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COUNTRY CLIMATE AND DEVELOPMENT REPORT

2026

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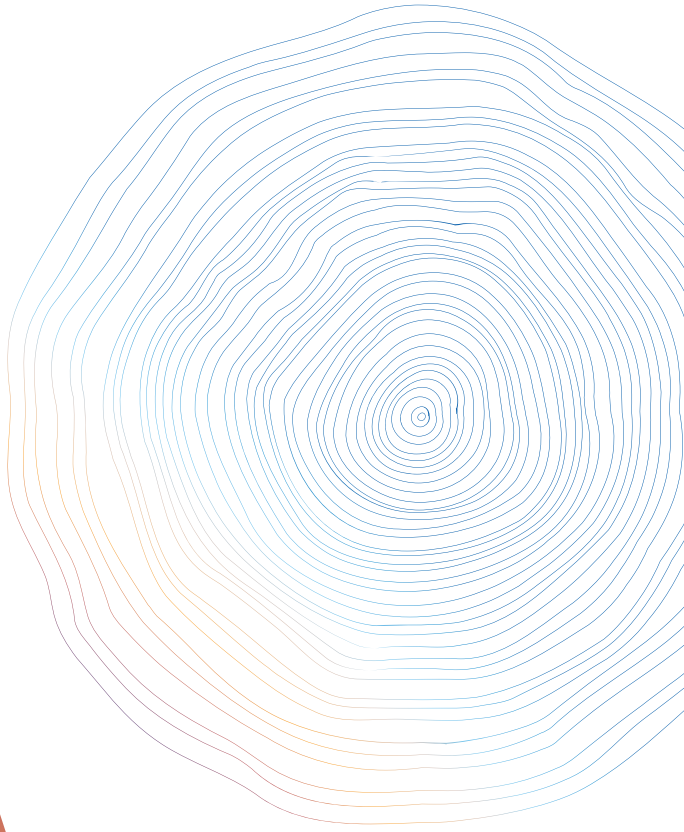

MALAYSIA

COUNTRY CLIMATE AND DEVELOPMENT REPORT

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Abbreviations and Acronyms

AC	Alternating Current
ADB	Asian Development Bank
AI	Artificial Intelligence
ASEAN	Association of Southeast Asian Nations
ASI	Avoid-Shift-Improve
ATIGA	ASEAN Trade in Goods Agreement
AWD	Alternate Wetting and Drying
B40	Bottom 40 percent
BAU	Business-as-Usual
BEI	Building Energy Intensity
BNM	Bank Negara Malaysia
BPN	Bantuan Prihatin Nasional
BSH	Bantuan Sara Hidup
CBAM	Carbon Border Adjustment Mechanism
CBI	Climate Bonds Initiative
CBU	Completely Built Unit
CCDR	Country Climate and Development Report
CCPT	Climate Change and Principles-Based Taxonomy
CCUS	Carbon Capture, Utilization, and Storage
CFIL	Climate Finance Innovation Lab
CIDB	Construction Industry Development Board
CIF	Climate Investment Funds
CO_2	Carbon Dioxide
CPTPP	Comprehensive, Progressive Agreement for Trans-Pacific Partnership
CREST	Collaborative Research in Engineering, Science & Technology
CSA	Climate-Smart Agriculture
DC	Direct Current
DFI	Development Financial Institution
DID	Department of Irrigation and Drainage
DIP	Digital Infrastructure Providers
DOA	Department of Agriculture
DTN	National Energy Policy 2022–40
E&E	Electrical and Electronic
EAP	East Asia and Pacific
EC	Energy Commission
ECI	Economic Complexity Index
EFT	Ecological Fiscal Transfer
EIA	Environmental Impact Assessments
ENEGEM	Energy Exchange Malaysia
EPI	Environmental Performance Index
EPR	Extended Producer Responsibility

ESG	Environmental, Social and Governance
ESM	Ecosystem Services Model
ETS	Emissions Trading System
EU	European Union
EV	Electric Vehicle
FDI	Foreign Direct Investment
FIZs	Free Industrial Zones
FTA	Free Trade Agreement
GCF	Green Climate Fund
GCI	Green Complexity Index
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GFDRR	Global Facility for Disaster Reduction and Recovery
GHG	Greenhouse Gas
GLIC	Government-linked investment fund
GLP	Green Lane Pathway
GST	Goods and Services Tax
GTFS	Green Technology Financing Scheme
GTMP	Green Technology Master Plan
GVCs	Global Value Chains
GW	Gigawatt
HA	High Ambition scenario
HFC	Hydrofluorocarbon
HIC	High-income country
ICE	Internal Combustion Engine
IDN	Indonesia
IEEM	Integrated Ecological and Economic Model
IoT	Internet of Things
IPEF	Indo-Pacific Economic Framework for Prosperity
IRBM	Integrated River Basin Management
IRENA	International Renewable Energy Agency
IWRM	Integrated Water Resource Management
JC3	Joint Committee on Climate Change
JKR	Jabatan Kerja Raya
JPS	Jabatan Pengairan dan Saliran
JPSM	Jabatan Perhutanan Semenanjung Malaysia
KKR	Kementerian Kerja Raya
KPKT	Ministry of Housing and Local Government
LA	Local Authority (e.g., municipal or city councils)
LCMB	Low Carbon Mobility Blueprint
LT-LEDS	Long-Term Low Emissions Strategy
LULUCF	Land Use, Land-Use Change, and Forestry
M&E	Monitoring and Evaluation

MA	Moderate Ambition scenario
MARDI	Malaysian Agricultural Research and Development Institute
MGTC	Malaysian Green Technology and Climate Change Corporation
MIDA	Malaysian Investment Development Authority
MITI	Ministry of Investment, Trade and Industry
MNCs	Multinational Corporations
MoF	Ministry of Finance
MSPO	Malaysian Sustainable Palm Oil
$MtCO_2$	Million tons of carbon dioxide (metric)
$MtCO_2e$	Million tons of carbon dioxide equivalent (metric)
MTPA	Million Tons Per Annum
MW	Megawatt
MYS	Malaysia
MySPC	Malaysia Social Protection Council
N_2O	Nitrous oxide
NADMA	National Disaster Management Agency
NAHRIM	National Water Research Institute of Malaysia
NAP	National Adaptation Plan
NDC	Nationally Determined Contributions
NEM	Net Energy Metering
NETR	National Energy Transition Roadmap
NIMP	New Industrial Master Plan
NPCC	National Policy on Climate Change
NPV	Net Present Value
NRES	Ministry of Natural Resources and Environmental Sustainability
NUE	Nitrogen Use Efficiency
NZC	Net-Zero Carbon
PADU	Pangkalan Data Utama
PBTs	Local Authorities
PETRA	Ministry of Energy Transition and Water Transformation
PHL	[the] Philippines
PMI	Partnership for Market Implementation
POME	Palm Oil Mill Effluent
PPAs	Power Purchase Agreements
PPP	Public-Private Partnership
PRAB	National Flood Forecasting and Warning Program
PV	Photovoltaic
QCE	Qualifying Capital Expenditure
R&D	Research and development
RCA	Revealed Comparative Advantage
RCEP	Regional Comprehensive Economic Partnership
RCP	Representative Concentration Pathway
REC	Renewable Energy Certificate

