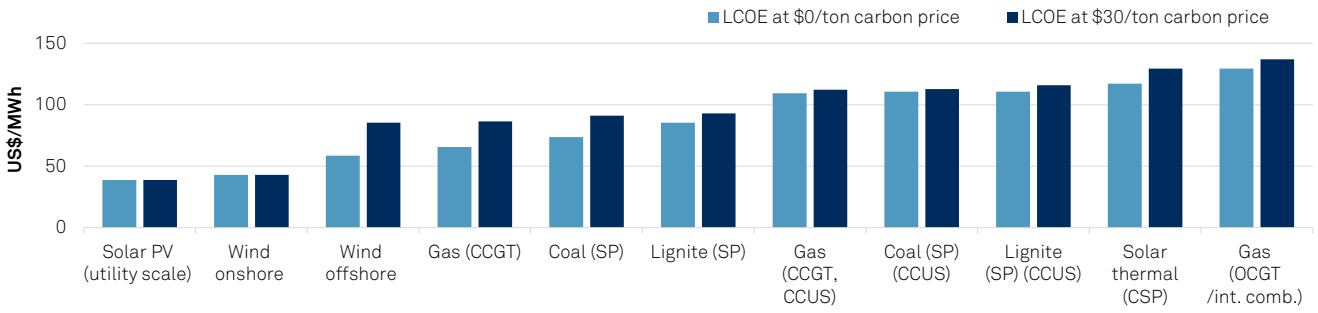


Source: AEMO, excludes Rooftop PV.

Impact Of Energy Security Considerations On Energy Transition

- Energy security and system stability is a big focus for the market operator. This is because 60% of today's generation comes from centralized coal-fired plants and these will be replaced by decentralized variable generation by 2040 or 2050. Currently, the market has 23 GW of coal-fired capacity and 20 GW of dispatchable firm hydro and gas generation.
- Under volatile supply and demand conditions, coal plants support the system strength. Firm storage will be needed as more variable wind and solar generation replaces coal generation. Few large-scale batteries storage sites have become operational in the past two years, and we expect the size and duration of support will evolve in the next 10 years.
- The Australian Energy Market Operator 's (AEMO) "step change" scenario of energy transition involves a rapid move away from coal, a swift fall in technology cost, and a rise in digitization. AEMO expects storage to play a greater role, increasing slowly from 3 GW in 2023 to about 15 GW in 2030, 30 GW by mid-2030, and 40 GW by the 2040s.
- We therefore believe that for generation purposes, gas will remain a transition fuel for next eight to 10 years by which time batteries, hydro, and storage solutions for at least eight hours' depth should be established. To ensure stability as the penetration of renewables accelerates, the 2022 integrated system plan comprises several market rule changes, strategies to integrate distributed energy sources, and network projects.

Low LCOE Of Renewables Is Accelerating The Transition Toward Clean Energy

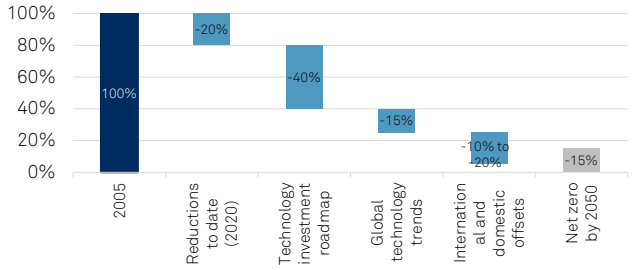


SP-- Supercritical pulverised. Source: IEA Levelized Cost of Electricity Calculator, December 2020. Other Assumptions: 7% discount rate.

Technological Focus And Grid Stability

- Australia's energy transition to 2050 relies on technology changes and lowers costs. This includes low-cost solar, energy storage for firming capacity, clean hydrogen, and carbon-capture solutions. Policies on how this will be achieved are opaque. The government plans to invest more than A$20 billion to 2030 and attract private investment (estimated at about A$80 billion) to support the change.
- The "technology platform" is an important factor for the following reasons and will be the key variable in the pace of transition.
  - The market will need to double the electricity output (from 180 terawatt-hour (TWh) currently) to replace the fossil fuel used in the economy i.e. power generation, transport, office, industry, and domestic use. Adapting networks for two-way flow of electricity.
  - Add 45 GW of firming capacity by use of batteries, hydro and pumped hydro for stability.
  - Incorporate hydrogen use in the economy as its costs become economical.
- EVs will likely pick up by 2030 if infrastructure is established. The cost factor may delay the influence of clean hydrogen until the mid-2030s. Less influence is expected from carbon-capture technology until 2040s.

Priority Technology Contributions To Meet Australia's Goal Of Net Zero By 2050



Source: Australian Government publication on Emissions Reduction Plan.

Major Sectors	Reduction Levels By 2050 From 2005
Electricity	91%-97%
Transport	53%-71%
Industry, mining, and manufacturing	18%-54%
Agriculture	29%-36%
Offsets	131%-278%
Net reduction	85%

Source: Australian Government publication on Emissions Reduction Plan.

Growth And Transition Capex Plans

- The capital investment required over the next decade is massive. We expect the generation market to become fragmented and the size of the dominant market players to decrease. This together with the highly competitive nature of the generation market implies credit pressure will increase in the generation and retail sectors. Secure and stable PPA arrangements and hedge contracts can reduce credit risks. In contrast, aggressive debt usage for network projects will affect credit quality. However, network entities generally like to manage this to a 'bbb' risk to attract cost-effective capital.
- The industry estimates new generation investments of about US$12 billion to US$20 billion over the next 10 years to phase out coal-fired generation. Much of this is expected to go into solar, wind and hydro generation alongside storage solutions. Coal-fired generation will also incur costs associated with retirement and remediation as sites shut down.
- Similar or higher investments will also occur in multiple transmission networks where the costs will evolve. While the market operator has identified committed and actionable network projects, the cost estimates can become firm only when the generation projects begin, and network routes and community consultation are completed.
- In contrast, the regulated network businesses see many growth opportunities. We expect the regulatory framework to remain supportive in helping attract adequate capital for the generational change in network configuration. The risk will come from access to appropriate contractors and contingencies to support the projects.

S&P Global
Ratings

China

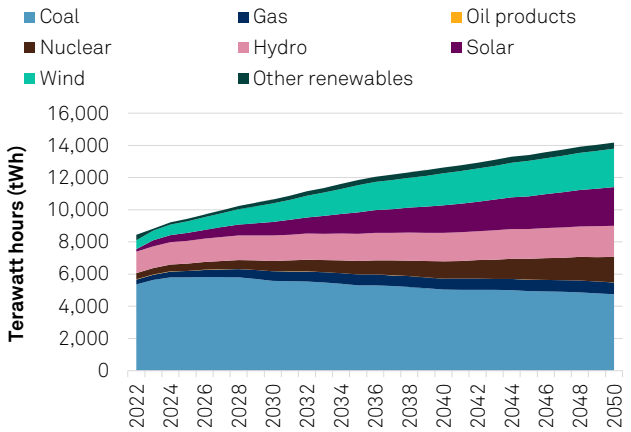
Energy Security Prioritized Over Speedy Transition

Primary Credit Analyst: **Apple Li**
Research Support: **Rick Yoon**

Key Takeaways

- Broader market-based reform will increase competition for generation companies (gencos); operators with a higher mix of renewables are better off.
- Renewables continue to receive supportive policies, but energy security is China's priority.
- Affordable new technology and reliable smart grids are key to long-term structural energy transition.

Likely Evolution Of Energy Mix



Source: S&P Global Commodity Insights, Global Integrated Energy Model March 2022 Reference Case.

Policy	Target
Net Zero	2060
2030 Emissions Commitment	Lower carbon emissions intensity by more than 65% from 2005 level
Peak Emissions*	2027
Renewable Energy	Wind and solar capacity to reach 1,200 GW by 2030. To add 80 GW hydro during 2021-2030.
Carbon Tax	None established
Carbon ETS	Nationwide ETS implemented in 2021, participants to be expanded from power generators to other industrial sectors
Coal Phase-Out	Only committed to phase 'down'
Electric Vehicles Penetration	20% of newly sold private cars in 2025

*S&P Global Commodity Insights, Global Integrated Energy Model March 2022 Reference Case.

