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Policy Brief

August 2026

Investor Perspective on Carbon Pricing and Climate Policy Uncertainty in Malaysia: Evidence from Financial Markets

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ABOUT THE SERIES

This policy brief is based on a double degree MSc thesis titled "*Climate policy uncertainty in Malaysia: energy stock volatility and renewable energy investment attractiveness*" written at the Asia School of Business' Center for Technology, Strategy and Sustainability.
The author of this issue is **Jos Bakker, ASB CTSS Visiting Research Associate.**

ABOUT THE AUTHORS

Jos Bakker was a Visiting Research Associate at the Asia School of Business, where he conducted research on renewable energy investments and stock market volatility under climate policy uncertainty in Malaysia. He constructed a Malaysian climate policy uncertainty index using newspapers and used this index to test its effect on energy and utility stock volatility and return. Moreover, he modelled several carbon prices which he used to assess the attractiveness of investments in power generation projects under carbon pricing. He combined his research at CTSS with his master's thesis and now holds master's degrees in Finance and Economics from the University of Groningen.

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Citation

This policy brief should be cited as: Jos Bakker. Investor Perspective on Carbon Pricing and Climate Policy Uncertainty in Malaysia: Evidence from Financial Markets 14/2026. Kuala Lumpur: Center for Technology, Strategy & Sustainability (CTSS), 2026.

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Executive Summary

In 2023, Malaysia launched its National Energy Transition Roadmap (NETR), which sets out the policies needed to achieve net-zero emissions by 2050 and significantly increase the share of renewable energy in installed capacity. Malaysia remains heavily dependent on fossil fuels for electricity generation, and given the need to reduce carbon emissions alongside rising geopolitical tensions worldwide, transitioning towards renewable energy is no longer optional. Achieving this transition, however, requires substantial capital investment.

Malaysia currently has no explicit carbon pricing mechanism. A voluntary carbon market (VCM) was launched in 2022, and a mandatory carbon tax or emissions trading system has been discussed since the Twelfth Malaysia Plan, but no compliance market has yet been established. This does not mean, however, that Malaysia lacks an effective carbon price altogether: the OECD finds that Malaysia's Net Effective Carbon Rate (Net ECR), which nets fossil fuel subsidies out of carbon-related taxes and credit prices, was EUR −26.52 (RM −130.90; USD −28.67) per tonne of CO2 in 2023 (OECD, 2026); a substantial negative effective carbon price (and subsidy of carbon emissions).

This combination of a negative effective carbon price and uncertainty around policies and the introduction of a carbon pricing framework creates genuine uncertainty for investors. This brief examines how Malaysian financial markets and power generation investors actually respond to this uncertainty. First, it constructs a Malaysian climate policy uncertainty (CPU) index and tests whether it affects the returns and volatility of energy and utility stocks. Second, it simulates the effect of introducing a carbon price on investment in solar, combined-cycle gas turbine (CCGT), and coal power generation.

No evidence is found that climate policy uncertainty is priced into Malaysian energy and utility stocks. This is best explained by how the electricity market is regulated: under the Incentive-Based Regulation (IBR) framework, generators are protected from fuel-cost and exchange-rate fluctuations. This closes off the main way climate policy uncertainty could otherwise affect firm value. But this protection does not cover carbon pricing itself: introducing a carbon price directly raises electricity generation costs for CCGT and coal plants, while solar remains unaffected. As the carbon price rises, the of CCGT and coal rises while their profitability declines, while solar's economics stay constant. On a stand-alone basis, this brief finds that solar is not an attractive investment, while CCGT remains commercially viable even under a relatively high carbon price. Within a portfolio, however, solar's imperfect (zero) correlation with CCGT and coal means that adding it reduces overall portfolio risk, even though its stand-alone returns are negative.

Even a very low carbon price already shifts risk-minimising portfolio allocations towards solar and renewable energy more broadly. This suggests that the Malaysian government could play a key role in the energy transition by introducing a modest carbon price, encouraging private investment in renewable energy from a risk-management perspective. Because such a low price is already effective at shifting investment behaviour, electricity can remain affordable while the transition accelerates. A modest carbon price would also help reduce carbon emissions and strengthen energy security amid rising geopolitical tensions.

Introduction

In 2023, the ministry of economy launched Malaysia's National Energy Transition Roadmap (NETR), which, among others, sets out what policies need to be considered to realise a successful energy transition and achieve becoming net-zero by 2050 (Ministry of Economy, 2023). For Malaysia, a middle-income country that is heavily dependent on fossil-fuel-based electricity power generation, the transition towards renewable and cleaner energy sources is critical both to strengthen energy security and to reduce carbon emissions. The former is required given the tensions in the Middle East and its effect on the fossil fuel supply. The latter is particularly necessary given that Malaysian per capita carbon emissions have increased annually from 2020-2024 (World Bank, 2024). The energy sector is central to this transition: it accounts for 78% of Malaysia's total emissions (ICAP, 2026), of which 47% comes from electricity and heat producers (IEA, 2023).

To reach net-zero, Malaysia requires an estimated RM 1.2 to 1.3 trillion (USD 263 to USD 285 billion; converted at RM 4.565/USD, the BNM average exchange rate for 2023) in new capital investment, about 18% of which is needed primarily for renewable energy power generation and green mobility (Ministry of Economy, 2023).

However, the current investment climate is constrained by market and policy uncertainty. Renewable energy projects require supporting policies to initiate investments and development, and financial institutions perceive these projects as risky due to challenges in project development. Regulatory barriers and a lack of pricing transparency further hinder renewable energy investments (Ministry of Economy, 2023), with the absence of a carbon pricing mechanism playing a key role.