REDD+	Reducing Emissions from Deforestation and Forest Degradation
RM	Malaysian Ringgit
ROI	Return on Investment
RTA	Revealed Technological Advantage
SA	Social Assistance
SBTs	Science-Based Targets
SC	Securities Commission Malaysia
SDGs	Sustainable Development Goals
SME	Small and Medium Enterprise
Sqm	Square meter
SRI	Sustainable and Responsible Investment
SSI	Social Sustainability Indices
SSP	Shared Socioeconomic Pathway
STEM	Science, Technology, Engineering and Mathematics
STR	Sumbangan Tunai Rahmah
TCO	Total Cost of Ownership
tCO_2	Tons of carbon dioxide (metric)
TDM	Transport Demand Management
TFP	Total Factor Productivity
THA	Thailand
TNB	Tenaga Nasional Berhad
TOD	Transit Oriented Development
TRX	Tun Razak Exchange
UHI	Urban Heat Island
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
VAT	Value-Added Tax
WB	World Bank
WBGT	Wet Bulb Globe Temperature
WDI	World Development Indicators
WHO	World Health Organization
WTO	World Trade Organization

1

Aiming High: Setting the Stage for Malaysia's High-Income, Sustainable and Resilient Future

Photo: © World Bank

1. Aiming High: Setting the Stage for Malaysia's High-Income, Sustainable and Resilient Future

This Country Climate and Development Report (CCDR) for Malaysia highlights the importance of aligning development goals with climate objectives. As the country aims to transition to high-income status by 2030, it is crucial to address the challenges posed by climate change. This report emphasizes the criticality of integrating resilient and sustainable practices into the nation's growth strategy. Achieving this will not only ensure long-term economic stability, it will also bolster Malaysia's ability to withstand and adapt to climate-related impacts.

Malaysia faces a dual challenge: attaining high-income status, while transitioning to a low-carbon, climate-resilient economy. While the shift from an agrarian economy to a manufacturing and service-driven one has brought substantial economic gains, it has also introduced environmental stresses. High energy demand, primarily met by fossil fuels, has led to significant greenhouse gas (GHG) emissions. Urban expansion and industrial growth have placed pressure on land and ecosystems. Balancing continued progress with sustainable stewardship is essential for Malaysia's future resilience and prosperity.

This CCDR offers analysis and guidance on how Malaysia can pursue resilient and sustained growth, while addressing the dynamically evolving climate change crisis. With macro modeling and sectoral analysis, it identifies major climate challenges, estimates potential impacts of climate risks on economic development, and provides tailored policy recommendations.

1.1. Looking back: Malaysia's development and climate interactions

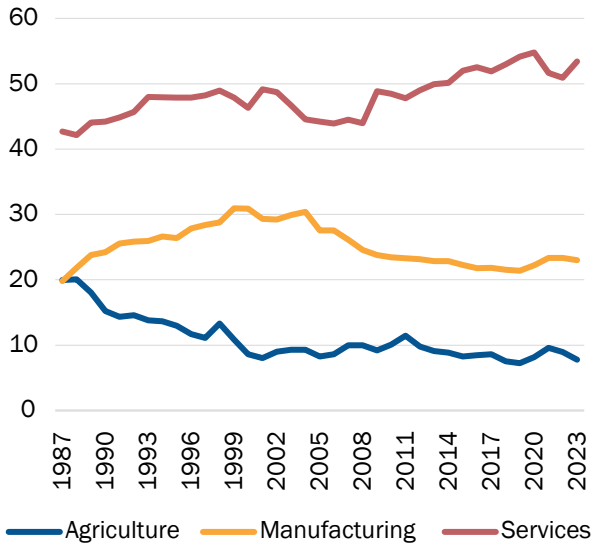
Malaysia's transformation from an agrarian economy to an export-oriented industrial powerhouse has been driven by strategic reforms, robust public investment, and targeted industrial policies. A decisive shift saw manufacturing and services overtake agriculture's share of Gross Domestic Product (GDP) (Figure 1.1), propelled by initiatives such as the establishment of Free Industrial Zones and the Malaysia Investment Development Authority, which attracted substantial foreign direct investment (FDI). This economic diversification—anchored by thriving sectors like electronics, semiconductors, petrochemicals, and energy—has delivered impressive milestones: poverty rates plummeted from 49.3 percent in 1970 to less than 0.5 percent by 2020, while urbanization surged to more than 79 percent by 2023 (Figure 1.2), supported by sweeping improvements in infrastructure and connectivity that have enhanced living standards across the country.

Yet, Malaysia's rapid industrialization and urban expansion have come at a cost, impacting people and the environment. Malaysia is one of the world's megadiverse countries, with many of its economic activities directly or indirectly dependent on nature and its associated ecosystem services. However, rapid development has harmed Malaysia's natural capital stock. Malaysia relies heavily on fossil fuels, which supply more than 85 percent of electricity and account for 66 percent of GHG emissions, while ambitious renewable energy targets remain unmet.[1] Urban sprawl and infrastructure growth have intensified deforestation and biodiversity loss, with agriculture driving further environmental degradation through land conversion, methane emissions, and fertilizer runoff. The car-dependent transport sector and energy-intensive industries, especially electronics and chemicals, exacerbate air and water pollution and resource strains, highlighting the urgent need for sustainable solutions to balance economic progress with environmental stewardship.

[1] Source: Yearly electricity data, Ember (https://ember-energy.org/).

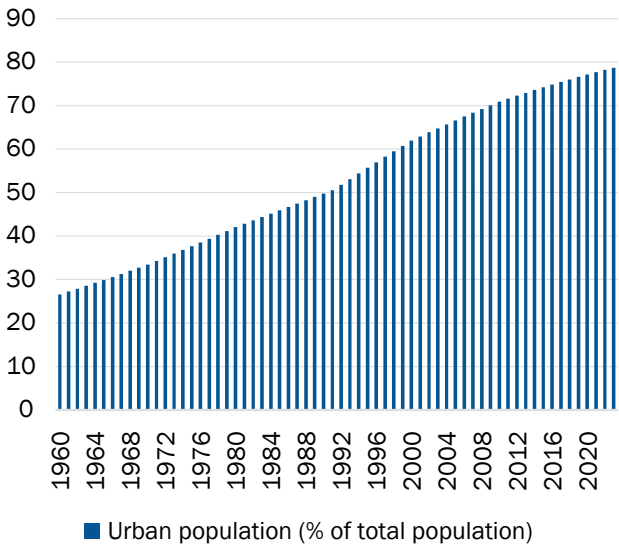
Urban expansion and infrastructure development have created vulnerabilities to urban heat stress, disaster and climate risks. Malaysia's urban sprawl has created and increased climate vulnerabilities. While forests are crucial for flood control and cooling the environment, replacing them with urban built-up areas results in acute urban flood vulnerabilities. Further, Malaysia's cities are often built in flood-prone areas, reducing natural water retention and leaving congested areas vulnerable to fluvial and pluvial floods, sea level rises, and landslides.