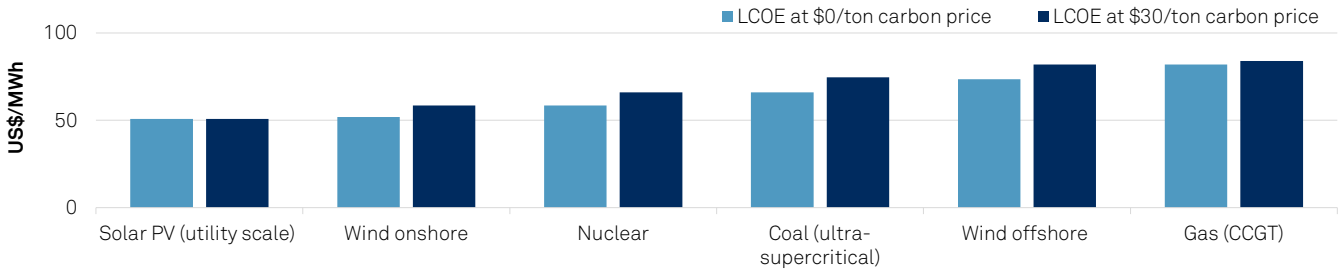
Shift Toward Market-Based Energy Policies With Focus On Renewables

- China's market-based reforms of the power sector will deepen over the next decade. The reforms will allow for better reflection of power supply-demand dynamics via market-based price setting and will accelerate the transition to renewable energy consumption. Gencos with better operational efficiencies and a higher mix of renewables will stand out amid the intensifying competition.
- For example, from 2022, all coal-fired power plants will enter market-based trading, with on-grid tariffs to float within a 20% band from the local base-tariff. The tariff policy enables gencos to pass through partial fuel cost to end users more frequently (except for residential and agricultural sectors). In some regions, the renewables price becomes even more competitive than coal-power given the absence of fuel cost.
- On the other hand, high energy-intensive industries will not be limited by the 20% tariff upper band when signing power supply contracts with coal-power suppliers, so their consumption of coal-power will be constrained. However, their consumption of green power will not be calculated in the total energy consumption target under the "dual-control" policy. This will incentivize the industrial sector's transition to the use of green power.
- By 2030, market-based trading will cover all renewable energy. We anticipate more supporting policies to accommodate higher adoption of renewables. This includes better transparency in trading rules and price settings for green power trading, promotion of various energy storage technology, and the establishment of transmission and distribution (T&D) facilities to ensure reliable supply.
- The central government aims to have 1,200 GW of wind and solar power by 2030, implying 7.3% of compound annual growth rate from 2020 (compared to about 33% between 2010-2020 on low base). In 2021, for the first time, renewable energy outpaced coal-fired power as the major power capacity and is expected to account for 92%-96% of capacity mix by 2050-2060, according to the Global Energy Interconnection Development and Cooperation Organization (GEIDCO).
- China is committed to the Paris Agreement on climate change targets and pledged to "phase-down" coal power in the 2021 UN Climate Change Conference (COP26). The country vows to achieve carbon peak by 2030 and net zero by 2060. In our view, China may achieve the targets earlier given its track record of overdelivering on its five-year targets in adding renewable capacity. This is also evidenced by the slower growth of CO2 emissions since 2010 when wind and solar capacity was added.
- We expect the growing demand for power--driven by wider electrification in the industrial and transportation sectors--to support the expansion of clean energy. The application of green hydrogen in producing steel and chemicals may be commercialized faster than we expect because China's oil majors are already using it to produce chemicals.
- Wind and solar projects without tariff subsidies still achieve satisfactory returns due to the decline in construction costs and improved utilization hours through participation in market-based trading. In the mid to long-term, green certificates and carbon credits will compensate the revenue loss on discounted tariffs.

Shift Toward Market-Based Energy Policies With Focus On Renewables... Continued

- Nuclear power is also poised to grow enormously in China as a zero-emission replacement for base-load power. Under its 14th five-year plan (14FYP), which runs to 2025, China will have about 70 GW of operational nuclear power projects. This compares to 54.6 GW under operation and 22.1 GW under construction by end of 2021. S&P Global Commodity Insights, expects operational capacity will grow to 67 GW by 2025, 105 GW by 2030 and 145 GW by 2035. That implies roughly 7% annual capacity growth for the next 15 years. New technology applications imply risks as well as approval for inland nuclear power projects, which may arouse public resistance because of safety concerns. Given geopolitical tensions, we anticipate new projects may prioritize China's self-designed G-III reactor, HPR1000 and CAP1400, to counter any international technology boycotts.
- China launched its national carbon trading scheme (CTS) in July 2021, following a trial period that began in 2013. The initial scheme only covered about 2,162 power generation companies. At present, gencos generally have limited incentive to trade carbon credits in the market. This is because most of them have mixed-asset portfolios and because carbon quotas are manageable for the time being.
- Nevertheless, we expect to see a more active and meaningful carbon price in the next five years following the participation in 2022 of other industrial sectors. Moreover, in time the government will post more stringent carbon quotas. Carbon credits will serve as an important market tool as these industrial companies seek to decarbonize. Eventually, carbon credits may supplement the income of suppliers, mainly renewable gencos, to compensate for the loss of tariff subsidies for their new projects.
- We also expect the CTS to function with other initiatives, including mandatory green certificates and the renewables quota system, to accelerate China's transition to a low-carbon economy. To achieve its goals, the government would have to implement more detailed trading rules, incentives and punishment policies, and innovative financing tools such as carbon-related derivatives.

Low LCOE Of Renewables Will Aid In The Transition Towards Clean Energy



Source: IEA Levelized Cost of Electricity Calculator, December 2020. Other Assumptions: 7% discount rate.

How Energy Security Considerations Will Affect The Energy Transition

- COVID-19 pandemic and the increasingly unpredictable geopolitical conditions have worsened supply-chain disruptions and prompted China to reiterate energy security as its priority. The power crunch in the second half of 2021 pushed the government to accelerate the commissioning of domestic quality coal mines to ensure sufficient supply. At the same time, the development and construction of renewable energy and power storage facilities will speed up in the next couple of decades.
- Decommissioning coal before the alternatives are sufficiently mature will cause irreversible damage to the economy and society. Coal will continue to act as the key base-load power source in China until at least to 2030 to ensure grid stability when massive wind and solar power is connected. By 2050, China will have more than 75% of power capacity from wind and solar. The mix will further move to 80% by 2060 when most of the coal power will be decommissioned except for the peak-shaving units.
- Before coal power is decommissioned, sufficient power storage capacity must be developed. This is to ensure the transition to wind and solar provides a stable power source. Pumped storage is the prevailing and the most economical way of addressing the intermittency issue associated with renewables. But it is constrained by location. China is targeting to have operational capacity of pumped storage to exceed 62 GW with another 60 GW under construction by 2025 (2020: 31.5 GW). Other new technology such as green hydrogen, battery and carbon capture, is still at a very early stage and not yet commercially viable.

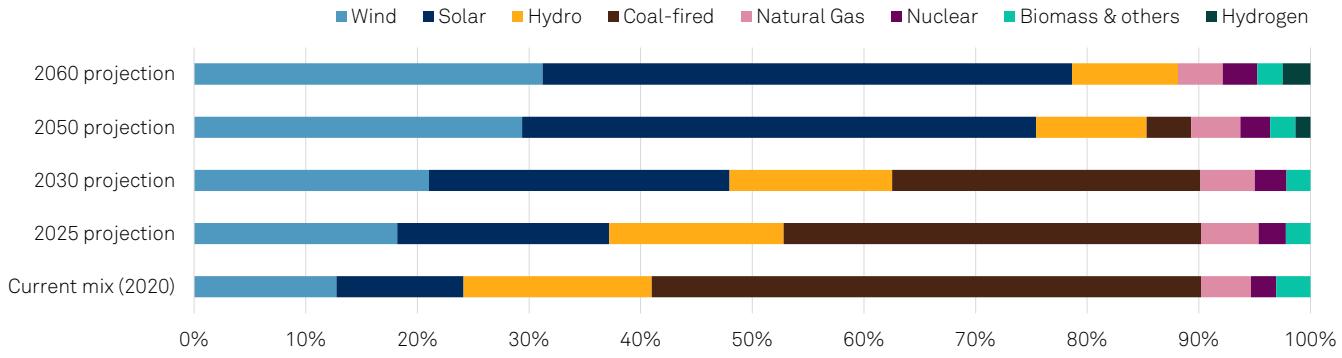
Technological Focus And Grid Stability

- According to the GEIDCO, by 2060, China will have 750 GW of total storage capacity, including 180 GW of pumped storage. Unit cost is likely to drop by 60%-75% in the 14FYP compared with the 13FYP. This capacity will mainly be developed by the grid companies (gridcos). The development cost may partially pass to the end user instead of being borne by the gridcos, protecting their credit profile. As of 2020, China had 31.8 GW of pumped storage capacity, accounting for about 17% of total power storage capacity in the world.
- The focus for the next decade will be cost reduction for core equipment, particularly for electrolysis for green hydrogen production. In January 2022, the National Development and Reform Commission and the National Energy Administration jointly released a mid to long-term plan for the hydrogen industry (2021-2035), specifying green hydrogen as the key component for the country's future energy system. It also targets to have green hydrogen annual production capacity of 100,000-200,000 tons.
- China is also speeding up development of carbon-capture technology. The industrial production sector, which includes steel, cement and chemistry producers, will have to rely on carbon capture, usage and storage (CCUS) technology to decarbonize alongside the use of green power. The current cost of CCUS makes it too high to commercialize --about RMB300-RMB900 a ton versus an average carbon trading price of RMB40-RMB60 a ton. Cost reduction through technological breakthrough and policy support is crucial to ensuring the wide application of CCUS.

