Climate-Economic Country Risk Profile

Indonesia

The current pace of climate change has impacts that range from rising sea levels to extreme weather patterns, forcing governments around the world to grapple with two distinct types of risk: The physical risks of climate change include the potential destruction of land and infrastructure, lost productivity in the agriculture sector and the health impacts of heat stress and natural disasters. Minimising future impacts through decarbonisation, however, creates a set of transition risks as the economy adjusts to new regulations, energy systems and consumer sentiment. Managing these risks will entail mitigation measures that tackle the root causes of climate change – chiefly by reducing carbon emissions – and adaptation measures that build resilience to the impacts that can't be avoided, such as investments in protective infrastructure.

These climate impacts, risks and actions do not exist in separate spheres – they affect one another. Mitigation can diminish impacts, and diminished impacts preserve more resources for pursuing emissions reductions. Successes and failures in this nexus also affect geopolitical, geoeconomic and security risks, not least due to their capacity to shape socioeconomic fortunes. This profile focuses on Indonesia as a country that faces high transition and physical risks simultaneously. Modelling has been used to understand a possible "double cost crunch" – a development-phase macroeconomic squeeze in which physical climate impacts reduce growth, productivity, fiscal space and domestic investment capacity, while a low-carbon transition requires large up-front capital mobilisation, infrastructure build-out and institutional reform.

In Indonesia, these pressures all interact – climate damages raise adaptation needs and can weaken revenues, while transition needs increase financing requirements precisely when capital remains expensive and public resources are under pressure. The result is a compression of near-term policy space at a critical stage of structural transformation. This profile highlights the geopolitical, geoeconomic and security dimensions of this challenge and offers recommendations.

BACKGROUND

The **GeoClimRisk** (The Geopolitics of Climate Risks) project examines how climate change, its economic impacts, and their interaction with geopolitics shape emerging security risks, with a focus on countries facing an intense "double cost crunch". It aims to inform international cooperation, policymakers and risk-management strategies.

The **"double cost crunch"** refers to the simultaneous financing pressure from climate damages and the low-carbon transition. Investments in green and decarbonised energy are widely recognised as a key engine of economic development, especially in energy-poor regions.

The urgent need for **climate action** in Indonesia – in terms of both mitigation and adaptation – has been recognised, but success will depend on simultaneously diversifying energy, enhancing adaptation and resilient infrastructure, and implementing development and social protection.

Climate change amplifies **geopolitical tensions**, reshapes participation in international trade and diplomacy, and intensifies resource strain in Indonesia and the wider region. Addressing these demands will require major investment, international cooperation and updated security planning.

PROJECT RESULTS

Indonesia's **energy transition** will require substantial investment and improved capital market conditions to increase wind and solar deployment by 2050, resulting in lower electricity prices and reduced reliance on fossil fuel imports. However, political economy risks arise from key actors prioritising short-term gains and energy security over decarbonisation, thereby delaying or even blocking the transition through a range of strategies.

Climate change weakens Indonesia's development trajectory in several ways: changes in terrestrial water storage, damage to capital and labour productivity, and shifting consumption and migration patterns can increase **economic risks** and jeopardise both growth and the energy transition.

An **ambitious climate policy** yields long-term benefits that far exceed near-term costs, but delays in mitigation intensify the double cost crunch, as accumulated damages erode fiscal capacity precisely when financing is expensive and large up-front investments are needed.

Early investments in renewable energy systems could reduce fossil fuel import dependencies and increase energy sovereignty, strengthening Indonesia's **geopolitical position**. The country's raw materials sector offers additional leverage in negotiating energy transition terms, while international climate finance for both mitigation and adaptation remains relevant for harnessing economic potentials.

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Residents flee Jakarta by dinghy after floods hit the capital city (February 2020).

1. Country context

1.1. CLIMATE AND TRANSITION RISKS

Indonesia faces a complex climate–development nexus: decoupling rapid economic growth and expanding energy demands from fossil fuel reliance, while coping with significant adaptation and loss-and-damage pressures.

Core vulnerabilities and climate-development pressures
Indonesia is highly vulnerable to climate change because of its island geography, dense coastal populations and fragile ecosystems. This interacts with exposure to climate hazards, socio-economic inequality and variegated resource-dependence – oil and gas in Sumatra, coal in Kalimantan, nickel in Sulawesi, and tourism- and agriculture-based livelihoods in Bali and Nusa Tenggara [3; 4] – which can turn environmental shocks into development setbacks [1; 5].

These physical risks form one side of the double cost crunch: they erode growth, productivity and fiscal space, reducing Indonesia's capacity to finance the transition. UN-led frameworks further underscore the difficulty of decarbonising a coal- and fossil-fuel-dependent energy system while protecting informal settlements, food systems and critical infrastructure [2].

Coastal, urban and sea-level-rise risks
Sea-level rise ranks among Indonesia's most critical physical risks, particularly for low-lying coastal communities across 17,000 islands [6; 1]. Major cities such as Jakarta, Medan and Surabaya are exposed to sea-level rise, tidal flooding and land subsidence [1]. Rapid urbanisation intensifies exposure, as informal settlements occupy flood-prone land with poor drainage and limited urban-cooling infrastructure [8]. Jakarta is one of the world's fastest-sinking cities, prompting the government to plan a new "green-and-smart" capital, Nusantara [7].

Changing extremes, monsoon variability and land-use pressures
Indonesia is experiencing shifts in extreme-weather patterns, with more frequent droughts in the south and wet extremes elsewhere [9]. Prolonged dry periods and land-clearing practices amplify wildfire and peat-fire risk, and put pressure on water-supply systems [10]. The monsoon has also become less predictable, increasing the likelihood of seasonal floods, landslides and droughts, with knock-on effects on agriculture and health systems.