Explicit carbon prices, policy tools to price carbon emissions expressed per tonne of CO_2 equivalent (Garsous et al., 2023), are one of the main instruments to price and reduce carbon emissions. These carbon prices, or pricing frameworks, can take the form of a carbon tax or an emissions trading system (ETS). Malaysia launched a voluntary carbon market (VCM) in 2022, a platform where carbon credits can be traded on a voluntary basis, intended to offer transparency, efficiency, and liquidity by connecting buyers and sellers (Bursa Malaysia & MGTC, 2025). So far, however, the VCM has not offered liquidity, and no clear carbon price has been established. Plans for a mandatory carbon tax or ETS were signalled in the Twelfth Malaysia Plan (Economic Planning Unit, 2021) but have since been suspended, creating uncertainty from 2021 onwards.

The plan currently remains on hold in spite of geopolitical tensions (Ho, 2026), leaving private markets exposed to uncertainty due to the lack of transparent climate policy (NRES, 2024).

Malaysia currently does not have an explicit carbon price. This does not mean, however, that Malaysia operates without an ***effective*** carbon price. The OECD's Net Effective Carbon Rate (Net ECR) framework, which measures the price on carbon emissions by summing up subsidies and taxes related to carbon emissions and the price for carbon credits (Garsous et al., 2023), finds that Malaysia's Net ECR was EUR −26.52 (RM −130.90; USD −28.67) per tonne of CO_2 in 2023 (OECD, 2026). A substantial negative effective carbon price.

Given that Malaysia's effective carbon price is already substantially negative, and no explicit carbon price is currently planned, an important question follows: do investors and financial markets in Malaysia actually respond to climate policy uncertainty, or is this uncertainty simply not priced at all? This policy brief addresses that question directly for both financial markets and investments in power generation projects and further discusses what would happen if a carbon price were introduced.

MEASURING CLIMATE POLICY UNCERTAINTY

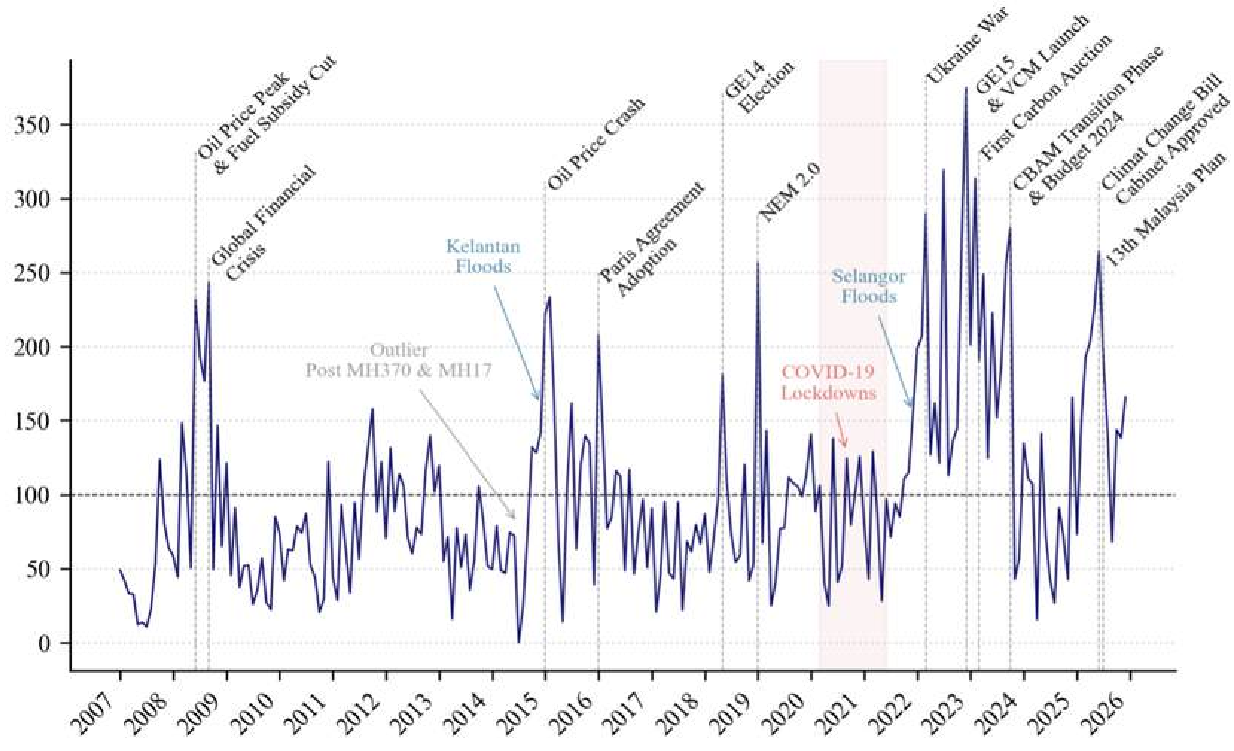
While the NETR provides a roadmap for the energy transition, commitments to energy-related policies are subject to change. Such policy risks are of particular concern, as changes in policy directly increase the costs of doing business (NRES, 2024). For investors, changes in policies require operational adaptation, increasing the complexity and risk of investment decisions. In the absence of policy commitment, this uncertainty may even cause investors to postpone investments.

Carbon pricing remains unclear in Malaysia. The absence of a clear carbon price, combined with the uncertainty around when and at what price level it might be implemented, directly affects the investment decision-making process (Blyth et al., 2007; Yang et al., 2008). The unpredictability in both regional and international policies related to climate change is referred to as climate policy uncertainty (Siddique et al., 2023). One way to measure this uncertainty is by using a newspaper-based climate policy uncertainty (CPU) index, which quantifies the frequency of newspaper articles discussing climate policy ambiguity. Baker et al. (2016) have first come up with such an index to measure economic policy uncertainty.

A Malaysian CPU index constructed using this methodology is shown in figure 1. The index illustrates the monthly intensity of media attention on climate policy uncertainty, where higher values indicate more media attention and, hence, more discussion or instability. The index captures media intensity rather than sentiment, implying that policy discussion and transition elevate measured levels, while policy implementations do not necessarily do so.