Technological Focus And Grid Stability... Continued

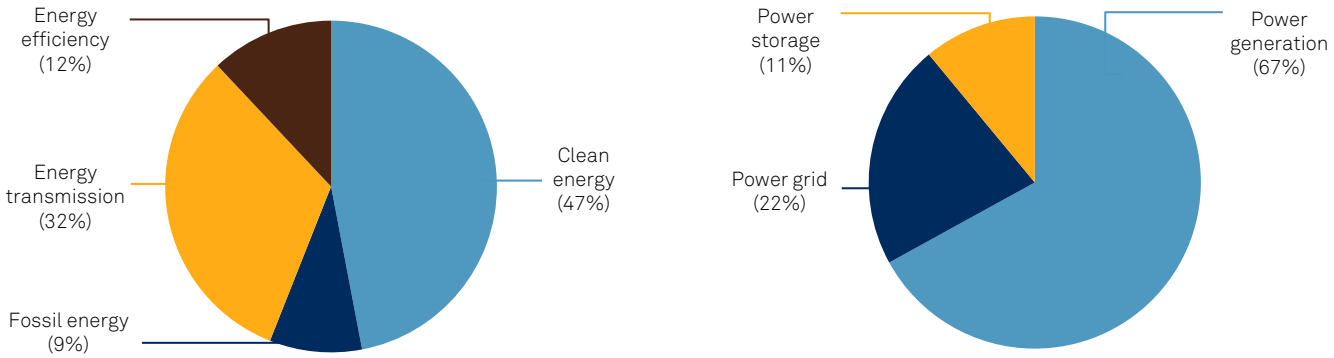
- Power grids must be upgraded with highly efficient transmission and distribution (T&D) networks that have the capacity to distribute power over long distances. This is because of the mismatch between China's renewable power source (mainly in northern and western regions) and its demand center (eastern and southern regions). During the 14FYP, the two giant power grid operators, State Grid Corporation of China and China Southern Power Grid, will build more ultra-high voltage (UHV) lines. As of 2020, China had 30 UHV projects commissioned, comprising 14 AC and 16 DC lines, and another five projects in the pipeline, for more than 48,000km of total length and 140 GW of power transmission capacity. By 2050, China aims to have in place a nationwide energy network.
- Regulatoion governing the T&D tariff will be further enhanced with details including inter-regional power trading. Despite a moderate declining trend for T&D tariffs, we expect the regulatory regime to become more transparent and stable. Hence the T&D revenue, given the gridcos are generating returns based on permitted assets instead of earning a difference between purchase and sales price.
- The T&D networks must be equipped with smart facilities that enable stability and safety of supply from the intermittent renewables. Both gridcos have diverted more capital into digitalization infrastructure and technologies They plan to build up an energy ecosystem (e.g. demand-side management, electricity trading); set up smart services (digital solutions to help energy retailers); set up operations optimization (automated grid dispatch); smart operations management (human capital, supply chain); build data centers at group and provincial level; construct internet-of-things networks comprising grid equipment and users; and increase digital applications R&D.

Capacity Mix Until 2060



Source: Global Energy Interconnection Development and Cooperation Organization Presentation March 2021.

Capital Investments Of US$19.2 Trillion During 2021-2060 For Decarbonization



Source: Global Energy Interconnection Development and Cooperation Organization Presentation March 2021.

Growth And Transition Capex Plans

- The "big-five" state-owned independent power producers (IPPs), who contribute about 45% of power supply in China, will accelerate their expansion of renewable capacity to align with the national goals. They are all aiming to have at least a 50% mix of renewable capacity by 2025. We anticipate capex in the generation segment will increase by 15%-20% to RMB600 billion-RMB620 billion in 2022, mainly in renewable projects. Unit construction cost will gradually decrease as technology advances.
- Investment by State Grid Corp. of China may peak at RMB530 billion-RMB550 billion annually in 2022 for the construction of ultra-high voltage transmission lines and the installation of power storage facilities to accommodate the rising mix of renewables. China Southern Power Group will also support key infrastructure projects, such as in Guangdong province within the Greater Bay Area. We expect companies to prioritize domestic market investment because travel has led to a stagnation in overseas expansion.
- Green finance development will continue to expand in China to facilitate funding needs for sustainability projects. The People's Bank of China, the country's central bank, will enhance the financing tools specifically supporting decarbonization and encourage financing institutions to provide such funding supports. As of 2020, China has provided RMB12 trillion credit facilities to support green projects, accounting for 6.9% of total credit facilities and is the largest of its kind in the world.

S&P Global
Ratings

India

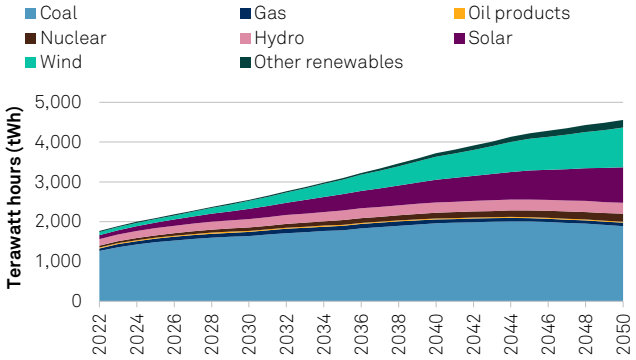
Private Sector Will Lead The Way

Primary Credit Analyst: **Abhishek Dangra**
Research Support: **Vernice Tan**

Key Takeaways

- Economics will drive India's private sector-led energy transition, meaning significant growth in cheaper renewables will reduce the proportion of fossil-fuel based power.
- Increasing competition and low returns in the traditional renewables space will drive capital expenditure (capex) and investments for pumped hydro and new technologies such as battery storage and green hydrogen.
- Multi-decade growth opportunities to invest in the energy transition will keep capex and leverage elevated, limiting the potential for improvement in credit profiles from better diversity and scale.

Likely Evolution Of Energy Mix



Source: S&P Global Commodity Insights, Global Integrated Energy Model March 2022 Reference Case.

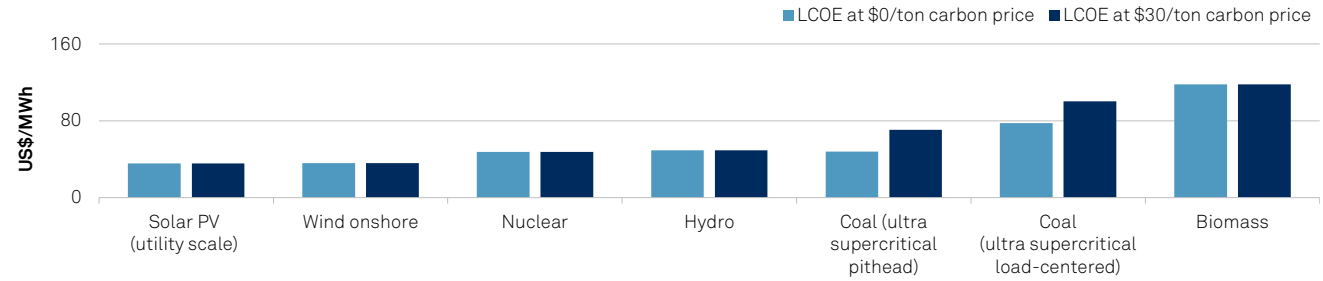
Policy	Target
Net Zero	2070
2030 Emissions Commitment	45% reduction in intensity vs 2005
Peak Emissions*	2044
Renewable Energy	500 GW of renewable capacity by 2030§
Carbon Tax	None established
Carbon ETS	None established
Coal Phase-Out	Only committed to phase "down"
Electric Vehicles Penetration	30% of new private car sales by 2030

*S&P Global Commodity Insights, Global Integrated Energy Model March 2022 Reference Case. §Excludes large hydro.