Food, livelihoods and climate-linked migration
Agriculture, forestry and fisheries underpin Indonesia's economy, with agriculture providing livelihoods for over 60% of the poor [11]. Climate-hazard exposure raises the probability of substantial paddy-yield reductions and short-distance climate-linked migration, especially from rural and coastal areas [12].

Adaptation limits and institutional frontiers
Despite national adaptation plans, Indonesia's vulnerability stems from the interplay of exposure, rapid development and limited adaptive capacity [1; 4]. Vastly scaled-up, cross-sectoral adaptation investment – especially in coastal protection, urban planning and climate-resilient agriculture – is needed to reduce displacement, food insecurity and long-term welfare losses [13; 14]. Adaptation financing remains constrained, however, by high borrowing costs and limited fiscal space, exacerbating the double cost crunch.

1.2. ENERGY

Importantly, climate change affects both energy demand and supply in Indonesia. Demand for energy is set to rise by up to nine times by 2060 [15] for multiple reasons, including a rapidly growing economy. Rising temperatures prompt a growing demand for cooling in homes and commercial settings, and it is projected that by 2030 half of peak demand will be driven by household appliances, particularly air conditioning [16]. Peak demand, in turn, strains a national grid that is still overwhelmingly reliant (ca. 80%) on fossil fuels [17] and prone to uneven stability across the archipelago. Hydropower is important in Indonesia, but it is affected by unpredictable rainfall and droughts. Finally, extreme weather damages power plants, ports and transmission lines, contributing to outages and increased maintenance costs.

Investment in a clean and reliable energy supply, however, must be made in a context where climate impacts are increasing sovereign risk and the cost of capital, while simultaneously raising the demand for public spending on social programmes and services.

Despite Indonesia attracting attention from international partners and being perceived as a potentially growing market, available cooperation still shows limited progress. The Just Energy Transition Partnership (JETP)[1] mobilises USD 20 billion from international partners, but financing gaps remain for grid modernisation, storage deployment and just transition measures (i.e., social protection, retraining, and alternative employment for workers in coal-dependent regions).

In addition to JETP, other international cooperation initiatives such as the Energy Transition Mechanism of the Asian Development Bank (ETM-ADB), the Belt and Road Initiative, and Indonesia's active role in regional energy cooperation through ASEAN illustrate that multiple forms of international cooperation are already present.

1.3. POLICY

Indonesia's climate-linked risks are significant and require careful management to lower emissions while strengthening resilience and adaptation. Indonesia is the sixth-largest greenhouse gas emitter globally, and emission cuts are pursued through forest and peatland restoration, better forest governance and clean energy investment. Indonesia has also introduced a carbon tax on coal-fired power plants (starting at USD 2/tonne CO_2, although its implementation has been postponed) and is developing a domestic carbon market. Under its Second Nationally Determined Contribution (NDC) [18] and the JETP, it seeks to reduce deforestation, expand renewable energy and gradually phase out coal (though the flagship early retirement of the Cirebon-1 coal-fired power plant [19] has apparently been delayed).

The Second NDC notes that national emissions are projected to peak on average by 2030 and decline by 2035 under low-carbon pathways, while net zero will be reached by 2060 or earlier (with international support). There are concerns [20] that Indonesia cannot achieve either goal [21]. Additionally, while the National Action Plan for Climate Change Adaptation (RAN-API) [22] initially guided policy concerning water security, climate-resilient agriculture, disaster risk reduction, coastal protection and ecosystem restoration, the National Adaptation Plan (NAP) [4] took effect in late 2025 as the active framework, and adaptation measures have also been integrated into national development planning [23].

This is where the double cost crunch becomes policy-relevant: delaying the transition may protect near-term growth in carbon-intensive sectors, but it can also increase cumulative adjustment needs later on. Simultaneously, physical climate impacts are already raising adaptation costs and straining fiscal capacity. Overall, Indonesia's policy challenge is no longer the balance between adaptation and mitigation, but how to finance both under tightening development constraints.

1.4. SECURITY AND GEOPOLITICAL CONSIDERATIONS

Indonesia's geopolitics, in the context of climate change, are shaped predominantly by interlinkages between its geography, its ongoing dependence on natural resources (including fossil fuels) and its global position in the competition for minerals critical to the energy transition.

Geography is particularly critical with respect to sea level rise. Indonesia's island geography makes many low-lying areas vulnerable to submergence, which can affect the baselines that underpin territorial claims. Potential changes to its Exclusive Economic Zone (EEZ) [24] could impact fisheries, access to seabed minerals and strategic sea lanes, and could further heighten regional unease. Ongoing tensions with China over Natuna Island [25] serve as a pertinent example here. Geography has also gifted Indonesia large tropical forests and peatlands, which are important carbon sinks, providing geopolitical leverage but also pressure points. On the one hand, there are international interests in maintaining these resources to contribute to emissions reductions [26]. This bumps up against Indonesia's national economic aspirations, however, linked to oil palm expansion and deforestation [27], for example. Navigating this nexus in global climate diplomacy is challenging.

As a major coal exporter, Indonesia is also at the heart of energy transition geopolitics [28]. Its economic reliance on coal raises challenges in both bilateral and global climate diplomacy. Its dominance in nickel production furthermore places Indonesia at the heart of strategic competition for the minerals [29] vital to the global energy transition. Navigating foreign influence and access to these resources is a core strategic concern.

The double cost crunch complicates Indonesia's position: constrained fiscal space limits domestic nickel processing capacity, increases dependence on fossil fuel exports and foreign investment, and creates political economy trade-offs between near-term export revenues and long-term decarbonisation and value chain development.