As shown in figure 1, Malaysia has shown elevated levels of climate policy uncertainty from the COVID-19 period onwards, relative to its normalised sample mean of 100 over 2007-2025.

Figure 1: Malaysian climate policy uncertainty index (2007-2025)



Notes: *This figure presents the monthly intensity of climate policy uncertainty in Malaysia during the period 2007-2025, measured by media attention. The index represents the scaled monthly frequency of news articles containing keywords related to climate, policy, and uncertainty within three Malaysian newspapers: The Edge, The Malaysian Reserve, and the New Straits Times. The index is normalised to a mean of 100 over the full sample period to illustrate deviations from the long-run average. Values above (below) 100 indicate periods of increased (decreased) climate policy uncertainty relative to this average, with abrupt surges identifying significant policy discussions or events that captured intensive media attention.*

Prior research finds that climate policy uncertainty, measured using a CPU index, affects energy assets. Siddique et al. (2023) find that fossil-based energy commodity futures are negatively affected by the CPU index, while renewable energy assets serve as a hedge. Xu et al. (2022) find that elevated climate policy uncertainty levels predicts higher renewable energy returns. Gavriilidis (2021) finds that climate policy uncertainty shocks even lead to lower carbon emissions, showing that climate policy uncertainty has real external effects.

Are Malaysian Assets Affected by Climate Policy Uncertainty?

Given these prior findings, an important question is whether climate policy uncertainty also affects Malaysian assets; meaning, do investors in Malaysian markets actually price this risk. This brief draws on a previous analysis (Bakker, 2026) testing whether climate policy uncertainty affects Malaysian energy and utility stocks using a GARCH framework. In this analysis, the Kuala Lumpur Energy (KLEN) and Kuala Lumpur Utility (KUTL) Malaysian stock indices are studied, because energy and utility companies should be most affected by climate policy risk. GARCH models allow volatility to depend on past market volatility, with the CPU index added as an extension to test whether it also affects index volatility. The models also allow both returns and volatility to be analysed using mean and variance equations.

When climate policy uncertainty carries information relevant to firm risk, elevated levels or changes in climate policy uncertainty levels should predict higher volatility in these indices. Moreover, changes in climate policy uncertainty levels possibly affect, or are associated with changes in, the returns of the indices (Xu et al., 2022). Table 1 summarises the results.

Table 1: Climate policy uncertainty (CPU) effect on index return and volatility

	KLEN	KLUTL
CPU effect on returns	0.0359	0.0204*
	(0.0223)	(0.0119)
CPU effect on volatility	-0.1659	0.0004
	(0.1484)	(0.0034)

Notes: ** $p<0.10$ ** $p<0.05$ *** $p<0.01$. Standard errors in parentheses. KLEN refers to the Kuala Lumpur Energy Index and KLUTL to the Kuala Lumpur Utility Index. For KLEN, a GARCH(1,1) variance specification is used, whereas for KLUTL an EGARCH(1,2) specification is used. The mean equation includes market return (the FBM100 index is considered as proxy), CPU index, ΔBrent (denominated in MYR), and the lagged dependent variable.*

The CPU index shows no significant effect on energy or utility stock volatility. Additionally, no significant association between the CPU index and KLEN stock returns is found. The KLUTL coefficient is statistically significant at the 10% level, but the size is economically negligible given that the coefficients should be interpreted based on a one standard deviation change in the CPU index. One standard deviation change is equal to an index level change of 75.9. Meaning, while Xu et al. (2022) find that a CPU index predicts renewable energy returns, the Malaysian energy and utility stock indices do not show any association.

WHY MIGHT THIS BE THE CASE?

This null finding aligns closely with how the Malaysian energy sector is regulated. In Malaysia, power generators receive a fixed electricity tariff. For large-scale solar (LSS), investors bid competitively, with the lowest bidder receiving the fixed tariff bid for the electricity generated. For combined-cycle gas turbine (CCGT) and coal power generation projects, the electricity tariff is instead based on the Incentive-Based Regulation (IBR) framework, under which tariffs are negotiated and set through Power Purchase Agreements (PPAs) with the Single Buyer. This electricity tariff consist of two parts: a base tariff (consisting of a capacity payment and a fuel payment (ST Energy Comission, n.d.-a)) and an automatic fuel adjustment (AFA). The capacity payment covers forecasted generation, fixed, and variable costs (excluding fuel) plus some additional margin. The fuel payment covers fuel costs based on a fixed benchmark and exchange rate. The AFA then adjusts for changes in the market price of fuel (e.g., the coal price and LNG price) and changes in the dollar exchange rate (MYR/USD) (Single Buyer, 2026a). Hence, the AFA is an adjustment mechanism ensuring that the electricity tariff received by generators is based upon real fuel costs and not solely on some fixed benchmark price. This ensures that the regulated electricity tariff is as close as possible to a liberalised market price.

The consequence is, however, that CCGT and coal generators are largely protected from fuel-cost and exchange-rate risks: fluctuations that would otherwise expose an unregulated generator to real financial risk which should be hedged are instead absorbed through the tariff mechanism. This mattters directly for the CPU result, because the Malaysian CPU index correlates with Brent crude oil denominated in Malaysian Ringgit at 0.373 (Table 2). This correlation implies that climate policy uncertainty is related to Brent oil price and exchange rate movements. Because Malaysian generators are protected from these exact fluctuations, the impact of climate policy uncertainty on energy and utility stocks is limited. For generators fuel costs and appreciations or depreciations of the Malaysian Ringgit are the most important risks, because the in USD denominated fuel costs are the input for generating electricity. Nevertheless, within the PPA-contracted energy market, firms are protected from these risks.