Economics Drive Renewable Growth

- India lacks comprehensive energy transition policies and a clear commitment to phase out of coal. It will fail to reach its target of 175 GW renewable capacity by 2022. By December 2021, it had about 105 GW of capacity, excluding large hydro. In the past few years, it has made annual gains of only about 10 GW to 15 GW. Its target of 500 GW renewable energy capacity by 2030 is even more ambitious. The addition of new capacity will need to rise by 2x-3x for India to achieve 50% generation from renewables by 2030.
- India's high customs duty levy on solar modules and cells--aimed at increasing self-sufficiency--will marginally affect the renewables rollout. Domestic capacities will be insufficient to meet demand in the next three to five years and the additional import duties on raw materials will increase the cost of solar panels by about 10%. From April 1, 2022, India announced customs duty of 40% on solar modules and 25% on cells.
- Government subsidies for battery and solar manufacturing capacities could help improve India's renewable ecosystem over the next five years. India has allocated about 10% of its funds for production-linked incentive schemes to support clean technologies.
- India's aim to be net zero by 2070 reflects the challenge of energy transition in a low-income economy with a growing population and rising power demand. The lack of commitment to phase-out coal plants indicates coal will remain in the generation mix for decades.
- India's lack of a clear plan for carbon trading reflects the favorable economics of renewables, which are cost-competitive, even in the absence of any carbon tax. The lack of new coal plant builds (apart from those under construction) in the next decade further reduces the dependence on carbon policies (except for existing assets, which India is in no rush to retire). India is working on stricter renewable purchase obligations for offtakers and revamping the Renewables Energy Certificate (REC) mechanism to make RECs perpetually valid to freely trade according to market demand and supply.

Low LCOE Of Renewables Will Aid Transition Toward Clean Energy



Source: IEA Levelized Cost of Electricity Calculator, December 2020. Other Assumptions: 7% discount rate.

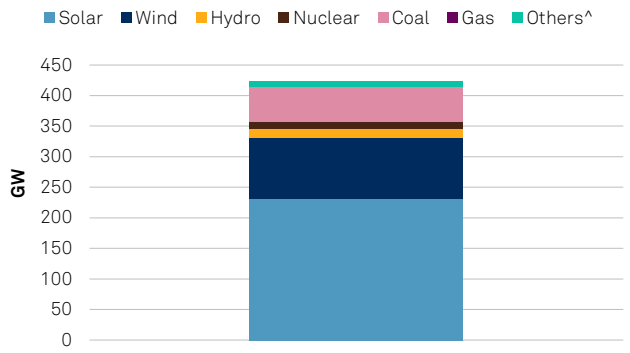
Impact Of Energy Security Considerations On Energy Transition

- Improving self-sufficiency remains the key focus for India; intermittency of renewable power is causing concerns about the stability of the grid.
- The self-sufficiency goal is also driving production incentives for solar power panel manufacturing and duties on cheaper Chinese panels.
- Grid stability is a challenge because of several factors. These include high and increasing share of renewables, particularly in the key wind and solar states (some of which already have renewables contributing more than a quarter of the generation), lack of a national smart grid, and insufficient storage solutions.
- India is aiming at encouraging more stable power supply by increasing the share of tenders for peak power and round-the-clock (RTC) projects. However, most of these projects lack the technology to provide stable base-load power to replace coal. At best they can create some flexibility to balance demand for a few hours. India's policies to incentivize battery storage solutions aim to mitigate this risk.

Technological Focus And Grid Stability

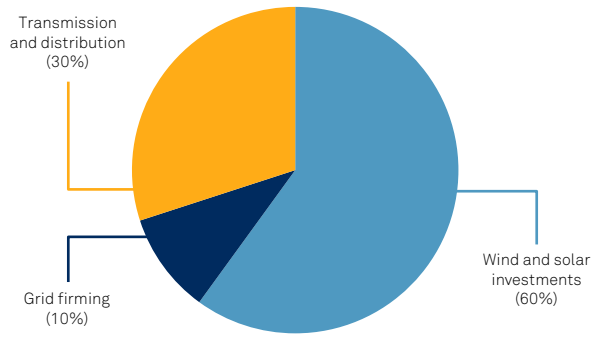
- India's national power grid has stabilized. This follows significant investments over the past five to seven years of about US$3 billion a year by the Indian transmission major, Power Grid Corporation of India Ltd. These investments have strengthened the grid by including a dedicated green corridor for transmission of renewable power. However, regional state-level grid imbalances do occasionally lead to some curtailment risk (1%-5%).
- India's power grid balancing is assessed as achievable, with 175 GW of renewable capacity by 2022 and minimal curtailment risk (1%-2%). The grid will be able to manage the added variability of wind and solar without the need for gas and other demand-balancing mechanisms. That's according to a government study, based on forecast renewable generation, scheduling, and dispatch.
- India's Central Electricity Authority (CEA) modelling shows the need for 10% battery and energy storage capacity by 2030 to balance the grid, as renewables capacity is targeted to scale up to 500 GW.
- Pumped hydro storage will play an important role in balancing power demand in India with RTC projects. India is also targeting 44 GW from grid-scale battery energy storage out of a total capacity of 897 GW by fiscal year 2032.
- Investments in green hydrogen will be led by large private-sector corporate groups such as Adani and Ambani. India's green hydrogen policy aims to meet a target of 5 million mt/year of green hydrogen. These policies aim to speed clearances, bank surplus renewable power, allow access to interstate grids, and provide interstate power transmission charge waivers.

Capacity Additions From 2021-2030



Source: CEA, Ministry of Power. ^Includes waste to energy, pumped storage and biomass.

Capital Investments Of US$500 Billion Required From 2021-2030 To Achieve 2030 Renewables Target



Source: IEEFA, 2021.

Growth And Transition Capex Plans

- India will make nearly US$500 billion investment in adding renewables and expanding the grid. We expect the private sector to lead the investments while national power majors will also participate in energy transition.
- ESG factors and strong green credentials are increasingly important for renewables players. Such credentials provide them with an increasing pool of long-term domestic bank funding, frequent access to international dollar bond markets, and continuing equity investments with support from large sovereign wealth funds, pension funds and asset managers. This is despite their relatively weaker financials with leverage of above 7x Debt/EBITDA, EBITDA interest coverage of about 1.25x, and significant negative free cash flows.

S&P Global
Ratings

Indonesia

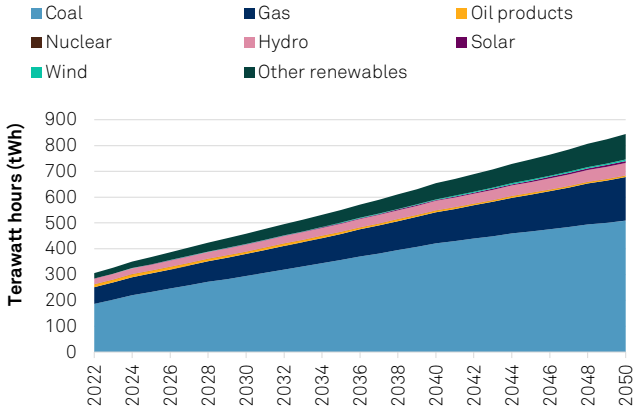
Cheaper Coal And Restrictive Policies Delay An Ambitious Transition

Primary Credit Analyst: **Abhishek Dangra**
Research Support: **Vernice Tan**

Key Takeaways

- Indonesia lacks the concrete measures to match the sharp acceleration in its ambitions for energy transition, which include a target of net-zero emissions, a ban on coal-fired power plants and a carbon price.
- The country's energy policies and regulatory framework will need to tackle subsidized power, cheaper coal, and government reluctance to increase tariffs.
- We expect increasing investments for energy transition will face twin challenges. Evolving policies create policy risks for under-construction coal plants while the lack of full measures to support renewables inhibits renewable growth.

Likely Evolution Of Energy Mix



Source: S&P Global Commodity Insights, Global Integrated Energy Model March 2022 Reference Case.

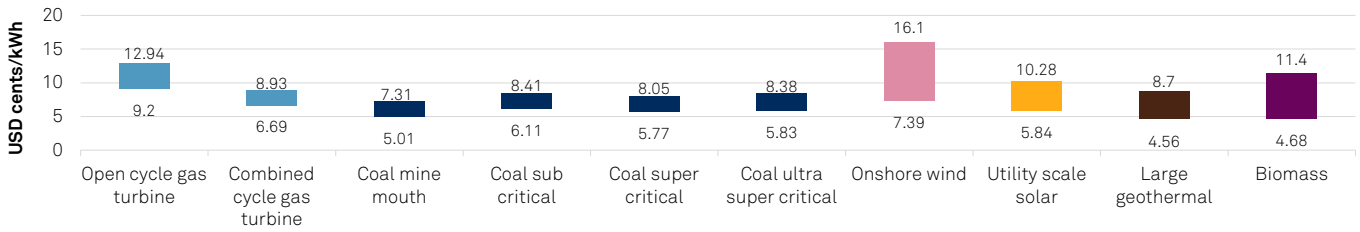
Policy	Target
Net Zero	2060
2030 Emissions Commitment	Lower emissions by 29% below business-as-usual scenario
Peak Emissions*	2050
Renewable Energy	23% generation by 2025; 31% generation by 2050 (includes large hydro and geothermal)
Carbon Tax	To begin in July 2022§ at US$2.1/mt CO2 equivalent for coal-fired generators
Carbon ETS	Under consideration, plans for a fully operational carbon market in 2025
Coal Phase-out	2056, possibly 2040 with international help
Electric Vehicles Penetration	2 million EVs by 2030

*S&P Global Commodity Insights, Global Integrated Energy Model March 2022 Reference Case. §Postponed from April 2022 to cushion impact of rising energy prices on consumers.