Figure 1.1. Sector value added (% of GDP)



Source: World Development Indicators (WDI) – World Bank

Figure 1.2. Urbanization rate



Source: World Development Indicators (WDI) – World Bank

1.2. Looking forward: a vision for a sustainable, resilient future

Key Message #1: Urgent climate action is needed to support Malaysia's high-income aspirations.

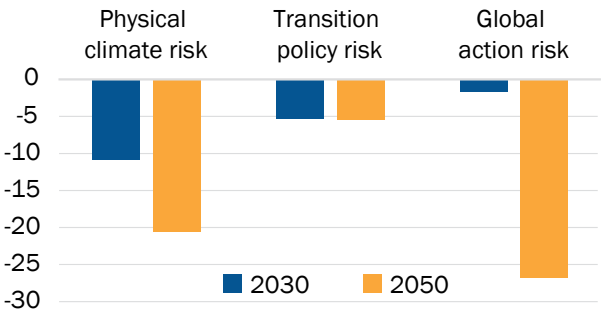
Malaysia remains caught in the middle-income challenge, though it still has scope to converge toward higher-income peers such as the Republic of Korea and Singapore. Malaysia's growth has been fueled more by capital and labor than productivity or innovation, hampered by low research and development (R&D) investment, skills shortages, and a persistent focus on low- to mid-value industries. Reliance on foreign investment and technology – combined with governance weaknesses, misaligned public investment, lagging education and workforce skills – has made it difficult for Malaysia to move up the value chain to achieve sustained, inclusive growth.

Significant climate risks, including severe weather events and resource challenges, threaten Malaysia's economic stability and long-term investment flows if left unmanaged. At the same time, the transition to a low-carbon economy can unlock substantial economic opportunities — ranging from investments in renewables and climate solutions, to the growth of new export-oriented green sectors and jobs. Achieving resilience and future competitiveness will depend on the country's ability to simultaneously invest in risk management, through comprehensive climate risk assessments and targeted adaptation strategies, while harnessing the momentum for sustainable growth by supporting innovative sectors and attracting green investment. Giving equal weight to climate risks and economic opportunities is crucial to charting a course where risk reduction and sustainable development work hand-in-hand to advance Malaysia's green competitiveness and long-term prosperity.

Malaysia is currently implementing a strategic and phased reduction in its reliance on coal as a primary energy source, a move central to achieving its net-zero emissions goal by 2050 under the National Energy Transition Roadmap (NETR). This commitment includes an immediate halt on building any new coal power plants, with full or near-full retirement expected by 2044–45. However, this transition faces multiple challenges. Existing coal-fired plants have long-term Power Purchase Agreements (PPAs) that are costly to renegotiate, creating financial and contractual hurdles. Ensuring energy security while phasing out coal requires significant investment in renewable generation, grid modernization, and storage solutions to manage variability in supply. Additionally, the transition must address social and economic impacts, particularly on communities and workers dependent on the coal sector, necessitating targeted retraining and just transition measures. Balancing affordability, reliability, and decarbonization remains a key challenge for policymakers as Malaysia navigates this complex energy transition.

Building a sustainable, resilient economy will also deliver the greatest benefits to Malaysia's most vulnerable populations, already disproportionately affected by intensifying climate impacts like floods and heat stress. Sustainable development can lower living costs, create new jobs, and provide targeted support to those at risk, including workers in sectors facing transition. The Government of Malaysia has articulated this vision in its five-year plans and policy consultations, but the real challenge lies in effective implementation and reform. Achieving a balance between federal and State interests, and following practical steps toward prosperity, sustainability, and resilience, will be crucial in underpinning Malaysia's next chapter of growth. Transitioning to a low-carbon, climate-resilient economy will require investment, but the risks of inaction are substantial. While decarbonization offers opportunities for growth and new industries, the country must also navigate significant climate-related risks that could impede its path to high-income status if not addressed. Figure 1.3 shows the scale of the *downside risks* compared to baselines in each case (not expected values), with the scenarios described in more detail in Box 1.1:

Figure 1.3. Value of GDP at risk from climate compared to a no-climate baseline in given year (%)



Source: World Bank staff calculations based on MFMod and MINDSET models
Note: GDP at risk estimates the potential decline in GDP under a worst-case scenario.

- **Risks from adaptation inaction:** Physical climate risk, especially extreme heat and flooding, poses significant threats. Under a high-impact scenario, heat stress alone could reduce GDP by up to 16 percent by 2050. If a one-in-20-year flood were to hit following an extended heatwave, annual GDP losses could exceed 20 percent (Section 2.7).
- **Risks from domestic climate action:** Transition policy risk could affect industrial competitiveness in the near term. In a worst-case scenario with high carbon prices and price-sensitive exports, GDP could decline by 5.4 percent by 2030 and 5.5 percent by 2050, although these losses may be partially offset by lower electricity prices and long-term efficiency gains (Section 3.9).
- **Risks from global climate action:** Global action risk arises if Malaysia is inactive in decarbonization, while other countries accelerate their transitions. Oil and gas export revenues would decline as global fuel demand drops (potentially costing 8.5 percent of GDP), and Malaysian firms could be excluded from green global supply chains. Failure to adapt could suppress innovation and reduce GDP by a further 18 percent by 2050 compared to a baseline scenario. Even by 2030, the risks of inaction either in climate change adaptation or mitigation outweigh those from implementing climate policy. By 2050, the risks of inaction are further magnified. Climate change policy will, thus, be critical to achieve Malaysia's future economic vision.