Table 2: Correlation coefficients of the variables used in the GARCH estimations (September 2018-December 2025)

Variables	(1)	(2)	(3)	(4)	(5)
(1) KLEN return	1.000				
(2) KLUTL return	0.458***	1.000			
(3) FBM100 market return	0.595***	0.651***	1.000		
(4) CPU index	0.012	0.006	-0.003	1.000	
(5) Brent price (MYR)	0.026	0.028	-0.011	0.373***	1.000

***Notes:** This table presents the correlations between the KLEN return, KLUTL return, FBM100 market return, the CPU index, and the Brent price over the sample period. Variables defined as in table 1. * p<0.10, ** p<0.05, and *** p<0.01.*

Table 2 partially confirms the findings that the CPU index is not associated with the index returns, as the correlation between the CPU index and the respective indices is small and insignificant. This is also consistent with the nature of the CPU index itself, which measures media attention rather than fundamental information on firm value. Rational investors invest based on fundamental value; the CPU index should only move stock prices to the extent that it reflects, or predicts, changes in fundamental firm value. Given the protected cashflows within Malaysia's regulated energy sector, and the fact that energy and utility firms are often government-linked (Stek et al., 2023), this effect is limited.

This insulation, however, applies specifically to fuel-cost and exchange-rate risk under the current tariff design. Carbon pricing, if introduced, represents a new cost category not covered by the AFA mechanism. This raises the question addressed in the remainder of this brief: even if markets do not currently price climate policy uncertainty, would the introduction of a carbon price affect investment decisions?

INVESTMENT IMPACT OF A CARBON PRICE

Even though Malaysian electricity generators are unaffected by climate policy uncertainty as measured by the CPU index, the introduction of an explicit carbon price could still directly affect investments in power generation projects. While a CPU index cannot be directly translated into investment decision-making, climate policy uncertainty can be represented in this process through uncertainty around the introduction and level of a potential carbon price (Blyth et al. (2007); Yang et al. (2008).

To examine this, solar, CCGT, and coal power generation projects are analysed on both a stand-alone and portfolio basis under a range of assumed carbon prices. Using Monte Carlo simulations and modelling the carbon price using Geometric Brownian Motion (GBM), the attractiveness of power generation project investments can hence be assessed. The input assumptions are shown in table 3 below. Note that the simulation outcomes are very sensitive to changes in input. Nevertheless, the effect of the introduction of a carbon price does not change. The exact numbers might be off, but the effect of introducing carbon pricing stands. However, given this, the results discussed below should only be interpreted as indicational rather than exact estimates.

Table 3: Input for the evaluation of new energy investments (USD)

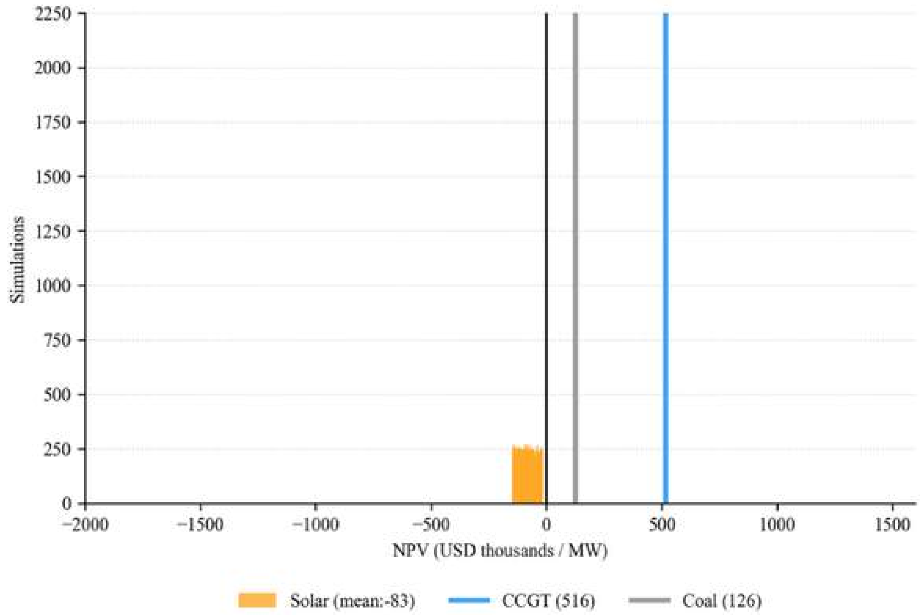
	Solar (PV)	CCGT	Coal
Investment cost (per MW)	596,536	1,018,876	1,387,491
Fixed O&M cost (per MW/year)	13,191	31,314	39,208
Variable O&M cost (per MWh)	0.00	2.30	4.50
Carbon factor (t/MWh)	0.00	0.48	0.90
Capacity factor (%)	E[14.18]	56.80%	75.10%
Degradation rate (yearly)	0.5%	0.13%	0.096%
Lifetime (years)	25	30	40
Discount rate	8.0%	10.0%	10.0%
Fuel payment (USD/MWh)	-	46.21	41.74
Capacity payment (USD/MWh)	-	37.91	34.24
Electricity tariff (USD/MWh)	37.15	87.95	72.14

Sources: *Cost input based on BloombergNEF (2025) and in line with Rystad (2025). Lifetime years based on Rystad (2025) and own assumptions. The capacity factor of solar is modelled stochastically; other inputs are fixed. The electricity tariff for solar is based on the last large-scale solar bidding in Malaysia (16 sen/kWh). Tariffs for CCGT and coal are derived from the Regulatory Period 4 base generation tariff and equal the sum of the fuel and capacity payments. Tariffs are converted at 4.307 MYR/USD (Single Buyer, 2026b). Solar's investment cost is shown net of the GITA tax allowance; because Return in Table 4 is expressed as a percentage of this GITA-adjusted CAPEX base, GITA can produce a more negative percentage return even though it improves the NPV of solar.*

On a stand-alone basis, the projects are compared on net present value (NPV) and risk. The NPV is the current value of all discounted future cash flows of an investment minus the initial capital investment costs. As shown in figures 2a, 2b, and 2c, solar shows a negative NPV across all scenarios even when accounting for the Green Investments Tax Allowance (GITA). Under GITA, approved companies are eligible for a five-year tax allowance of 100% of the eligible CAPEX, offset against 70% of statutory income (MIDA, n.d.). Assuming that the investing companies are mature and invest actively in multiple projects, their statutory income is higher than the applicable CAPEX implying that the GITA incentive can be deducted as a one-time discount on CAPEX.