Finally, climate hazards could threaten military assets [24], affecting national security in the traditional sense. They could also contribute to greater internal or regional migration. Regional cooperation [30] and international engagement to address adaptation, security and humanitarian concerns will become increasingly important.

Technicians work on a wind turbine at the Sidrap wind farm in South Sulawesi.

2. Results

Our research[2] explores how climate damages, the transition to a low-carbon economy, and their interaction in the double cost crunch might impact the geopolitics of Indonesia. It sheds light on some previously downplayed, yet critical, components of climate pressure, including various climate change impacts and their long-term persistence, the effect of capital market frictions on the total cost of the transition, and technological choices within the energy sector.

2.1. TRANSITION TO A LOW-CARBON ECONOMY

Indonesia's energy sector remains heavily reliant on emissions-intensive fossil fuels. Oil, natural gas and coal, in particular, constitute approximately 90% of the domestic energy supply [31]. The most recent national electricity supply plan [32] also outlines significant ongoing investments in fossil fuel capacity. At the same time, Indonesia is seeking to reduce its reliance on fossil fuels and targets 70–72% renewable energy in the national supply by 2060 [18]. Renewable energy potential is high: solar, wind, hydropower and geothermal energy are all possible, but structural hurdles remain. Among them are inadequate grid and storage infrastructure, lack of regional integration (not least for emerging renewables), credible regulatory frameworks and support for "sunset industry" workers. Furthermore, renewables, storage and transmission have high capital costs and rely on stable low-cost finance.

2.1.1 The cost of capital

Indonesia's population is expected to peak around 2055 before steadily declining toward the end of the century, returning approximately to 2020 levels.[3] In parallel, the country is projected to undergo a profound economic transformation over the coming decades, requiring substantial investments across the economy. Figure 1 presents the annual electricity sector investments (Panel A) and the overall economy investments (including electricity sector; Panel B) over 2025–2050 under a current climate policy scenario.[4] The blue bars represent absolute investment levels (left axis), while the red lines reflect these investments as a share of projected GDP, providing a macroeconomic perspective.[5]

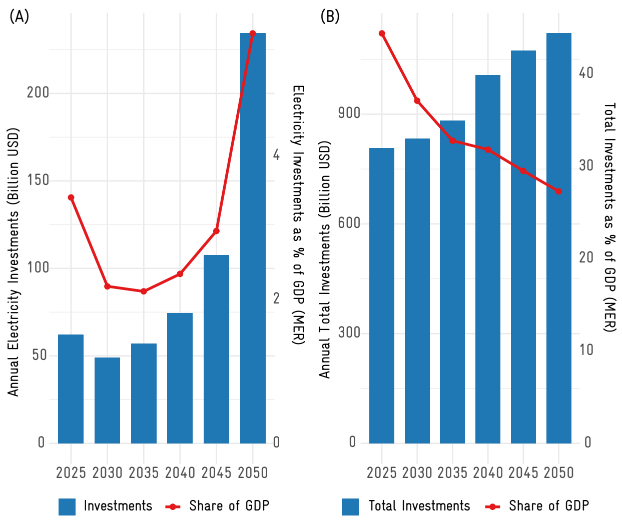

Figure 1. Annual investments in the electricity sector (Panel A) and whole economy (Panel B) over the 2025–2050 period under a current climate policy scenario. Blue bars represent absolute investment levels on the left axis, while the red lines show their share relative to GDP (MER) on the right axis.

As shown, substantial investments are required in the power sector, even under a current climate policy scenario. Specifically, electricity investments are projected to escalate towards the middle of the century, both in absolute terms and as a share of GDP. This trend is mainly driven by the exponential expansion of solar power (see below for details) and highlights a risk of capital scarcity as the country approaches mid-century. Conversely, non-electricity investment starts at a higher absolute level and grows at a modest pace, but declines as a share of GDP. This reflects the growing demands of electricity investment and the competition for finite capital resources.

These investment requirements are already significant in the near term, representing a large share of GDP. However, over time, they display relatively modest growth and gradually decline as a share of GDP, reflecting higher projected GDP growth relative to the increase in economy-wide investment requirements. This pattern highlights the scarcity of capital in the short-term and, thus, its high economic value due to strong investment demand during this period.

In addition, capital costs as reflected by the weighted average cost of capital (WACC) increase the overall cost of transforming both the energy system and the broader economy. Since WACC is applied to investment volumes, the resulting capital costs for economy-wide investments significantly exceed those for energy technologies alone. This pattern changes, however, as the country approaches mid-century and energy sector investments increase. These additional costs can dampen economic growth and reduce energy demand. Moreover, their cumulative effect increases over time as capital stock accumulates, since financing costs apply to both current and past investments that remain within their lifetime. Nevertheless, total capital costs remain relatively stable over time as a share of GDP.

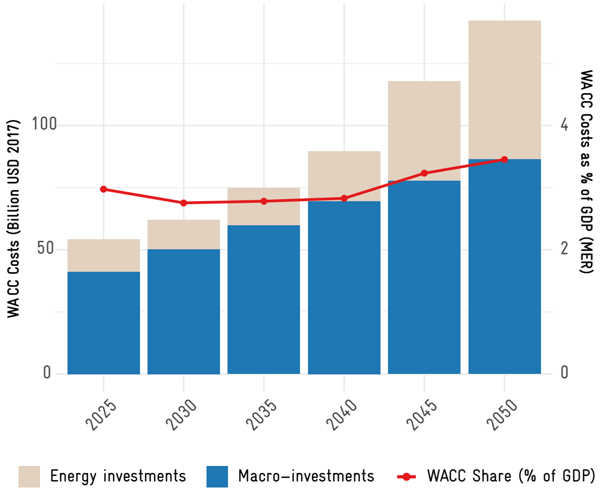

Figure 2. Annual cost of capital requirements over the period 2025–2050 for investments in the energy sector and the overall economy under a current climate policy scenario. Bars represent absolute values (left axis), while the red line shows their share relative to Indonesian GDP (MER) (right axis).