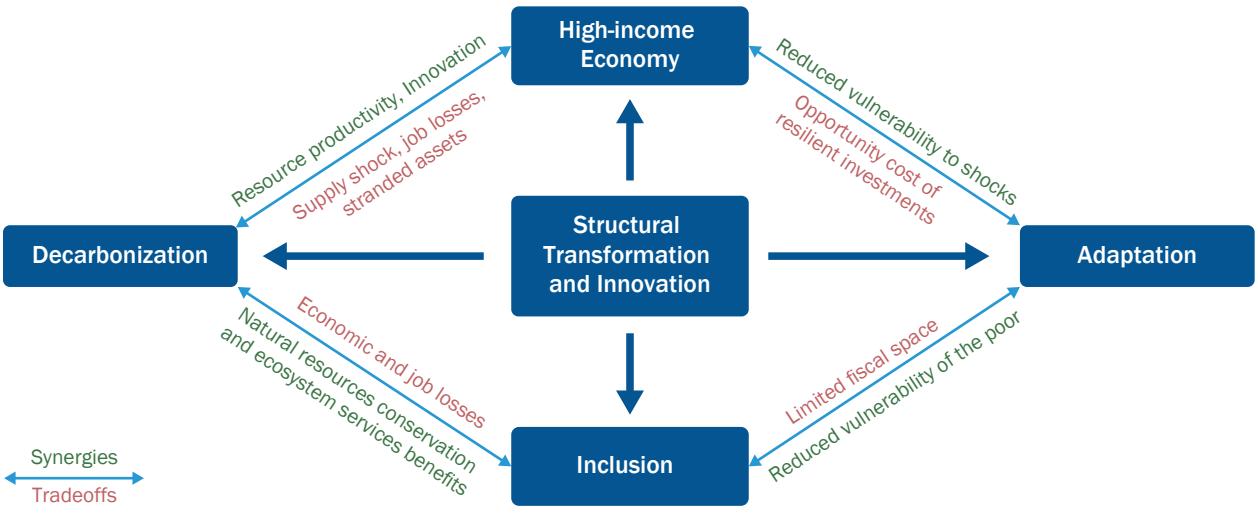
1.3. Structure of this report

Climate change presents Malaysia with both significant risks and transformative economic opportunities. By investing in clean technologies and aligning with the global shift toward greener products, Malaysian businesses can boost innovation, efficiency, and long-term competitiveness. Yet, this CCDR identifies three interconnected climate risks that threaten Malaysia's journey to high-income status: physical risks from extreme weather, transition risks from moving away from fossil fuels, and global linkages risks as international climate policies evolve. Addressing these challenges, while seizing green economy opportunities, is crucial to achieve and drive sustainable growth.

To secure long-term prosperity, Malaysia must act on three fronts. These three focus areas are building resilience against worsening climate impacts through public and private financing for adaptation and infrastructure investment, transitioning to a low-carbon economy by reducing emissions, promoting clean energy and supporting affected workers and lastly, transforming development pathways by integrating nature, rethinking land use, and investing in green innovation. These strategies will not only protect vulnerable communities, but also position Malaysia to lead in emerging green value chains and sustain high-income growth in a decarbonizing world.

The report is organized into key sections addressing critical aspects of climate action. Chapter 2 outlines the risks and challenges of climate change, focusing on its impacts on ecosystems, economies, and communities. Chapter 3 explores the challenges of transitioning to a low-carbon economy, highlighting the technical and socio-economic hurdles to be overcome. Chapter 4 emphasizes the need to manage risks from global linkages, such as trade and supply chains, in addressing climate change. Chapter 5 discusses the policies and institutions necessary for effective climate action, while Chapter 6 examines the financing needed for climate transformation. Finally, Chapter 7 presents a roadmap for achieving climate-resilient development, offering strategic recommendations for long-term sustainability (see Figure 1.4).

Figure 1.4. An integrated climate and development framework for Malaysia



Box 1.1. Modeling in this report

This report uses a set of modelling tools to address the specific issues raised.

MFMod is a New Keynesian macroeconomic model developed by the World Bank, used primarily for medium-term macroeconomic forecasting and policy analysis. It captures the relationships between key macroeconomic variables—such as GDP, inflation, interest rates, exchange rates, and fiscal balances—based on both economic theory and empirical estimations. MFMod is country-specific and calibrated to use national data, while flexible enough to incorporate various policy scenarios. It is especially useful for simulating the impact of shocks or policy changes on growth, inflation, and debt dynamics over a five to 10-year horizon.

MINDSET is a post-Keynesian macroeconomic model developed by the World Bank. It focuses primarily on the demand side of the economy. The model assumes that the economy operates below full capacity, meaning that more resources (such as labor) may be brought into production when needed, and captures positive and negative multiplier effects. MINDSET is based on the recent global GLORIA database, which allows for a high level of sectoral disaggregation. Substantial labor market detail is added by linking the model to micro-level data.

For estimating distributional impacts, a **microsimulation model** was constructed. The model assesses employment choices and changes in individual earnings, household income and consumption, using employment, income, and price results from MINDSET.

Integrated Ecological and Economic Model (IEEM) analyzes the impacts of alternative land use configurations in maximizing value added and carbon sequestration in grazing, agriculture, and forestry using the optimization approach described in Damania et al. (2023) and Polasky et al. (2019). The analysis relies on the InVEST model from the Natural Capital Project (Sharp et al. 2020).

The models are used to assess four main scenarios:

- **Impact (RCP4.5 and RCP7.0) scenarios** assess the average expected effects of climate change through the following channels: floods, heat stress, human health, crop yields, and tourism. They use standard RCPs to estimate temperature change. Variants of these scenarios with adaptation measures are also tested.
- **Moderate Ambition (MA) scenario** follows the government's National Energy Transition Roadmap for the power sector and government targets for transport. It includes a carbon price reaching US$25/tCO$_2$ by 2035 and increasing by 2.25 percent per annum thereafter.
- **High Ambition (HA) scenario** includes faster renewable uptake and net-zero transport emissions by 2050. It includes a carbon price reaching US$50/tCO$_2$ by 2035 and increasing by 2.25 percent per annum thereafter.

In addition, for each risk category there is a specific scenario:

- **Physical Climate Risk** scenario includes an estimate of heat stress at the 95th percentile of impacts, plus a one-in-20-year flood in the same year.
- **Transition Policy Risk** scenario is the same as the HA scenario, but with model trade price elasticities set to -2.5 to show a higher sensitivity to trade competitiveness.
- **Global Action Risk** scenario includes a fall in oil exports to zero by 2050 and a reduction in Total Factor Productivity (TFP) growth due to reduced trade volumes (20 percent by 2050).

Each scenario is compared to a business-as-usual **(BAU) scenario** that is based on BAU trends in the period up to 2050.

2

Confronting the Rising Risks of Climate Change

Photo: © World Bank.

2. Confronting the Rising Risks of Climate Change

Key message #2: Risks from inaction on adaptation are large, but much can be done to reduce the economic impacts of climate shocks and support the most vulnerable populations.

Climate change is increasing the likelihood of extreme weather events, high temperatures, and sea level rises, posing significant risks to infrastructure as well as economic and financial stability. Shifting weather patterns threaten food security and private sector productivity, ultimately affecting a country's economic potential. Addressing these risks through proactive adaptation and resilience measures—such as sustainable land and water management practices—can transform vulnerabilities into opportunities to strengthen infrastructure as well as promote and achieve sustainable development. In Malaysia, incorporating nature-based solutions into development strategies can enhance climate resilience and economic sustainability. Strengthening disaster risk management, including effective early warning systems and emergency response mechanisms, is crucial for minimizing the impacts of climate-induced disasters.