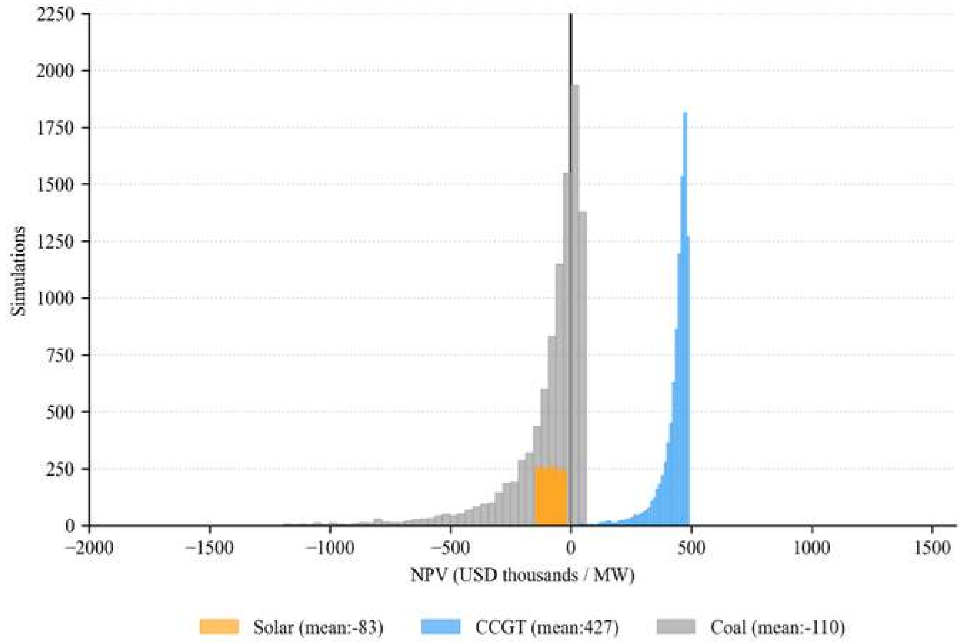
Figure 2a shows NPV distributions under current market circumstances. For both CCGT and coal, the NPVs are deterministic as all risks are covered within the PPAs. The NPV of solar solely fluctuates because of the stochastic modelling of irradiation. Looking at figures 2b and 2c, the NPV distributions of CCGT and coal shift leftwards and become left-skewed when a carbon price is introduced. This can be explained by the fact that the carbon price enters the costs of CCGT and coal power plants. The upside potential is capped by the electricity tariff received, however, when a carbon price is introduced the costs of generating electricity increases. Hence, the NPV distributions shift to the left. The carbon price itself is modelled as if it follows a random walk with an upward trend through GBM, simulated 10,000 times using Monte Carlo simulations.

Figure 2a: NPV distributions per technology in the absence of a carbon price



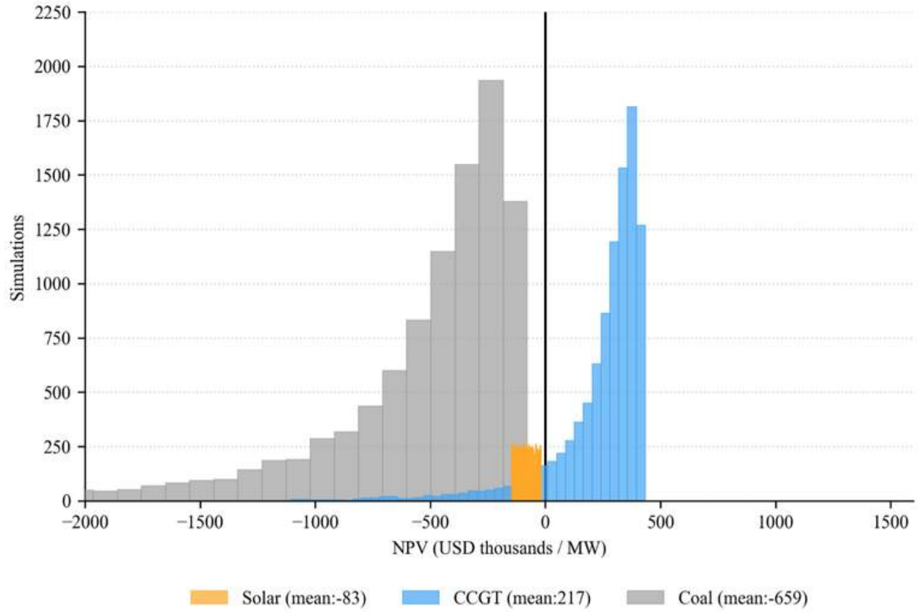
Notes: *This figure plots the NPV distributions (USD thousands per MW) per technology under current market circumstances. No carbon price is introduced. For solar, the capacity factor is modelled stochastically, resulting in an NPV range with mean USD -83,000/MW. The distribution is plotted using 40 bins, each representing 2.5% of the simulated NPVs.*

Figure 2b: NPV distributions under carbon price with launch price of RM 15 (USD 3.48)



Notes: *As in figure 2a. A carbon price is modelled using an annual drift (= 0.017) and volatility (= 0.388) parameters. The carbon launch price equals RM 15 (USD 3.48), with mean price USD 5.50 over a period of 40 years.*