Capital costs can significantly influence technological dynamics in the power sector, as illustrated in Figure 3. This figure presents the cost-optimal power mix under scenarios with perfect (circles) and imperfect (triangles) capital markets up to mid-century. Both scenarios assume current climate policy ambition and SSP2 socioeconomic conditions for Indonesia. In the imperfect capital market scenario, heterogeneous risk premia are applied on top of the risk-free rate, whereas a uniform interest rate applies across the whole economy in the perfect capital market scenario. In other words, no additional capital cost is considered for low-carbon investments in the perfect capital market setting.

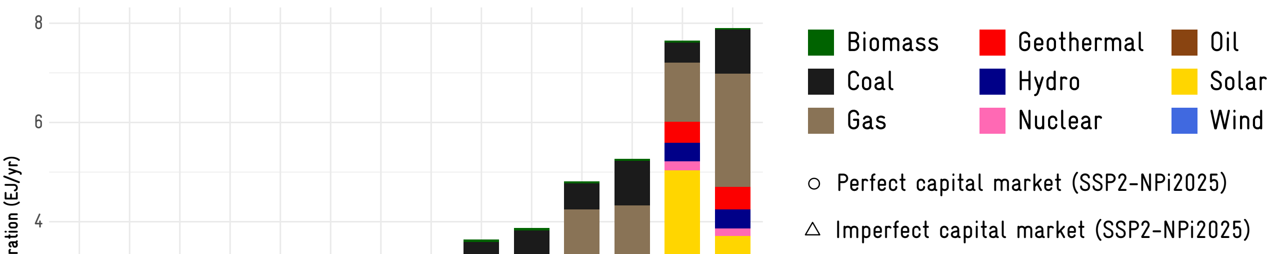

Figure 3. Cost-optimal Indonesian power mix up to mid-century under perfect and imperfect capital market (CM) scenarios, assuming current climate policy ambition and Second Shared Socioeconomic Pathway (SSP2) conditions.

The results indicate that higher costs of capital reduce the deployment of wind and solar technologies, instead relying on gas and, to a lesser extent, coal. This is because renewable technologies are more capital intensive, requiring higher up-front investment compared to fossil fuel technologies. The inclusion of capital costs therefore leads to a relatively higher levelised cost of electricity for renewables compared to fossil fuels, lowering the share of renewable technologies in the power mix and raising electricity prices. The increased use of fossil fuels can also lead to higher import dependency.

These results should not be interpreted as forecasts of Indonesia's future power mix, as outcomes will depend on the level of climate policy ambition – renewable technologies would dominate the power mix under more ambitious climate scenarios. Instead, these results reflect the impact that capital markets may have on technological choices within the power sector.

2.1.2 Political economy

Indonesia's energy transition is constrained not only by technology or finance, but by domestic political interests and the distributional consequences of reform. The most influential actors evaluate decarbonisation through the lens of economic growth, energy security, electricity affordability and the preservation of incumbent interests, whereas advocates for decarbonisation such as think tanks, NGOs, and international partners have limited direct leverage [33]. This creates a political economy risk: technically feasible transition measures may be blocked when they threaten vested interests. Three mechanisms illustrate this risk.

Nickel-based industrial strategy: Indonesia's "down-streaming" strategy, anchored in the 2014 raw nickel export ban, aims to position the country within global battery and EV supply chains. Framed as a matter of sovereignty and national development, it nevertheless depends heavily on foreign capital, imported technology and Chinese-linked investment. Analysis of 2,702 English-language media articles from 2014–2025 identifies five recurring conflict arenas: environmental and health, labour and social, governance and corruption, economic and industrial policy, and geopolitical conflict [36]. Local communities and workers tend to be cast as victims, while the Indonesian government occupies a dual position: both a promoter of development and an actor implicated in governance failures. This contested legitimacy constitutes a transition risk because nickel processing underpins rapid captive coal expansion – more than 20 GW of captive coal capacity is planned by 2032. Unresolved conflicts may erode social licence and weaken the stability of Indonesia's nickel-led pathway.

Power sector reform: A recent analysis [34] shows that Indonesia's power sector trajectory is shaped by actors whose objectives only partially align with decarbonisation. The presidency, line ministries and well-connected business groups prioritise growth, energy security and low electricity prices. As monopsonist buyer and grid operator, the state-owned electricity company (PLN) has strong incentives to resist reforms that weaken its market position. Fossil fuels remain politically attractive because they serve influential interests, while no powerful renewables constituency has yet emerged to challenge this. Climate mitigation is therefore acknowledged but it remains secondary.

Household distributional risks: Evidence across 88 countries shows that income alone is an insufficient predictor of exposure to climate policy costs; horizontal differences shaped by geographic location and appliance and vehicle ownership can be equally important [35]. For Indonesia, carbon pricing or subsidy removal could create politically salient burdens that are not easily addressed through income-based compensation. As Figure 4 illustrates, a carbon price of USD 40/tonne CO_2 without revenue recycling imposes rather neutral costs across income deciles, with considerable within-decile variation. Recycling 70% of revenues as lump-sum household transfers would substantially shift the distribution towards strong progressive outcomes, overcompensating more than half of the poorest 30% of the population. The wide interpercentile ranges, however, signal that many households would remain net losers, even after redistribution. Poorly targeted compensation could therefore weaken public acceptance and reinforce political pressure to subsidise coal-based electricity, placing an additional burden on the national budget [36].