Urban expansion in Malaysia is a major driver of deforestation, dramatically reshaping the country's landscapes and amplifying disaster risks. From 2001 to 2018, built-up areas soared from 3.3 to 9.4 percent of national land with the urban population jumping from 62.9 to 76.0 percent of the national population during the same period, while the nation led the world in deforestation rates between 2000 and 2012 with cities such as Kluang losing nearly half their forest cover.[2] This rapid urbanization fundamentally disrupts natural hydrological systems, as the reduction in green landcover diminishes adaptive capacity and accelerates precipitation runoff, leading to heightened flash flood and landslide risks. Recent WWF studies attribute more than 15 percent of Malaysia's widespread deforestation directly to urban development, with cascading impacts including diminished natural flood mitigation and increased vulnerability in urban watersheds. Landslide hazards, triggered by heavy rainfall on denuded slopes, now threaten all major urban areas and underscore the urgent need for integrated land use planning and green infrastructure to restore lost ecological functions and bolster resilience against climate and disaster-related vulnerabilities.

Flooding is the most significant natural disaster affecting urban and rural areas in Malaysia. The northeast and inter-phase monsoons are the main drivers of flooding in Malaysia, causing river overflows and flash floods, while coastal flooding threatens low-lying areas. Floods accounted for 85 percent of all natural disasters since 2000 and by 2100, more than a third of Malaysian towns and cities may be prone to flash floods.[3] In response, the National Disaster Management Agency, established in 2015, coordinates early warning and disaster responses, but proactive risk reduction—especially through land use planning—remains crucial. Although current planning laws are not fully aligned with climate resilience, new national guidelines have been approved to support low-carbon, climate-resilient urban development.

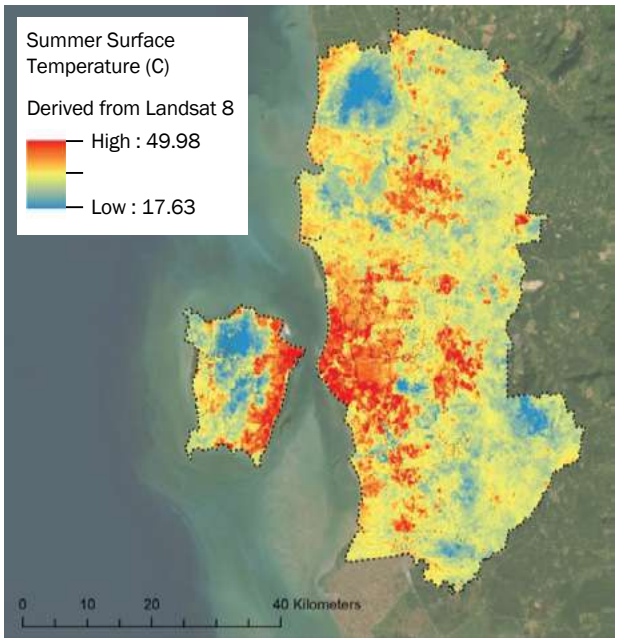
Malaysian cities face growing challenges from urban heat, making Malaysia one of the three countries most severely affected by the Urban Heat Island (UHI) effect in Asia (World Bank, 2023).[4] The UHI effect – in which a combination of building materials, reduced vegetation, and human activities leads to higher temperatures in cities – is particularly pronounced across the East Asian region, where Malaysian cities exhibit temperature differentials of 1.6–2.0°C higher than their immediate rural surroundings (Think City & World Bank, 2024). Historical temperature data reveals long-term warming trends across major urban centers, with documented temperature increases over the past century ranging dramatically from 1.35°C

[2] According to the global forest map published in partnership with Google, Malaysia experienced the highest rate of deforestation worldwide between 2000 and 2012: about 14.4 percent of its forest cover in 2000 was lost by 2012, equivalent to around 47,278 km² (an area larger than the size of Denmark).

[3] As reported in Malaysia's Fourth National Communication to the UNFCCC.

[4] Based on a comparison of 100 cities in 14 countries in East Asia.

Map 1.1. Urban Heat Island effect in George Town



Source: GFDRR (2025)

to 6.33°C in metropolitan areas including Kuala Lumpur, Kuching, and Kota Kinabalu (NRES, 2024b). Map 1.1 illustrates the UHI effect in George Town and Penang, where higher surface temperatures correspond with the presence of built-up areas.

Malaysia is highly exposed to the impacts of sea-level rise due to its long coastline and concentration of economic activity in coastal zones. Approximately 13% of Malaysia's land area lies within 5 km of the coast, and major urban and industrial centers such as Port Klang, Penang, and Johor are in low-lying coastal areas, increasing the potential economic and infrastructure risks from coastal flooding and erosion (Ehsan and others, 2019). Sea-level rise is already contributing to coastal erosion, flooding, saltwater intrusion, and ecosystem loss, with studies estimating that a 1-meter rise in sea level could lead to the loss of around 180,000 hectares of agricultural land and 15–20 percent of mangrove forests (Ehsan and others, 2019), alongside substantial damages to coastal infrastructure and settlements. However, estimating the full economic impact of sea-level rise remains challenging because projections depend on complex coastal processes and modeling assumptions. Impacts vary significantly depending on local topography, subsidence, storm surge dynamics, and socioeconomic exposure, and different hydrodynamic and spatial models can produce widely varying estimates of inundation and damage (Mohd and others, 2022). As a result, most assessments present results as ranges or scenario-based projections rather than precise estimates, reflecting the substantial uncertainty inherent in modeling long-term coastal risks. Conducting such detailed coastal inundation and damage modeling is not attempted in this report.

2.1. Risks to the agriculture sector

Malaysia's agriculture sector faces a range of interconnected challenges that threaten its productivity, rural livelihoods, and overall national development. Key crops such as rice, rubber, and palm oil—each central to land use, rural livelihoods, and Malaysia's export base—face growing vulnerabilities related to climate change, technological stagnation, labor shortages, and evolving market demands. While yields have not uniformly declined across all subsectors, these structural pressures pose significant risks of future yield deterioration, which could undermine food security, dampen rural incomes, and constrain long-term economic growth. Framing these as emerging risks rather than existing declines provides a more accurate picture of current conditions, while still underscoring the urgency of investing in innovation, productivity enhancements, and climate-resilient practices to achieve resilient and inclusive development.

Climate change will continue to impact Malaysia's three main crops – rice, rubber, and palm oil – essential to its economy and land use. Rice, the country's staple food, is cultivated mainly in the states of Kedah, Kelantan, and Perak, with a cultivation area of 637,955 hectares in 2022 (DOSM, 2022; IPAD, 2025). All three crops are vulnerable to the effects of climate change (see Box 2.1). Recent dips in palm oil yields suggest that sustained high temperatures may be exerting stress on oil palm physiology, with overall yields decreasing since 2015. Rice and rubber yields have also been declining since 2016. According to Malaysian Palm Oil Board data cited by CIMB Securities, the average Fresh Fruit Bunch yield fell to 15.47 tons/hectare

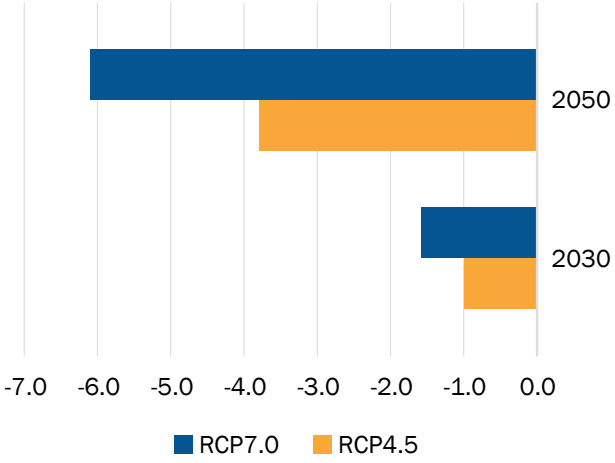
in 2021 — the lowest since the board began publishing yield statistics. In contrast, at its historical peak (1986), yields reached 22.15 tons/hectare.