An Absence Of Concrete Measures For Greener Policies Makes Success Doubtful

- Indonesia's plans are highly dependent on future technological breakthroughs in improving battery life and lowering costs. The country's new electricity plan (2021-2030) also envisages 23% renewable energy by 2025 compared to 11.2% in 2021; 50% of the planned capital expenditure (capex) will go toward renewables.
- The requirement for a tariff price cap on wind and solar to ensure they are 15% cheaper than regional grid prices makes renewables less attractive for investors. This is even more challenging as Indonesia's current electricity prices are highly subsidized by the government. The industry expects the new renewable energy law or Presidential Regulation on FiT (feed-in tariff) to be passed in 2022, which can help improve pricing for renewable.
- Indonesia has announced draft policies to progressively increase carbon taxes for coal generators. But we expect the availability of offsets and lack of clarity on rules will have limited impact on project economics and the financial position of fossil fuel-based generators. Indonesia's aim to reduce greenhouse gas emissions by 29% by 2030 will fall short of the Paris Agreement targets.
- Indonesia's net zero-target of 2060 is a positive surprise. Its low-carbon scenario stipulates emissions will peak by 2030. S&P Global Commodity Insights' reference case, on the other hand, forecasts Indonesia's emissions to peak only by 2050. However, coal-fired power projects with carbon capture, usage and storage (CCUS) will still account for about 37% of power generation by 2060. We believe this raises questions on achievability of net zero because utility-scale CCUS projects remain costly. According to the Institute for Essential Services (IESR), this will require high carbon prices of about US$240 a tonne of CO2 to incentivize the adoption of CCUS.

Lower LCOE For Renewables Remains Key To Reducing Reliance On Fossil Fuels



Source: IESR Levelized Cost of Electricity in Indonesia, 2019.

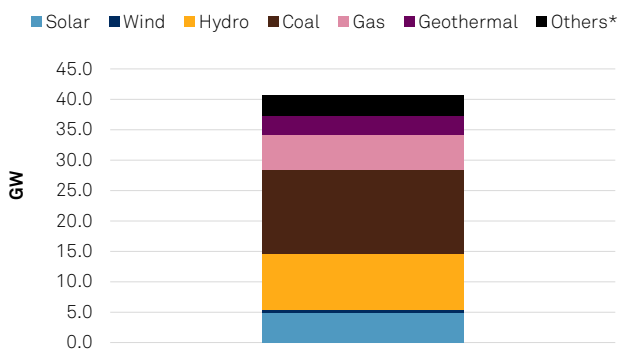
How Energy Security Considerations Will Affect The Energy Transition

- Affordability of electricity is the key barrier for energy transition in Indonesia. The government plans to revisit the coal-capping mechanism and introduce more expensive renewable energy. Removing regional price caps for renewables will also reduce affordability, making such decisions more challenging to implement.
- Indonesia has achieved near full electrification only recently and continues to provide subsidized power. The government is loath to raise tariffs for fear of reducing purchasing power and hurting economic growth. Indonesia's electricity plans from 2021-2030 forecast flat electricity tariffs. This focus on affordability means government policies require renewables to be cheaper than regional grid price levels, which is dependent on future reduction in technology costs, making it less attractive for investors, in the meanwhile.

Technological Focus And Grid Stability

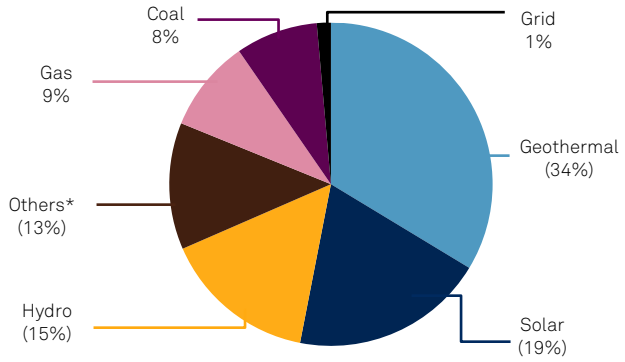
- As an archipelago, Indonesia's inter-island grid connectivity will be crucial. According to the IESR, Indonesia will require 158 GW transmission capacity by 2050 to accommodate an entirely green grid.
- Indonesia aims to leverage its geothermal resources to accelerate the energy transition. Relying on carbon capture to meet net zero-targets and replacing coal plants with battery storage solutions will require technological and cost breakthroughs.

Capacity Additions From 2021-2030



Source: RUPTL 2021-2030. ^Others mainly include waste and biomass.

Capital Investments Of US$235 Billion From 2021-2030 Led By Renewables



Source: IESR Deep Decarbonization of Indonesia's Energy System Report, 2021. *Mainly includes biomass/waste, storage solutions and battery.

Growth And Transition Capex Plans

- Lower private sector participation in Indonesia and stretched financials for its national power major can limit necessary investments for energy transition. By the third quarter of 2021, Indonesia's renewables investments had only reached US$1.12 billion (as per IESR), while investments in battery and electric vehicle (EV) manufacturing plants were only at about US$2.75 billion combined. To fully decarbonize by 2050, over the next decade Indonesia will require 10 times the government targets for renewable investments.
- In contrast to global trends, some of Indonesia's local banks have no immediate plans to set a net zero-target, which may keep funding channels open over the next three to five years.

S&P Global
Ratings

New Zealand

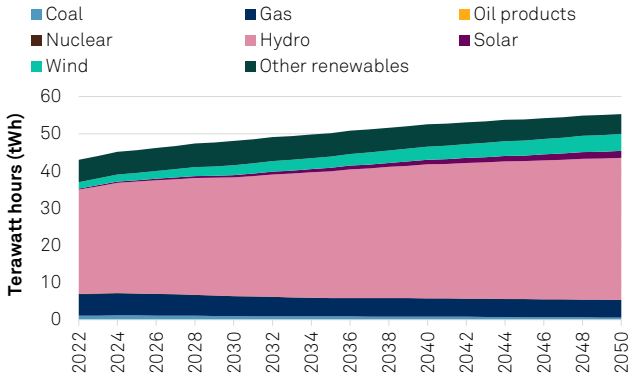
Quietly Racing To 100% Renewables By 2030; Leader In APAC

Primary Credit Analyst: **Parvathy Iyer**
Research Support: **Ambrose Beaney**

Key Takeaways

- New wind and geothermal projects under way will see renewables getting close to 90%-95% of total generation by 2025.
- Hydrology risks and industrial thermal use could cause thermal generation to continue to 2030, until batteries are established.
- Emissions reduction from the agricultural sector is formidable; electric vehicles (EV) is a policy focus and will aid new generation investment.

Likely Evolution Of Energy Mix



Source: S&P Global Commodity Insights, Global Integrated Energy Model March 2022 Reference Case.

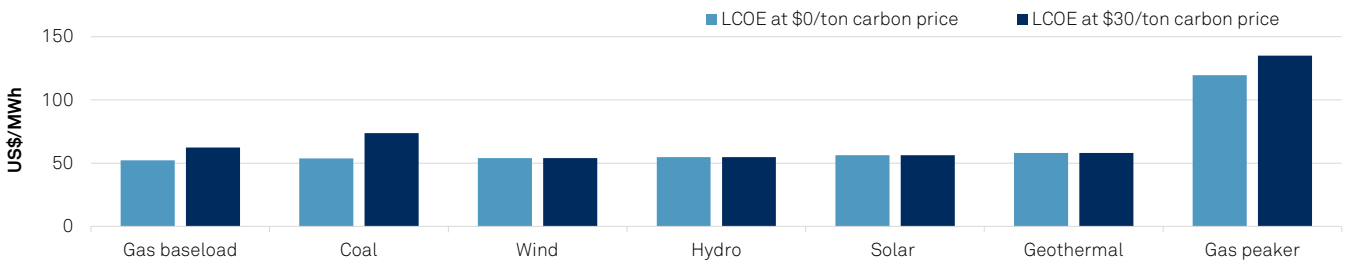
Policy	Target
Net Zero	2050
2030 Emissions Commitment	50% reduction on gross 2005 levels
Peak Emissions*	2032
Renewable Energy	100% by 2030 (normal hydrological conditions)
Carbon Tax	No tax, but has emissions trading scheme
Carbon ETS	Implemented in 2008
Coal Phase-Out	2037 for industrial thermal use (earlier for electricity generation)
Electric Vehicles Penetration	No federal target

* S&P Global Commodity Insights, Global Integrated Energy Model March 2022 Reference Case.