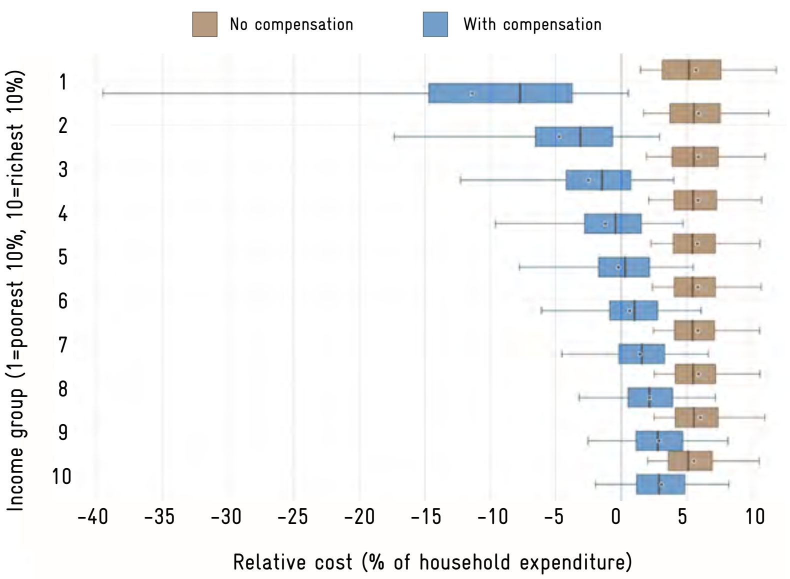

Figure 4: Distributional effects of a national carbon price of USD 40/tonne CO_2 with and without revenue recycling. Blue bars reflect recycling of 70% of revenues through a lump sum to households across ten income deciles. Horizontal lines indicate median values, circles mean values, boxes the 25th–75th interpercentile range, whiskers the 5th–95th interpercentile range [38].

Source: Carbon Pricing Incidence Calculator (2026). Own calculation based on household expenditure data (Indonesia Social Economic National Survey) and multi-regional input–output data (GTAP).

2.2. ECONOMIC DEVELOPMENT AND CLIMATE IMPACTS

Climate change affects economies and socioeconomic systems, for example through impacts on labour productivity, food security and health. Extreme weather events linked to climate change can also destroy property and infrastructure and exacerbate migration trends. The impact of changing climate conditions [38] and weather extremes [39] on economic growth in Indonesia [40] has already been assessed. We further highlight the economic impacts of (i) changes in terrestrial water storage linked to climate change and (ii) the effects on capital and labour. In addition, we consider the multiple factors that underpin climate-linked migration and offer a measure of extreme weather and drought impacts on consumption and rural–urban migration.

2.2.1 Changes in terrestrial water storage

Terrestrial water storage (TWS) encompasses all freshwater resources on, above and below land. This includes groundwater, root zone soil moisture, surface water, snow, glacier ice and permafrost, as well as vegetation water [41]. TWS is an essential climate variable as defined by the World Meteorological Organization (WMO) and an important natural resource for food and energy production, manufacturing and ecosystem health. Satellite gravimetry-based methods have revealed substantial TWS changes over the past two decades, with heterogenous effects on Indonesia: southern Kalimantan and eastern Sumatra experienced negative anomalies, while many other regions encountered positive trends – among them central and eastern Java [42]. The main drivers of these changes are climate variability and anthropogenic groundwater extraction,[6] although biomass burning in Kalimantan has also been linked to local TWS decrease [43].

To date, there has been no quantitative assessment of the economic impact of TWS changes, hampering the development of sustainable water management and adaptation strategies. Yet, such an assessment is needed to estimate the costs and benefits of sustainable water management decisions, in particular under future climate change. In a global analysis, we statistically evaluate Gross Regional Product per capita (GRPpc) data from more than 1,600 subnational regions worldwide [44], and map these to changes in TWS between 2004 and 2019 [45]. Using a fixed-effects panel regression model, we assess the effect of year-to-year changes in TWS on GRPpc growth[7] and arrive at heterogeneous results, with the highest negative economic impacts around the Caspian Sea and in northern India. Furthermore, a heterogeneity analysis based on machine learning suggests that regions with a high share of agricultural area, or low-income per capita, are economically more vulnerable to declining TWS [46].

This analysis informs preliminary estimates of the cumulative economic impacts of TWS changes in Indonesia at the subnational level, depicted in Figure 5. Since these results build on a global average impact estimation, they should be complemented by further local analyses; nonetheless, these estimations highlight the link between sustainable water management and economic costs and benefits in Indonesia.

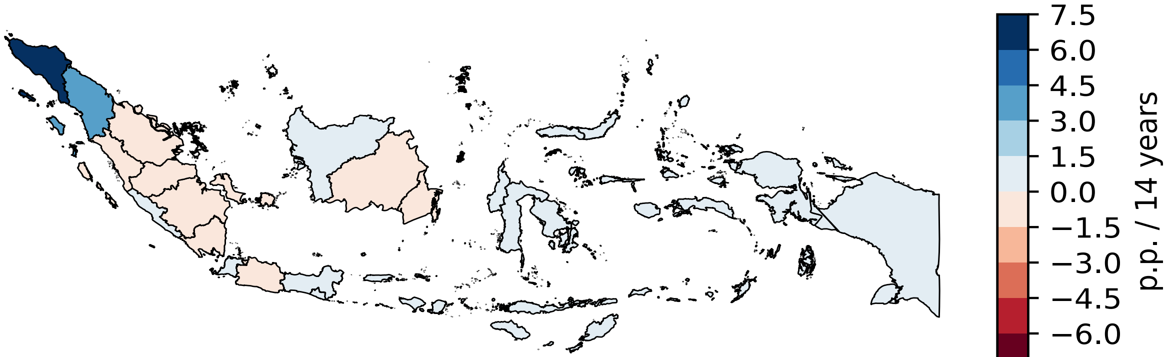

Figure 5: Preliminary cumulative difference in economic growth, relative to a counterfactual scenario with no TWS change, in percentage points (p.p.) (2004 to 2019).[8] Regions coloured in blue have likely benefitted from more TWS while red regions have experienced overall TWS decline, and therefore negative economic impacts (although not necessarily negative growth rates).