Figure 2c: NPV distributions under carbon price with launch price of RM 50 (USD 11.61)



Notes: *As in figure 2a. The carbon price is modelled using an annual drift (= 0.017) and volatility (= 0.388) parameters. The carbon launch price is equals RM 50 (USD 11.61). The mean price is USD 16.51 over a period of 40 years.*

Table 4 shows that risk (measured as standard deviation, probability of loss, and conditional value at risk (CVaR)) increases in carbon price while the returns decrease. Solar is the only technology that is unaffected by the introduction of carbon pricing under current market conditions. In other words, a carbon price makes solar relatively more attractive from a risk perspective compared to conventional technologies. So, from a risk perspective, a negative NPV for solar does not mean the technology is unattractive: solar's appeal stems from its insensitivity to carbon price risk, which becomes increasingly valuable as carbon prices and/or fluctuations in carbon prices increase.

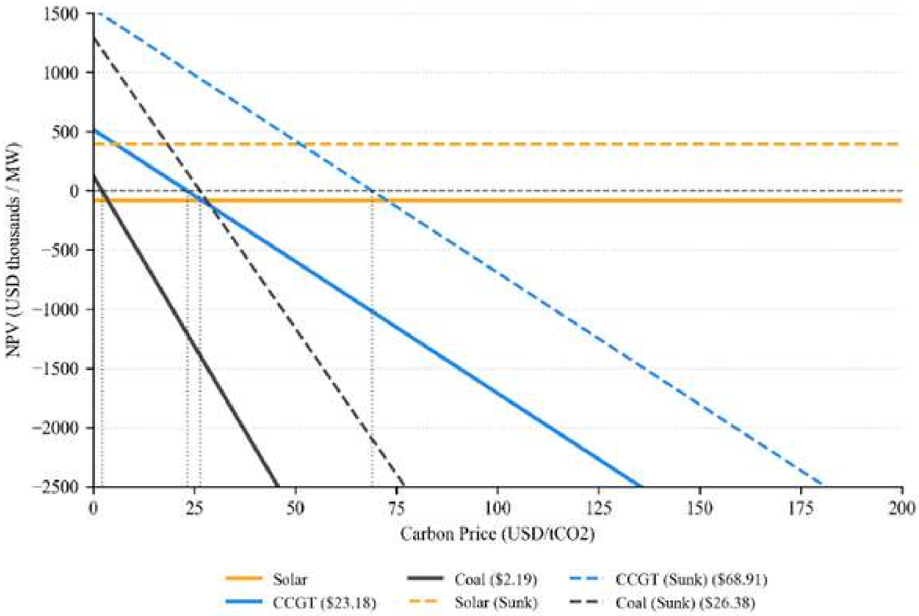
Table 4: Risk metrics per technology under different carbon pricing scenarios (USD)

	Scenario	Return (%)	Std. (%)	Sharpe	P(Loss)	CVaR (%)
Solar	All	-17.43	8.08	-2.16	1.00	-30.60
CCGT	No carbon	50.68	0.00	-	0.00	50.68
CCGT	RM5	47.75	4.18	11.42	0.00	36.69
CCGT	RM15	41.88	12.54	3.34	0.01	8.71
CCGT	RM25	36.01	20.90	1.72	0.03	-19.27
CCGT	RM50	21.33	41.80	0.51	0.11	-89.21
Coal	No carbon	9.07	0.00	-	0.00	9.07
Coal	RM5	3.41	9.04	0.38	0.12	-19.81
Coal	RM15	-7.90	27.13	-0.29	0.65	-77.58
Coal	RM25	-19.20	45.21	-0.42	0.95	-135.34
Coal	RM50	-47.48	90.42	-0.53	1.00	-279.75

Notes: *This table presents the risks for solar, CCGT, and coal investments under five carbon price scenarios. Return is the mean NPV divided by CAPEX. The Sharpe ratio divides return by its standard deviation. P(Loss) is the share of simulations with negative NPV. CVaR represents the average loss in the worst 5% of the simulations (as a percentage of CAPEX).*

Using a linear breakeven approach, the carbon price at which each technology's NPV reaches zero can be derived for both new investments and currently operating plants. To derive the breakeven carbon price for currently operating plants, CAPEX is treated as a sunk cost. Figure 3 shows the breakeven carbon price for the technologies under both approaches. It shows that even a very low carbon price (approximately USD 2) already makes new coal investments unviable. This suggests that a modest carbon price would already help align market incentives with the within the NETR mentioned target of not investing in new coal capacity. To fully phase out coal by 2045, another target of the NETR, the carbon price would need to increase to approximately USD 26. This figure should not be read too precisely due to its sensitivity to input assumptions, but it does indicate that either the carbon price needs to rise substantially, or the tariff structure for coal generation needs to be adjusted significantly, to make this target commercially self-enforcing.

Figure 3: Breakeven carbon prices for each technology



Notes: *This figure presents the breakeven carbon prices per technology. The breakeven carbon price equals the carbon price for which the NPV is zero. The solid lines represent new investments. The dashed lines represent operating projects, where CAPEX is a sunk cost. For the sunk of coal, it is assumed that in 2045 no coal is operating anymore. Hence, the maximum lifetime is limited up until this year. For CCGT (and solar), the lifetime(s) shown in table 3 is (are) assumed.*