Box 2.1. Climate change impacts on major Malaysian crops

Malaysia's most important crops are vulnerable to temperature fluctuations and changing precipitation patterns. Rice thrives under stable water and temperature conditions, but faces risks from erratic rainfall, extreme heat, and frequent flooding, all of which reduce paddy yields (Tan et al., 2021; Makhtar et al., 2022). Rubber is vital to Malaysia's export economy, but is highly sensitive to drought and changes in precipitation patterns (Hazir et al., 2018, 2020). Palm oil is a globally significant commodity, yet is impacted by erratic rainfall and extreme temperatures, which disrupt flowering cycles and compromise oil quality (Sarkar et al., 2020; Abubakar et al., 2021). Climate change could also lead to higher production costs, reliance on food imports, and economic instability, particularly among smallholder farmers.

Climate change-driven rising temperatures could cause a further 6 percent drop in all crop yields by 2050. An econometric analysis of yields shows a significant relationship between average temperatures and yields. Under the RCP4.5 climate impact scenario, average yields are expected to fall by 1.0 percent by 2030 and 3.8 percent by 2050. Under the RCP7.0 climate impact scenario, the losses could be 1.6 percent by 2030 and 6.1 percent by 2050. Increased variations in year-to-year climate conditions will also increase volatility in future yields (see Figure 2.1).[5]

Figure 2.1. Decrease in crop yields from temperature increases (%)



Source: World Bank staff estimates based on econometric analysis

Floods also pose a serious risk to agricultural production. Malaysia's land use practices have increased agricultural exposure to natural disasters, particularly floods and landslides. Unregulated deforestation, peatland drainage, and hill clearing for plantations have exacerbated runoff, soil erosion, and slope instability, heightening the frequency and severity of hydroclimatic disasters. These risks will become more acute as climate change intensifies rainfall extremes and storm surges. Strategies to reduce risk include preserving primary forests, restoring degraded peatlands, enforcing buffer zones along rivers, and implementing climate-smart agroforestry. These measures could also help reduce Malaysia's emissions from agriculture and land use (Chapter 3).

[5] "Pessimistic" and "optimistic" projections refer to climate outcomes under different emission pathways in the IPCC AR5 scenarios. Pessimistic scenarios correspond to RCP7.0, reflecting higher GHG emissions and limited mitigation, while optimistic scenarios correspond to RCP4.5, reflecting moderate mitigation and lower emissions.

This report recommends:

- **Safeguard Malaysia's food security** and align agriculture with climate goals by developing climate-resilient rice and palm oil varieties, expanding water-efficient irrigation in states such as Kedah, Perlis, other key highland areas, and promoting sustainable practices. These include soil conservation in the Cameron Highlands, Lojing, and Kinta highlands, agroforestry in Sabah and Sarawak, and peatland water management. Integrating climate-smart agriculture (CSA) tools—such as real-time weather data, precision farming, and pest monitoring—will help farmers adapt to unpredictable weather and shifting growing seasons.
- **Harness digital technologies** to strengthen resilience by deploying hyperlocal weather forecasts, early warning systems for floods and droughts, and index-based crop insurance tailored for smallholders. Expanding mobile payments and digital farmer registries can accelerate disaster recovery and ensure targeted aid, but this requires investment in rural broadband and digital infrastructure, especially in East Malaysia. Existing programs and initiatives under the National Agrofood Policy, MyDIGITAL, the National Science, Technology, and Innovation Policy (NSTIP), and the Fourth Industrial Revolution (4IR) Policy are already targeting farmers, fishers, and livestock producers, with a particular focus on smallholders and potential for further strengthening.
- **Overcome CSA adoption barriers** by subsidizing CSA tools, expanding affordable internet access in rural areas and delivering practical, Bahasa Malaysia-based training in CSA for farmers. Community-led demonstration projects in states like Johor and Kelantan can build trust and showcase the benefits of new climate-adaptive practices.
- **Foster innovation and partnerships** through increased public R&D funding for climate-resilient crops, collaboration with agritech startups and plantation companies, streamlined regulatory processes, and clear frameworks for climate adaptation financing. A coordinated national approach will help future-proof Malaysia's agriculture sector, while supporting rural livelihoods and economic growth.

2.2. Risks to infrastructure

Malaysia's infrastructure expansion is powering fresh growth prospects. However, persistent challenges—including escalating material costs, skilled labor shortages, fragmented land management, and regulatory hurdles—threaten to undermine project quality and long-term impacts. Mega-investments in highways, rail links, and urban mobility like the Pan Borneo Highway and MRT3 Circle Line are transforming connectivity and boosting regional business activity, but delays and financial constraints often hold back timely completion and limit the economic multiplier that infrastructure can deliver.

Floods pose the biggest climate risk to Malaysia's infrastructure. Extensive studies on climate change's influence on extreme weather events have been carried out. Malaysia's flood risks, especially fluvial floods, are well-documented with periodic assessments for major river basins. By 2100, most of its river basins are projected to see a 15 percent increase in flood risk (NRES, 2024a). Increased flooding exacerbates vulnerabilities in low-lying regions and disrupts livelihoods. More than 5,496 flood hotspots have been identified nationwide, requiring improved protection measures.

The greatest economic threat to infrastructure also comes from floods in urban areas. Although the economic impacts of floods can vary substantially from year to year, the largest impacts on infrastructure occur when large floods hit urban areas. In 2021, 10 majority urban districts accounted for 59 percent

of Malaysia's flood losses in that year, reaching RM2.38 billion (US$539 million in 2025).[6] Concentrated infrastructure and economic activities means that urban flooding results in high economic losses. The National Policy on Climate Change 2.0 (NPCC 2.0) noted that urban flooding will increasingly affect "critical public infrastructure, including healthcare facilities, roads, railways, ports, airports, power stations, and flood relocation centers, [that] are exposed to floods and sea level rises" (NRES, 2024b).