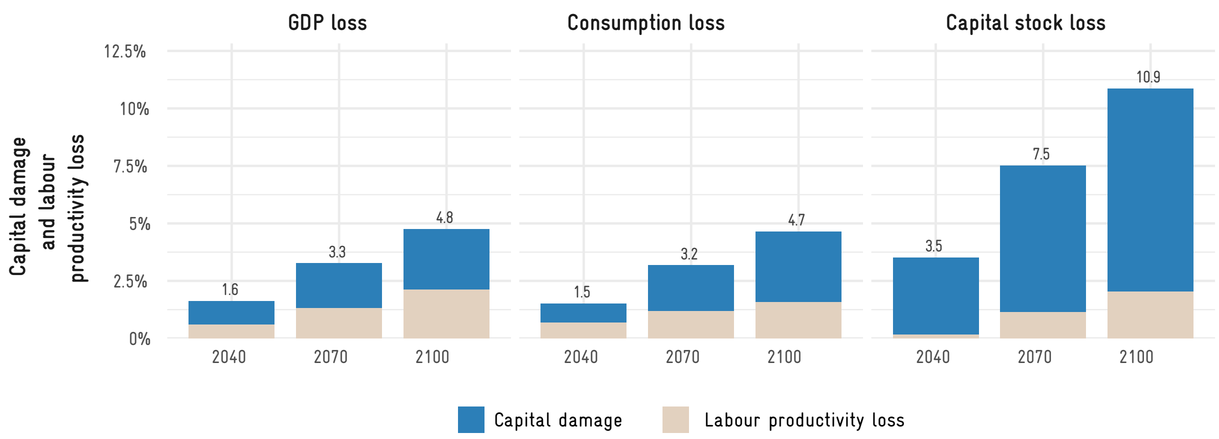

Figure 6. Economic losses due to climate change in Southeast Asia (including Indonesia) projected by the MOSAIC multi-sector growth model under the SSP2 scenario. Bars represent additional losses on top of today's climate baseline (% deviation from a counterfactual run without additional climate change).

2.2.2 Capital and labour channels

Having established the economic impact of TWS as a function of climate change, we next examine the potential extent of climate impacts through two key economic channels: capital and labour productivity. Extreme weather exacerbated by climate change damages productive capital, such as buildings, machinery and infrastructure, while rising heat stress reduces worker productivity, especially in outdoor sectors such as agriculture, construction and fisheries.[9] Cumulatively, these two channels could produce GDP losses of around 2% for Europe and the USA, around 4–5% for China, Japan and Southeast Asia (including Indonesia), as shown in Figure 6, and around 7% for India by 2100. Note that these are damages from further warming after 2025, not the total cumulative impact of climate change. To put this into context, climate change could mean an average household in Indonesia consumes 5% fewer goods and services by the end of the century than they would in a world without further warming.

In the case of Indonesia, the contribution of the capital channel to economic loss and damage is somewhat larger than the labour-productivity channel. This reflects Indonesia's particular exposure to extreme weather hazards such as compound coastal flooding amplified by rapid land subsidence in Jakarta, Medan and Surabaya; extreme rainfall and flooding driven by El Niño and changes to the monsoon season, as well as recurrent droughts, peat and forest fires during El Niño dry seasons.

By 2100, the combined damages lead to a regional drop of 11% in capital stock, relative to the counterfactual scenario (Figure 6, right-hand column) – more than twice the GDP loss in the same year. This reflects direct destruction by extreme weather events: (orders of magnitude for Southeast Asia: coastal flood 35%, river flooding 33%, tropical cyclone 24%, wildfire 8% of capital-damage exposure [49]) and the diversion of investment towards reconstruction rather than productive expansion. The implications are particularly acute for Indonesia, where coastal and urban capital stock concentrate economic activity in zones of compounding hazard: Jakarta is one of the world's fastest-sinking cities and substantial public investment is being redirected toward the new "green-and-smart" capital, Nusantara. This highlights the importance of disentangling the channels of economic loss: an aggregate estimate conceals how much investment is diverted to repair and relocation, and understates the drag on long-run capital accumulation on which durable productivity and consumption gains depend.

These damages also translate into concrete macro-financial risks. The adaptation investment they imply – coastal protection across 17,000 islands, sea walls and drainage upgrades in low-lying megacities, flood-resilient infrastructure, irrigation, cooled workplaces, and peatland and forest restoration – could be large, recurring, and hard to defer. The increased frequency and severity of extreme weather events could strain public finances and raise borrowing costs, posing exceptional challenges for highly-indebted emerging economies with high climate vulnerability [51; 52]. Indonesia has a relatively prudent fiscal stance anchored by credible fiscal rules: general government debt stood at around 40% of GDP in 2024, projected to rise slowly over the remainder of the decade [53], with an investment-grade sovereign rating (Moody's Baa2, S&P BBB, Fitch BBB). About three-quarters of central government debt is rupiah-denominated, so direct sovereign FX exposure is contained, but the rupiah remains sensitive to global risk-off, and a climate-driven import surge or portfolio outflow could trigger exchange-rate and capital-flow volatility [53].