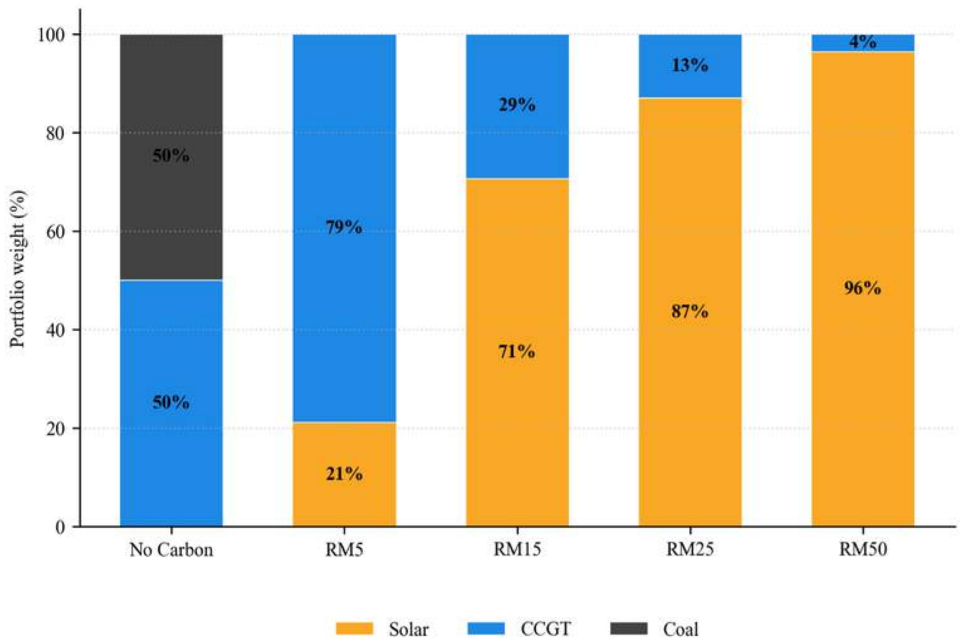
CARBON PRICING EFFECT ON INVESTMENT PORTFOLIOS

As is illustrated by table 4, CCGT investments are the only consistently attractive investments on a stand-alone basis. The average returns and Sharpe ratios for CCGT are greater than zero for all scenarios. This is broadly consistent with the NETR's framing of gas as a transitional fuel during the energy transition (Ministry of Economy, 2023). The CVaR and standard deviation do, however, increase significantly for CCGT investments, eroding much of the stand-alone attractiveness at higher carbon prices. Solar seems unattractive as its return is negative for each scenario. However, when considering diversification effects of investing in multiple projects, relatively unattractive stand-alone investments might still improve portfolio performance in the absence of perfect correlations.

To identify optimal generation portfolios under different carbon pricing scenarios, this brief applies mean-variance portfolio theory, following Markowitz (1952), Bhattacharya and Kojima (2012), and Tietjen et al. (2016). This approach combines the risk and return of individual technologies, accounting for how their returns move together through the covariance between them, to determine the risk and return of the overall portfolio. Since investors are assumed to be risk-averse, a higher expected return is not necessarily preferable if this substantially increases risk. An optimal portfolio can be found either by minimising variance, giving the lowest expected risk, or by minimising CVaR, giving the portfolio least exposed to extreme losses. Portfolio weights are derived from the returns and covariance matrix produced by the Monte Carlo simulations described above, with weights constrained to be non-negative and to sum to one, since power generation assets cannot be shorted.

Because solar is unaffected by carbon pricing (under current market circumstances and modelling assumptions) the NPV of solar is uncorrelated to CCGT and coal. Since CCGT and coal are exposed to the same carbon price risk when carbon pricing is introduced, these technologies are correlated. Hence, from a portfolio risk perspective, the introduction of a carbon price and the increase of a carbon price significantly shifts risk-minimising portfolio allocation towards solar. This can be explained by the asymmetric risk effect of carbon pricing. Solar remains unaffected, while the costs and risks of CCGT and coal increase. Figures 4 and 5 show the optimal portfolios under all scenarios.

Figure 4: Minimum-variance portfolios across carbon pricing scenarios

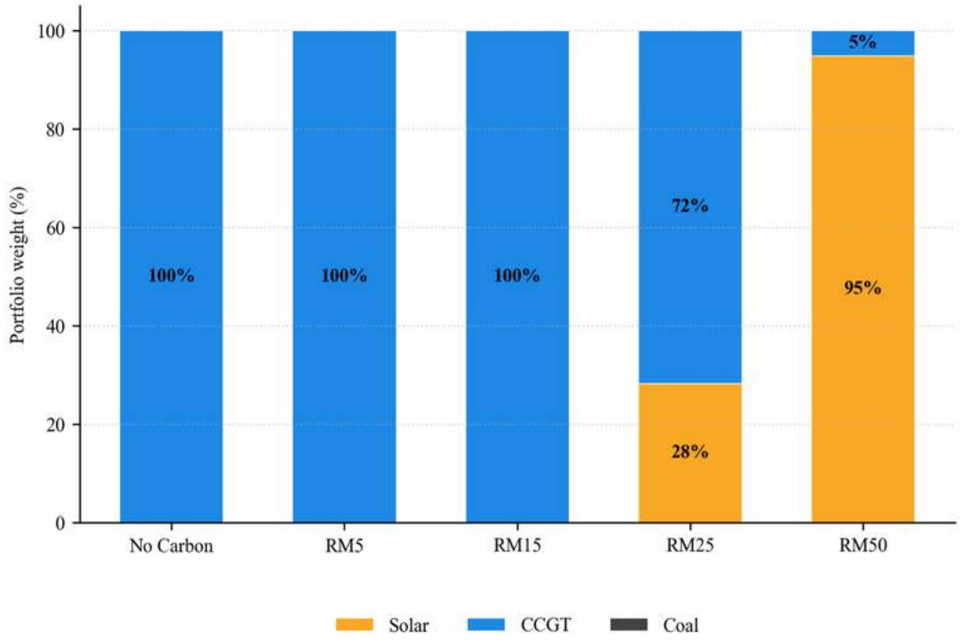


Notes: *This figure presents the optimal variance-minimising portfolios for five different scenarios: no carbon, RM5, RM15, RM25, and RM50. These denote scenarios with carbon launch prices of USD 1.16, USD 3.48, USD 5.80, and USD 11.61 per* tCO_2*, respectively.*

As illustrated in figure 4, the minimum-variance portfolio allocates 50% to CCGT and 50% to coal under no carbon pricing. The optimal allocation of investments shifts under carbon pricing: even at the RM5 scenario, solar enters the portfolio at a share of 21%. Because of its zero correlation with CCGT and coal, including solar reduces the overall portfolio variance. As the carbon price increases, the allocation shifts towards a more solar favourable portfolio, reaching 96% at the RM50 scenario.