The share of built-up areas exposed to flooding has expanded substantially in the past 40 years, with 20–40 percent of densely populated areas in most Malaysian cities now at risk of large-scale pluvial flood events (GFDRR 2025). Flooding is the most significant natural disaster affecting urban lives and assets in Malaysia, with a lack of planning increasing the risk of flooding in exposed areas by 240 percent between 1985 and 2015. More than 60 percent of the densely populated areas in Kota Bharu could be exposed, while in cities like Alor Setar a one-in-10-year flood could impact multiple densely populated neighborhoods in the city center. As urban expansion continues into flood-prone areas, more communities will be exposed to the risks and consequences of fluvial flooding.

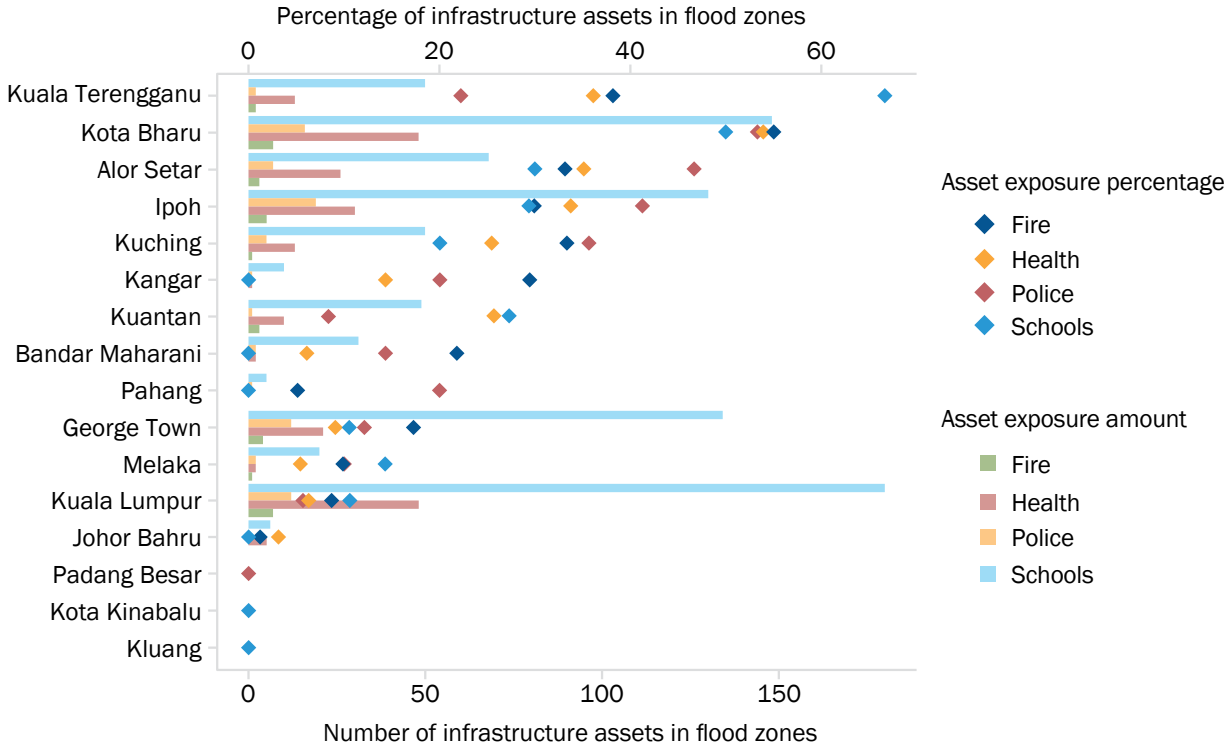
By 2059, 20-year and 50-year extreme precipitation events in urban areas are estimated to be 1.3–1.8 times more likely to occur, affecting Malaysia's most economically productive regions (GFDRR 2025). Flood hazard mapping indicates a heightened probability of flash flooding incidents in high GDP areas, including the Klang Valley metropolitan region, Alor Setar, Batu Pahat, Kota Bahru and Kuantan (BNM and World Bank, 2024). These economically significant urban centers face elevated risk profiles due to rapid infrastructure development that has frequently outpaced implementation of adequate drainage systems. Climate change introduces additional complexity to flood prediction and management efforts through increasing uncertainty in weather patterns, with projections indicating more frequent and intense precipitation events. Considering the location of infrastructure in flood-prone areas – including assets such as schools, police stations, and buildings related to health and firefighting services – managing existing infrastructure will become increasingly difficult (Figure 2.2).

Road infrastructure is also exposed to flooding, with disruptions to connectivity and supply chains. A vulnerability assessment of Malaysia's road network revealed that while projected direct damage costs are similar under both the optimistic and pessimistic climate scenarios (see Box 1.1), total costs are expected to double by 2050 and quadruple by 2080.[7] While fluvial flooding currently causes the highest damage to road infrastructure, coastal flooding is projected to become increasingly costly by 2030 and 2050, surpassing pluvial flooding for frequent events (five-, 10-, and 20-year return periods), highlighting the need for comprehensive flood preparedness with a focus on coastal risks. Corridor-level analysis identifies high-exposure along the western coasts of Peninsular Malaysia and Sabah. The 10 most vulnerable corridors comprise five in Peninsular Malaysia (federal routes 1, 3, 5, and 58), three in Sarawak (two segments of routes 1 and 902), and two in Sabah (routes 1 and A5), which should be prioritized for resilience investments. At the provincial level, Sarawak, Selangor, and Sabah are expected to bear the highest direct damage costs: Sarawak's high share of flood-prone roads leaves it vulnerable, while Selangor faces the highest long-term costs (US$40–43 million by 2080) with potential for substantial indirect impacts due to its economic significance and population density. Sabah's vulnerability is projected to intensify by mid-century.

[6] Due to the lack of consistent city-level data, this section uses an approximation based on districts with significant urban development. See background note (to be published) for details and the definition used of flood losses. This is also consistent with analyses from the Department of Statistics Malaysia, insurance industry reports, and academic research.

[7] The assessment estimated costs associated with direct damage to roads caused by fluvial, pluvial, and coastal flooding based on Fathom data for five return periods (in years): one-in-five, one-in-10, one-in-20, one-in-50, and one-in-100.

Figure 2.2. Infrastructure assets exposed to fluvial flood hazards



Source: GFDRR (2025)

Gaps in plans to protect infrastructure are acknowledged in the NPCC 2.0. The 2025 budget prioritized climate adaptation through large-scale infrastructure and flood responses, allocating RM3 billion for 12 flood mitigation projects—though coverage remains unclear. Ex-post support and other adaptation budgets include RM600 million for disaster risk management, RM250 million for landslide management and RM150 million for drainage cleaning. Local authorities (PBTs) bear most of the responsibility for adaptation, but are often hampered by complex governance and limited financing. While cities are developing disaster plans and the Climate Change Bill (RUUPIN) shows potential, harmonizing national-local efforts via the National Adaptation Plan is essential to overcome local ownership, coordination, implementation, and funding challenges.[8]

This report recommends:

- **Upgrade dams and reservoirs** by integrating climate-resilient designs and AI-driven predictive maintenance, as seen in recent projects in Malaysia to modernize water infrastructure in response to extreme weather. Involve local communities in monitoring to ensure adaptive water management is tailored to Malaysia's diverse river basins.
- **Enhance urban and road flood resilience** with innovative green infrastructure like permeable pavements and rain gardens, nature-based solutions like water retention areas, real-time flood monitoring (e.g., Kuala Lumpur's SMART Tunnel system), and stricter enforcement of flood zoning in high-risk cities such as Kuala Lumpur and Shah Alam, supported by the government's multibillion-ringgit flood mitigation plans.