Looking at the broader economy, few Indonesian households or firms carry insurance against natural disasters, pushing the cost of relief and reconstruction onto the government when such events occur [53; 54]. Structural exposure also runs through fossil fuel revenues (coal, gas) and the strategic nickel industry, both of which face their own physical climate and transition risks (Section 2.1). The cumulative picture also weighs on foreign direct investment: market-seeking flows face a smaller and less affluent target market as household consumption is depressed, efficiency-seeking flows lose part of their productivity advantage as heat stress weighs on outdoor and factory work, and asset-seeking flows face a higher country-risk premium. The latter is a particular concern for Indonesia's domestic nickel-processing strategy, which depends on sustained foreign capital and technology. For an economy still mid-transformation, the diversion of investment towards reconstruction and relocation also undermines the energy transition (Section 2.1).

2.2.3 Consumption and rural–urban migration

Climate events influence internal migration, particularly in agricultural contexts, where they affect harvests and job opportunities. Households often respond by sending one of their members to an urban area to diversify the family income [55].

While research on climate-related migration has increased in recent decades [55], both the mechanisms and the effects on different population groups need to be better understood [56]. To this end, our study on five low- and middle-income countries, including Indonesia, analyses climate-related changes in rural consumption and rural–urban migration responses, differentiated by education and wealth profiles.

The study uses causal inference techniques and relies on data from the Indonesian Family Life Survey, covering more than 8,800 rural households across 20 provinces in five survey waves from 1993 to 2014, yielding more than 32,000 observations. By linking climate data at the province-year level to households' yearly consumption and location data, this study derives estimates of climate-related changes in consumption and migration [57].

Indonesia, as a tropical country, is characterised by high temperatures throughout the year and exhibits high precipitation that varies with the monsoon. For rural households with a primary education, a 1-degree increase in mean temperature is associated with an overall 20% increase in rural consumption and a 4.8 percentage point decrease in rural–urban migration.[10] This can be explained by the relatively greater benefit of higher temperatures for households with lower education, likely involved in agriculture, compared to those with higher education [57]. This is also confirmed by a study by Thiede & Gray identifying a positive association between higher temperatures and farm business revenue, and declines in migration in warmer periods [58].

Furthermore, research often identifies stronger migration responses to climate events among middle-income households, as poor households often have insufficient resources to migrate [56]. This is also the case in Indonesia, where a 1-degree increase in temperature is associated with an 8% decrease in rural–urban migration among middle-income households, with no significant effects in other groups. The study also shows that households with an urban network are generally more likely to send migrants, likely due to the reduced material and non-material costs of migration [57].

2.3 THE BENEFITS OF AMBITIOUS CLIMATE POLICY

Ambitious international climate policy efforts in line with the Paris Agreement would mitigate global mean temperature increases to about 1.45°C by 2100, relative to preindustrial levels. Our modelling shows that achieving this target requires immediate action from all countries and would reduce expected climate damages in 2100 from 23% of GDP (under Scenario A) and 40% of GDP (under Scenario B) to 4% of GDP (Scenario A) and 7% of GDP (Scenario B), respectively (Figure 7). However, this target can no longer be achieved without a so-called overshoot: the temperature will exceed this level by mid-century before declining in response to net-zero greenhouse gas emissions. Net zero could require some carbon dioxide capture and storage, with the level, and therefore cost, of removals depending on the extent and pace of near-term emission reductions. Delayed emission reductions will also be more costly because they will have to be more ambitious and achieved over a shorter period of time. The benefits of ambitious climate action therefore far outweigh the costs in the long run.

Failing to meet the goals of the Paris Agreement will also result in substantial residual damages. These will feed into the double cost crunch (Figure 7), complicated by near-term fossil fuel dependence, demographic shifts and distributional effects. While delays in climate policy reduce near-term transition costs, they allow climate damages to accumulate, eroding the fiscal capacity to transition and adapt to climate change. And not all climate impacts will be reversible once they have been incurred.

Taken together, governments need to navigate the trade-off between early ambition, which increases near-term investment costs but minimises long-term climate damages, and delayed ambition, which reduces near-term costs but increase damages through (potentially irreversible) overshoot consequences. The double cost crunch – combining residual damages and transformation costs – thereby intensifies with postponement of mitigation.

The message is clear: immediate action is economically rational because long-term benefits exceed costs, post-ponement worsens the double cost crunch, and unavoided damages can reduce the fiscal capacity needed for both adaptation and transition. Nonetheless, making both burdens visible simultaneously enables better timing of investments and avoids costly misallocations.