Mature Policies And Favorable Generation Mix Support Energy Transition In The Electricity Sector

- Energy policies in New Zealand are mature and supported by the fact that nearly 80% of today's generation comes from renewable resources: hydro, wind, and geothermal.
- The country targets 90% of total electricity generation from renewables by 2025 and 100% by 2030. Several projects under way suggest that the 2025 target will be achieved. New Zealand's net zero target by 2050 includes all greenhouse gases other than biogenic methane.
- Dry-year risk is the main challenge for the country, which means it may need some thermal generation in the mix for system security and stability. This could be either gas or coal; and storage solutions will be an option as technology advances.
- Since 2008, a carbon emissions trading scheme has served the market well and is a key tool to address climate change. Annual review of the overall limit and price controls provide a five-year outlook.
- Electrification of transport and industrial boilers in the dairy and agricultural sectors are the big variable for New Zealand in its net zero target. Supportive policies are emerging to promote the use of EVs, and this is expected to cause a 38% increase in electricity demand by 2050. The government, together with network owners, is looking at smart EV charging to reduce peak demand.
- Reducing emissions in the agricultural sector is a quandary. At this stage, the target is to reduce biogenic emissions by 10% by 2030 (from 2017 levels) and to 25%-47% by 2050. New Zealand's first emission reduction plan (by mid-2022) across three rolling five-year periods is expected to provide more direction for the new zero target by 2050.

Carbon Price Enhances The Attraction Of Renewables



Source: MBIE Interactive Levelized Cost of Electricity Comparison Tool, January 2021. Other Assumptions: 7% discount rate, USD/NZD 1.4138.

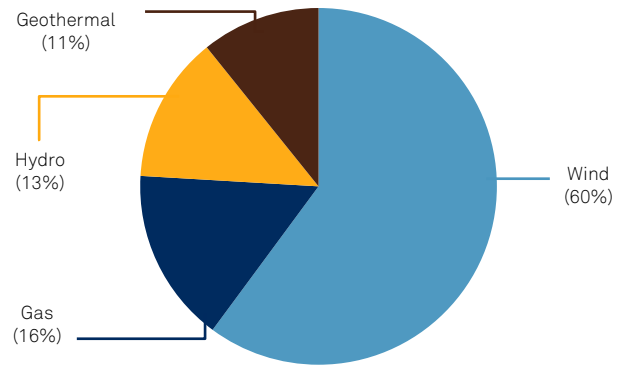
Impact Of Energy Security Considerations On Energy Transition

- New Zealand can face energy security issues during a dry year, extended weak hydrological phase or extended outage of major generation sites. This generally manifests in the form of high energy prices for a short period of time.
- New projects under way by 2023-24 should reduce this concern. The planned addition of gas capacity is less likely to proceed with embargo on all forms of new gas exploration in New Zealand and uneconomical gas prices.
- We expect storage technology to play a critical role by 2030. Thermal generation could decrease by 2030 in tandem with performance of storage solutions (clubbed with wind and solar).

Technological Focus And Grid Stability

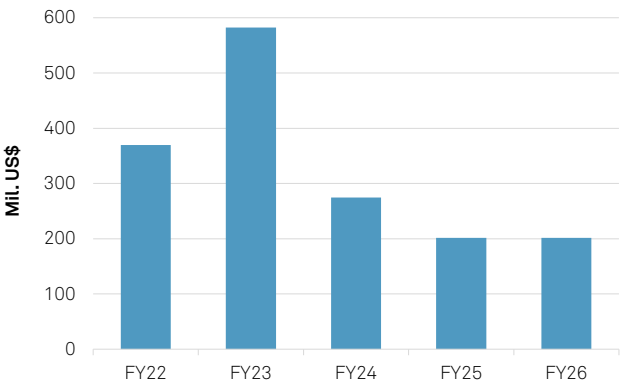
- Grid changes or enhancements are ongoing; but transformation is not as massive as it is in Australia. This is because of the already high proportion of renewable generation (particularly hydro) in the market.
- However, investment in transmission lines will increase over the next 10 years to connect the new projects as they come online to meet the 100% renewable power target by 2030. We expect regulatory process to incentivize and support the investments.
- EV and transport electrification will increase peak demand on the distribution network and associated capital expenditure.
- We also expect replacement of the aging interconnector between the South Island and the North Island over the next 10 years. This is an important link for the country, with about 60% of its generation capacity based in the South Island, but the load center being in the north.
- The hydrogen strategy is at a nascent stage with a small number of exploratory projects led by the private sector.

Planned Capacity Additions Of 3 GW As Of 2020



Source: MBIE New Zealand 2021. Consented and under construction projects.

Growth CAPEX To 2026 Totals US$1.6 Billion



Source: S&P Global Ratings.

Growth And Transition Capex Plans

- Investment in new generation is expected to be in the range of US$1.5 billion to US$2 billion over the next five to 10 years. The bulk of this investment is expected to occur by 2026, while projects in the later part of the decade will depend on the increase in electricity demand from the transport and agricultural sectors.
- Network investments are decided as part of the five-year regulatory process and we expect this will also increase relative to past 10 years. The increase will be toward reinforcement and augmentation to support new electricity uses particularly EVs. We believe the market and entities will fund these developments within the boundaries of 'bbb' credit risk.

S&P Global
Ratings

Malaysia

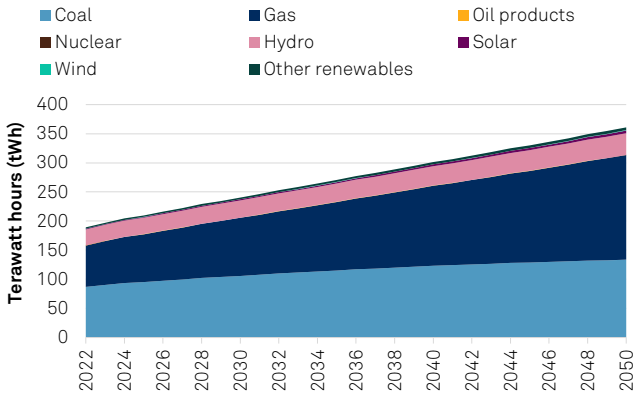
Gas Set To Fill The Void As Coal Reliance Declines

Primary Credit Analyst: **Abhishek Dangra**
Research Support: **Vernice Tan**

Key Takeaways

- Malaysia has included large hydro capacities to bump up its renewable energy targets by 2035.
- Coal plants with 7 GW capacity have a power purchase agreement expiring in 2030 and which will not be renewed. The government also claims there will be no more new coal plants after 2030, though plans still include 2.8 GW of additional capacity after 2030.
- As coal use declines, higher reliance on gas may lead to price spikes.

Likely Evolution Of Energy Mix

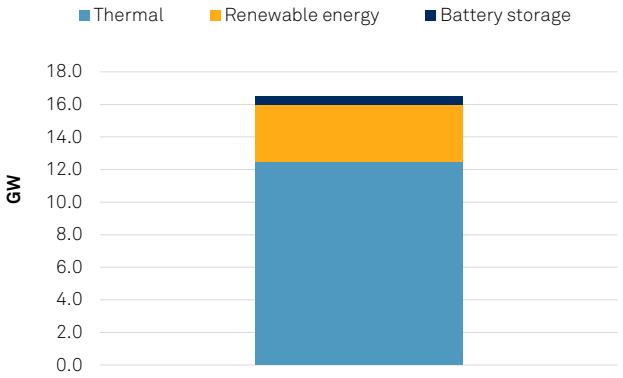


Source: S&P Global Commodity Insights, Global Integrated Energy Model March 2022 Reference Case.

Policy	Target
Net Zero	2050
2030 Emissions Commitment	Lower emissions intensity by 45% from 2005 levels
Peak Emissions*	2050
Renewable Energy	31% of total capacity by 2025; 40% by 2035 (includes large hydro and biomass)
Carbon Tax	Under consideration as part of 12th Malaysian Plan
Carbon ETS	Under consideration, plans to introduce in phases from end-2022
Coal Phase-Out	No target date
Electric Vehicles Penetration	No target

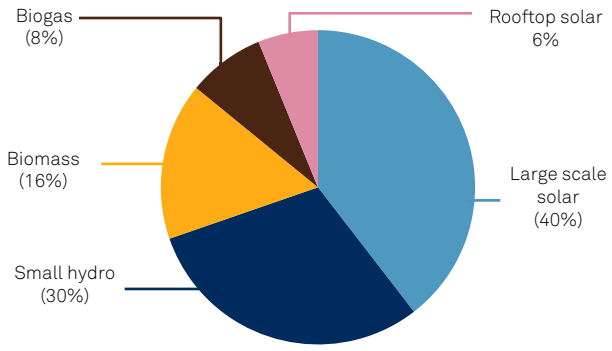
*S&P Global Commodity Insights, Global Integrated Energy Model March 2022 Reference Case.