The minimum-CVaR portfolio (figure 5) presents different optimal weights. Up until scenario RM15, 100% of the portfolio is allocated to CCGT since the downside risk of CCGT is below that of solar under low carbon pricing. Solar's expected loss exceeds the downside risk of CCGT. However, solar enters the minimum-CVaR portfolio at the RM25 scenario. Not necessarily because its downside risk is lower compared to CCGT, which is not even the case at a price of RM25, but because of imperfect (zero) correlation minimising portfolio CVaR.

Figure 5: Minimum-CVaR portfolio across carbon pricing scenarios



Notes: This figure presents the optimal portfolios based on the minimum conditional value at risk (CVaR) for the scenarios as described in figure 4. The portfolios present the optimal allocation for downside risk minimisation, minimising CVaR for each scenario.

The minimum-variance and the minimum-CVaR portfolios provide different optimal investment portfolios. Given this, these portfolios should also be interpreted differently. The minimum-variance portfolio focuses on minimising general variance: both upside and downside risk is minimised. When expected returns of a technology vary significantly, the variance increases. Solar is included under low carbon pricing, since it reduces portfolio variance despite its negative return. The minimum-CVaR portfolio focuses solely on downside risks, showings the optimal portfolios based on tail risk (extreme losses).

Hence, the investment attractiveness of solar depends on the perspective taken. Comparing the technologies from a stand-alone basis, CCGT is the most attractive investment provided its positive returns and low risks. However, from a portfolio perspective, including solar still improves (reduces) portfolio performance (risk) due to a so-called diversification effect. When carbon pricing is introduced, the relative risk of solar compared to CCGT and coal decreases because solar is unaffected by carbon risk. Hence, the attractiveness of including solar investments in a portfolio increases when a carbon price is introduced. For Malaysia, this implies that investors and companies should have a clear risk-management incentive to include solar generation to their portfolios once carbon pricing is introduced. Even if this price is relatively low. This also directly relates to energy security: a diversified power generation portfolio acts as a hedge against commodity price shocks, as solar power generation is unaffected by commodity price volatility (Bhattacharya & Kojima, 2012). Given that Malaysia is a net importer of both LNG and coal, this diversification benefit is particularly relevant.

Policy Implications

Taken together, these findings provide evidence of how carbon policy uncertainty is perceived in Malaysian markets. Investors do not currently price climate policy uncertainty into energy and utility stock valuations, which is consistent with the electricity tariff structure that shields generators from the fuel-cost and exchange-rate risk through which such uncertainty would, among other factors, transmit. However, this does not imply that carbon pricing is irrelevant to Malaysian investment decisions: the simulations show that even a very low carbon price meaningfully affects stand-alone project attractiveness and shifts risk-minimising investment portfolio allocations towards solar.

This has three implications for policy.

First, the carbon price needed to shift investment behaviour appears to be low. Because CCGT and coal generation remains commercially attractive under current market conditions, private investment in renewable energy could help achieve the NETR without requiring large increases in carbon costs. Given how low this price appears to be, concerns about energy affordability should not hinder its introduction: a low carbon price can drive the NETR without significant increases in energy prices.

Second, this makes the introduction of a carbon price a low-cost way for the Malaysian government to play a key role in the energy transition. Beyond shifting investment portfolios towards solar, or renewable energy more broadly, a low carbon price also helps reduce carbon emissions and secures the supply of energy, which is increasingly important given ongoing tensions in the Middle East.

Third, because CCGT and coal generation remains commercially attractive, the priority for Malaysian policymakers is to ensure that incentives and policies are aligned, rather than relying on carbon pricing alone to drive the transition.

One caveat is that these results depend on several modelling assumptions. Most importantly, carbon costs are assumed not to be incorporated into existing PPA contracts. It could, however, be that generators will negotiate to incorporate carbon pricing into future PPA contracts, which would reduce or eliminate the effect modelled here. The simulation results should therefore be interpreted as indicative of direction and scale, not as precise forecasts.

A second caveat concerns the pace of renewable investment already observed. Despite negative NPVs for solar generation projects as modelled within this analysis, investment in renewable energy has recently accelerated within Malaysia: renewable energy accounted for 31% of installed capacity as of December 2025 (Fuad & Bernama, 2026). Even though this figure includes hydropower and bioenergy alongside solar, it may reflect that significant investment in solar is already taking place, implying that these investments are based on incentives other than profitability. Corporate demand for renewable electricity, through mechanisms such as Malaysia's Corporate Renewable Energy Supply Scheme (CRESS), allows companies to contract directly for renewable power to meet sustainability commitments and carbon-neutral pledges, independent of carbon pricing. Multinational corporates operating in Malaysia, for example, often face reporting and procurement requirements tied to their home-market sustainability commitments, creating demand for renewable electricity independent of Malaysian policy. Continuing declines in solar CAPEX, project-specific higher electricity tariffs, and heightened commodity price volatility from geopolitical shocks (e.g., the Russia–Ukraine and US–Iran conflicts) may further explain why renewable investment has accelerated even where the modelling in this analysis shows unfavourable NPV outcomes.

This matters for how the evidence in this brief should be read: renewable investment in Malaysia is not starting from zero, and does not depend solely on carbon pricing to accelerate. Rather, the introduction of a carbon price represents an additional incentive to accelerate the energy transition as targeted within the NETR.

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