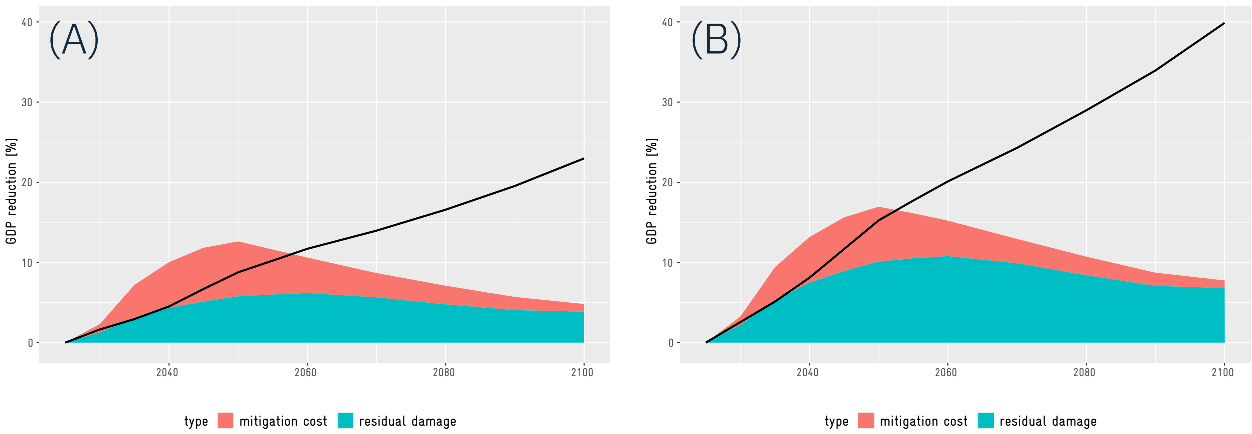

Figure 7: The double cost crunch for Indonesia: policy costs and residual damages under a Paris-compatible mitigation scenario for a medium (Scenario A) and high (Scenario B) damage specification. The black line illustrates the damages expected under the current level of policy ambition.

Topographical map of South-East Asia.

3. Conclusion in a geopolitical and security context

Physical climate impacts in Indonesia engender a complicated risk landscape. Indonesia's reliance on sea routes for domestic supply chains and foreign trade places maritime infrastructure at the heart of economic resilience and human livelihoods. But this economic nexus is threatened by changing precipitation patterns and temperatures, sea level rise, coastal and river flooding, and increasing weather extremes. These are also major concerns for agriculture and security, especially as population growth is set to continue through mid-century [59]. Given these growing adaptation needs and limited domestic fiscal space, increased (international) climate finance will be needed to manage these growing risks.

As highlighted above, the energy transition presents economic challenges, but there is also a window of opportunity. Early action, smart governance and policy design could lower long-term costs and offer significant geopolitical co-benefits. If appropriate funding and policies are in place, the country's additional electricity demand could be met mainly through domestically produced solar PV, wind and geothermal energy – even under imperfect capital markets. The renewables build-up could reduce dependence on imports of oil and gas, lowering import bills and freeing up resources, particularly in the context of rising global fuel prices [60]. Redirecting funding towards domestic green energy aligns with the government's ambition of promoting energy self-sufficiency while pursuing economic diversification and domestic development [61].

Indonesia can leverage its position as the world's largest producer of nickel and second-largest producer of tin – two key green technology minerals – on the international stage [62]. In plurilateral and bilateral partnerships, the country could offer raw material supplies in exchange for favourable financing conditions or technology transfers to support the domestic transition. At the same time, Indonesia's nickel mining has been connected to deforestation [63], and secondary processing often depends on the use of captive coal [64]. The integration of sustainability criteria into future partnership agreements should thus be prioritised.

Finally, given the significant upfront capital costs of implementing green technologies, including storage and grid infrastructure, international finance remains a precondition for climate mitigation. Further international support (such as that reflected in the JETP) will be important for Indonesia to turn its large green energy potential into reality.

ENDNOTES

1 JETP = Just Energy Transition Partnership (multilateral climate finance mechanism for coal-dependent emerging economies)
2 The reported climate impact numbers are based on structural economic and econometric models, and should be understood as broad orders of magnitude rather than exact forecasts. Because the underlying assumptions, input data and transmission channels from climate signals to economic damages are subject to uncertainty, the results are best used for comparing scenarios and regions within the model framework; our deliberate simplifications, such as smooth damage functions, a limited set of impact channels, and frictionless reconstruction help isolate these comparative patterns.
3 This projection is based on the second Shared Socioeconomic Pathway (SSP2) as defined in the IPCC Sixth Assessment. Although SSP2 represents "middle-of-the-road" assumptions for Indonesia and the global economy, there is considerable heterogeneity across alternative SSP scenarios.
4 A current climate policy scenario (also called Current Policies Scenario – CPS) is a climate and energy modelling pathway that assumes: Only policies that are already implemented and legislated remain in place — no new policies are introduced.
5 Due to data constraints, GDP per capita is calculated using the aggregate market exchange rate (MER) and purchasing power parity (PPP) values applied across the wider "Other Asia" region.
6 Indonesia is among the 25 countries in the world with the highest "water gap" – the amount by which water demand exceeds water supply [47].
7 To account for possible reverse causality – economic activity causing changes in TWS – this approach controls for human water consumption using the output of the WaterGAP v2.2d model [48].
8 The results are based on a linear time-trend fit of the year-to-year mean TWS changes and the coefficient of the fixed-effects panel regression model.
9 MOSAIC resolves the world into 12 macro-regions. Indonesia is grouped with the rest of Southeast Asia, the Korean peninsula, South Asia (excluding India), Mongolia and the Pacific island states in a macro-region the model labels "Other Asia–Pacific" (OAS). The underlying climate damage parameters applied to this macro-region, however, are predominantly Southeast Asian: the capital-damage shock is built from Mandel et al.'s "Southeastern Asia" value-share (around 98% of the weight, with negligible contributions from the Pacific island groupings and Central Asia) (2025) [49], and the labour-productivity shock from Garcia-Leon et al.'s East Asia/Southeast Asia/Oceania aggregate (2021) [50]. We therefore describe the results as Southeast Asia to reflect what the damage signal actually represents. Indonesia-specific impacts may still differ from this regional mean, as Indonesia's island geography, very high coastal exposure, dependence on capital-intensive extractive sectors (coal, nickel) and rapid land-use change are not fully captured by a single regional damage signal.
10 In Indonesia, the probability that a rural household had a migrant member was 2% in 1997, and 1.3% for households with a primary education.

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