Capacity Additions From 2021-2039 In Peninsular Malaysia



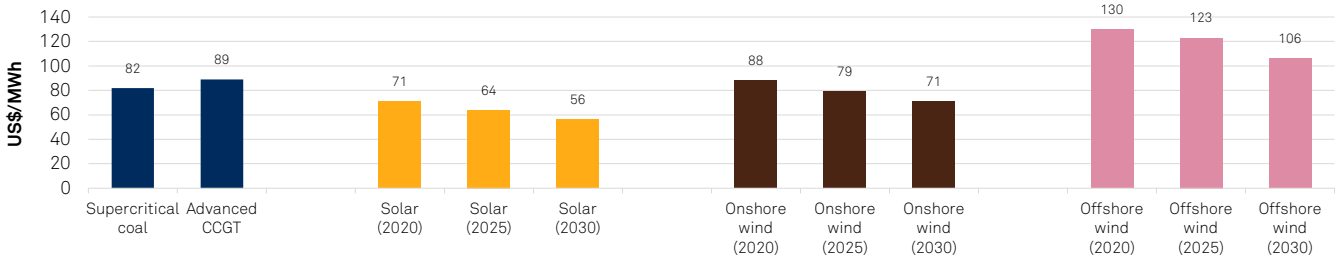
Source: Report on Peninsular Malaysia Generation Development Plan 2021-2030.

Capital Investments Of US$5 Billion In Renewables Required From 2021-2025



Source: Malaysia Renewable Energy Roadmap, 2021. Projections under New Capacity Target scenario of 31% renewable energy installed capacity by 2025.

Declining LCOE Of Renewables In ASEAN Will Support Energy Transition



Source: Accelerating Clean Energy in Vietnam and Indonesia 2021, WaterRock Energy Research and Analysis.

S&P Global
Ratings

Philippines

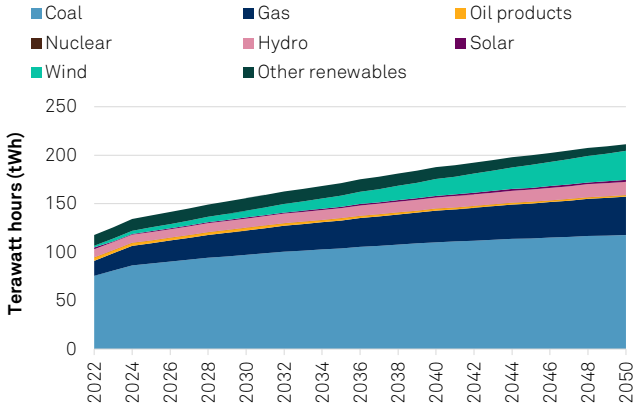
Energy Transition Highly Dependent On Foreign Support

Primary Credit Analyst: **Abhishek Dangra**
Research Support: **Vernice Tan**

Key Takeaways

- Philippines' "unconditional" reduction in emissions of just 3% below business-as-usual scenario is hardly ambitious. This indicates its progress on energy transition with the reduction target of 72% is highly dependent on funding support from developed countries.
- Renewable growth has slowed down since the discontinuing of the feed-in-tariff regime. But the country is now aiming to speed up offshore wind and LNG projects and is banning new coal plants.
- To meet the target of 35% of generation from renewable sources by 2030, the reliability and strength of the grid will have to improve, and this will require increased investment.

Likely Evolution Of Energy Mix

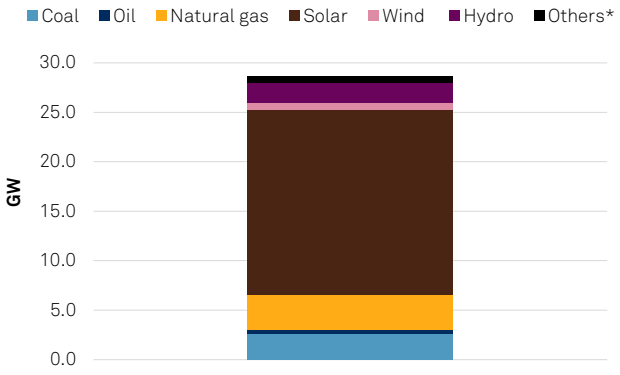


Source: S&P Global Commodity Insights, Global Integrated Energy Model March 2022 Reference Case.

Policy	Target
Net Zero	No target set
2030 Emissions Commitment	Lower emissions by 75% below business-as-usual scenario, with 72% conditional on support from developed countries
Peak Emissions*	2048
Renewable Energy	35% generation by 2030 (includes large hydro, geothermal and biomass)
Carbon Tax	None established
Carbon ETS	Under consideration
Coal Phase-Out	No target date
Electric Vehicles Penetration	10% of total registered vehicles by 2040

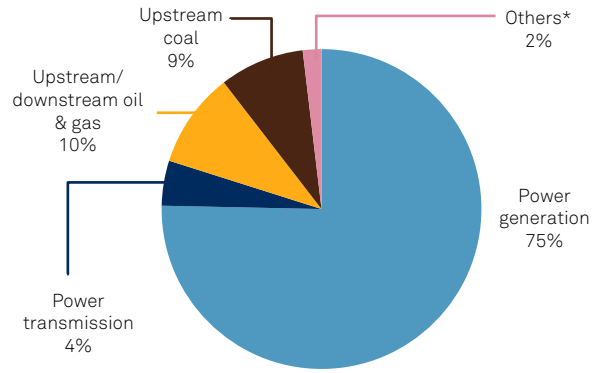
*S&P Global Commodity Insights, Global Integrated Energy Model March 2022 Reference Case.

Capacity Additions From 2021-2030 Dominated By Solar



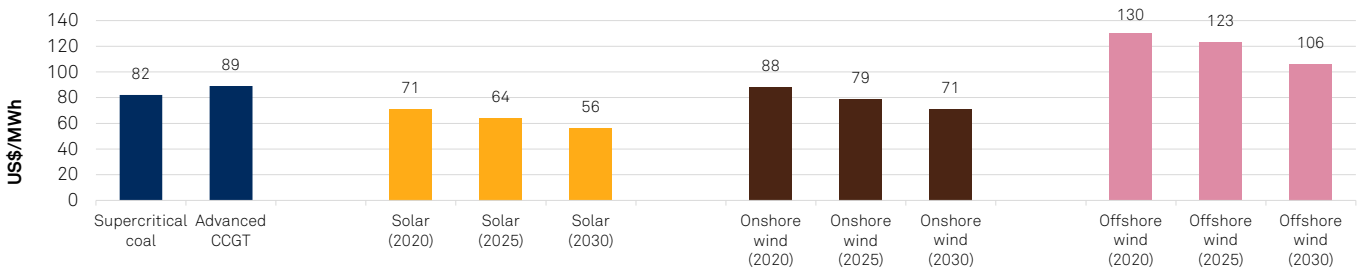
Source: Philippines Energy Plan 2020-2040. *Mainly geothermal and biomass.

Capital Of US$145 Billion Required From 2020-2040 To Achieve Clean Energy Targets



Source: Philippines Energy Plan 2020-2040 (Clean Energy Scenario). *Others include pre-development of renewable energy, downstream development of biodiesel and bioethanol.

Declining LCOE Of Renewables In ASEAN Will Support Energy Transition



Source: Accelerating Clean Energy in Vietnam and Indonesia 2021, WaterRock Energy Research and Analysis.

S&P Global
Ratings

Thailand

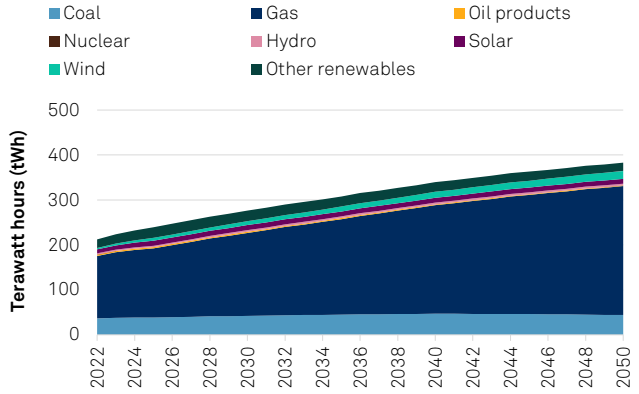
Reliance On Gas Unlikely To Decline In Next Few Decades

Primary Credit Analyst: **Abhishek Dangra**
Research Support: **Vernice Tan**

Key Takeaways

- Sociopolitical pressures will continue to limit coal capacities. However, Thailand's reliance on gas is unlikely to decline in the next few decades as there are less ambitious plans for renewables.
- Imported power (including renewable) from neighboring countries such as Laos will remain a critical component in Thailand's energy transition plans.
- Expiring coal power purchase agreements are unlikely to be extended. This can create cash flow uncertainty at a time when Thai utilities are simultaneously exploring international acquisitions for growth and seeking to transition to renewable energy.

Likely Evolution Of Energy Mix

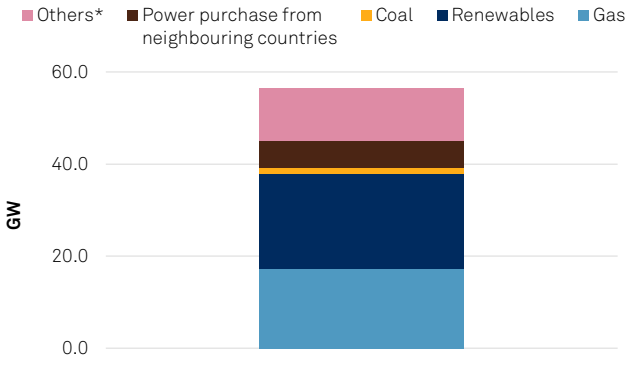


Source: S&P Global Commodity Insights, Global Integrated Energy Model March 2022 Reference Case.

Policy	Target
Net Zero	2065; carbon neutrality by 2050
2030 Emissions Commitment	Lower emissions by 20%-25% below business-as-usual scenario
Peak Emissions*	2044
Renewable Energy	30% generation by 2037 (includes large hydro)
Carbon Tax	None established
Carbon ETS	Under consideration, has had a voluntary emissions reduction system since 2015
Coal Phase-Out	No target date
Electric Vehicles Penetration	50% of new car registrations by 2030

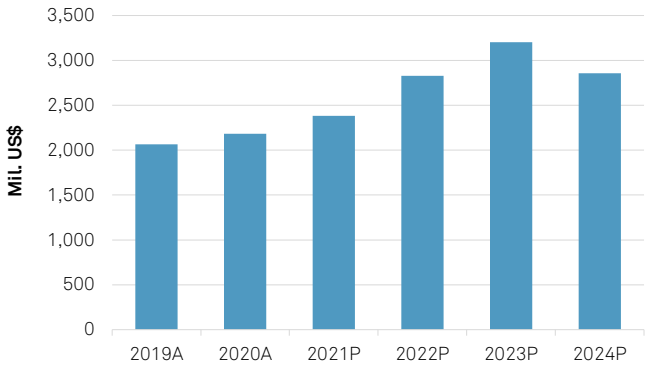
*S&P Global Commodity Insights, Global Integrated Energy Model March 2022 Reference Case.

Capacity Additions From 2018-2037



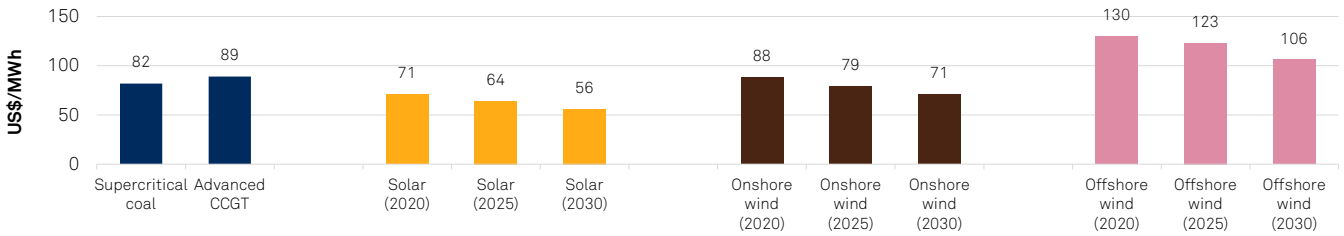
Source: PDP 2018-2037 Rev1. ^Others includes pumped storage and energy conservation.

Capital Expenditure Of Thai Utilities* Remains Elevated



Source: S&P Global Ratings. *Thai utilities include rated entities such as Electricity Generating Authority of Thailand (EGAT) and Ratch Group Public Co. Ltd, and other unrated entities.

Declining LCOE Of Renewables In ASEAN Will Support Energy Transition



Source: Accelerating Clean Energy in Vietnam and Indonesia 2021, WaterRock Energy Research and Analysis.

S&P Global
Ratings

Vietnam

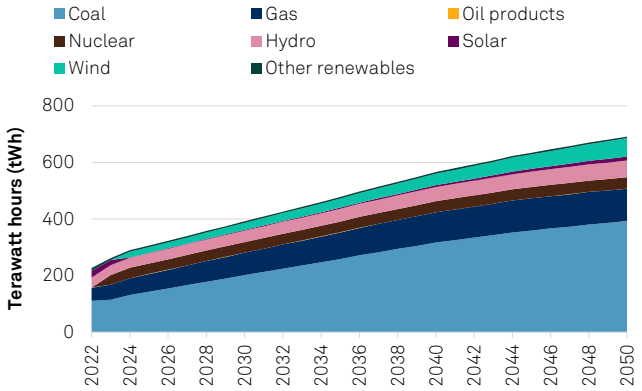
Bold Promise To Phase Out Coal By 2040 Risks Stranded Assets

Primary Credit Analyst: **Abhishek Dangra**
Research Support: **Vernice Tan**

Key Takeaways

- Vietnam's commitment to phase out coal plants by the 2040s creates the risk of stranded assets. This may entail the early retirement of more than 30 coal plants. More than 80% of new coal plants in Vietnam were commissioned in only the past 10 years. Further, about 20 GW of coal plants (under the country's draft Power Development Plan (PDP) 8) are at various stages of financial closure and construction could potentially become unviable.
- Sharp growth in renewables capacity without a concomitant improvement in the quality of the grid may cause higher curtailment risks. Under the feed-in-tariff mechanism (now discontinued), Vietnam's energy policies incentivized the addition of solar and wind capacities and led to large capacity buildout. However, rapid growth creates challenges. Uncoordinated expansions lead to curtailment and grid instability.
- For Vietnam to meet its increasing energy demand and fuel its economic growth, sufficient and reliable power is a key priority. The country's higher dependence on hydro power and its growing share of renewables creates some risk for energy reliability.
- The World Bank estimates Vietnam will need US$12 billion-US$14 billion annually to meet its energy transition needs. As these investments rely heavily on private sector investments, policy reforms for public-private participation projects and supportive regulations will be crucial for success.

Likely Evolution Of Energy Mix

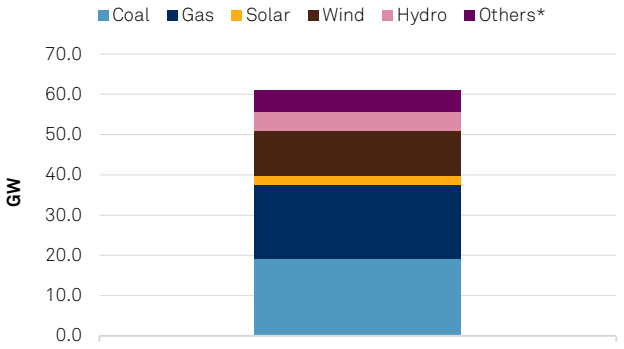


Source: S&P Global Commodity Insights, Global Integrated Energy Model March 2022 Reference Case.

Policy	Target
Net Zero	2050
2030 Emissions Commitment	Lower emissions by 9% below business-as-usual scenario
Peak Emissions*	2050
Renewable Energy	45% of total capacity by 2030 in Draft PDP 8 (includes large hydro)
Carbon Tax	None established
Carbon ETS	Under consideration, pilot carbon exchange to start in 2025
Coal Phase-Out	2040
Electric Vehicles Penetration	No target

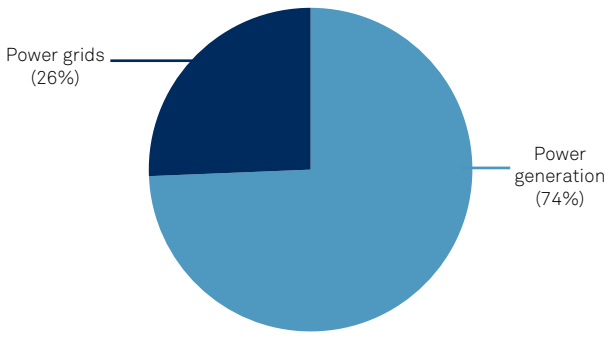
*S&P Global Commodity Insights, Global Integrated Energy Model March 2022 Reference Case.

Capacity Additions From 2021-2030 Dominated By Coal



Source: Vietnam Draft PDP8. ^Others includes biomass, storage, and imports.

Capital Investments Of US$128 Billion From 2021-2030



Source: Vietnam Draft PDP8.