[8] Federal government, through the Ministry of Housing and Local Government, does have a strategic plan for climate adaptation through its National Physical Plan 4.

- **Unlock adaptation and resilience financing** by piloting blended finance models, including public-private partnerships and green bonds, in step with aligning water and flood projects with national climate funds such as the Green Technology Financing Scheme to attract domestic and global investors.
- **Boost coastal resilience** by mandating mangrove conservation in State development plans, expanding community-led restoration projects like those in Sarawak's Rajang Mangrove National Park, and integrating nature-based solutions into Malaysia's national disaster risk frameworks.
- **Scale-up capacity building** by establishing regional hydroclimate data hubs, training local experts in advanced modeling tools, embedding Indigenous and local knowledge into early warning systems, and running community education campaigns on flood risks and road safety, particularly in flood-prone states.

2.3. Challenges to water supply

Water supply challenges in Malaysia carry significant economic consequences. Frequent disruptions impose heavy costs on commercial, industrial, and residential users, especially in growth hubs like the Klang Valley. Rapid urbanization, rising demand from households and manufacturers, inadequate infrastructure upkeep, and fragmented water management have left key regions exposed to shortages, production stoppages, and escalating business expenses. In 2020, water supply disruptions in Selangor and parts of Kuala Lumpur caused significant economic losses, highlighting how water insecurity threatens Malaysia's competitiveness, investment climate, and sustainable development trajectory.

Increasingly erratic rainfall patterns triggered by climate change, resulting in more frequent and severe floods as well as longer, more intense droughts are a reality for Malaysia. These shifts have already disrupted the country's vital water cycle. Peninsular Malaysia is facing potential declines in rainfall, while Sabah and Sarawak may see increases (see Figure 2.3). The consequences are profound for a nation that relies on its 189 river basins for nearly all treated water, as extreme weather events challenge both water supply and quality. Floods can contaminate water sources, while droughts reduce river flows, impair dilution of pollutants, and strain reservoirs—issues already witnessed in states like Sabah, which declared a drought emergency in early 2024.

Compounding these challenges, the country's water infrastructure faces heightened risks from dam overtopping during floods and water quality degradation during dry spells. Pollution from urbanization, agriculture, and industry further threatens river health, with key rivers like the Klang remaining unsafe for consumption despite national efforts to reduce pollution. As climate extremes intensify, ensuring long-term water security will require urgent investment in resilient infrastructure, adaptive management, pollution control, and robust conservation programs to safeguard both water resources and public health across diverse regions.

Climate change is projected to cause divergent impacts on Malaysia's hydropower generation. Analysis done for the CCDR suggests that, under wet/warm futures, national hydropower output could increase by 3.5 percent by the 2040s due to a 10 percent average increase in runoff, while dry/hot futures may reduce generation by 1.0 percent due to slightly lower runoff. Basin-level analysis reveals Sarawak's large reservoir facilities (such as Bakun and Murum) would see increased generation even under dry/hot conditions, leveraging their substantial storage capacity for climate resilience. Conversely, smaller reservoirs like Batang Ai and most Peninsular Malaysia basins face significant declines of up to 14 percent under dry/hot scenarios. Monthly projections show consistent generation increases year-round under wet/warm futures, enhancing power reliability. In contrast, dry/hot futures would reduce output in critical months, highlighting storage-dependent vulnerabilities beyond annual averages. This underscores the need for targeted investments in storage and climate-proofing of hydropower assets.

Figure 2.3. Change in average annual hydropower production by 2041–50 relative to no climate change reference

Source: World Bank Group staff estimates

The National Water Resources Policy 2012 laid the foundation for integrated water resource management in Malaysia, emphasizing governance, conservation of water ecosystems, and ensuring sustainable water availability. Building on this, the National Water Policy, approved by the Cabinet in December 2024, expands the approach to integrated and sustainable water management, covering water resources, supply services, and sewage. It addresses key factors affecting water security and resilience, including rising demand, climate change, emerging pollutants, and sustainable financing. In response to climate challenges, the National Water Policy introduces proactive strategies such as water disaster risk management, efficient water use, development of climate-resilient infrastructure, ecosystem restoration, and strengthened governance. Complementing this, the Water Sector Transformation Roadmap 2040 (AIR2040) incorporates a Climate Change Impact and Adaptation module, while the Ministry of Energy Transition and Water Transformation's (PETRA) Climate Change Adaptation Framework for Water Sectors (2021), developed through the National Water Research Institute of Malaysia (NAHRIM), provides actionable adaptation measures at planning and implementation levels, ensuring the water sector is better prepared for climate risks.

While current water sector policies and institutional arrangements have been reviewed by the study team, they require further enhancement to effectively tackle climate-related challenges. The government is shifting from a reactive to a proactive approach in flood risk management, particularly following the severe floods of December 2021. This shift requires long-term commitment, a comprehensive master plan for sustainable flood management, and public access to flood hazard maps, alongside local adoption of Department of Irrigation and Drainage (DID) guidelines. While the National Water Resources Policy 2024, Climate Change Adaptation Framework for Water Sectors, and the forthcoming Climate Change Adaptation Framework aim to strengthen water resilience and equity, progress is hindered by inconsistent implementation and fragmented governance across states—especially in less developed, climate-vulnerable regions.[9]

[9] World Bank, Malysia Climate Change Institutional Assessment.

This report recommends:

- **Accelerate nationwide Integrated Water Resource Management (IWRM) implementation** to address climate-driven water variability, prioritizing conservation, leakage reduction, digital monitoring and basin-level planning, especially in water-stressed and rural areas. This approach will ensure more equitable and sustainable water allocation across Malaysia's diverse regions.
- **Strengthen integrated river basin management** for major river systems by enforcing action plans, improving pollution controls for industry and agriculture, and increasing transparency to protect water quality and reduce flood risks. Coordinated action at a basic level will help safeguard both urban and agricultural water supplies from climate extremes.
- **Modernize dams and reservoirs** with climate-resilient designs, AI-driven predictive maintenance, and multi-purpose functions (flood, irrigation, energy). Involve local communities in monitoring and adaptive management.
- **Bridge funding gaps for water and adaptation projects** by piloting innovative finance mechanisms, such as green bonds and public-private partnerships, performance-based contracts to reduce water losses, and reuse to attract investment in sustainable water management and nature-based solutions. Mobilizing diverse sources of finance will accelerate implementation of critical adaptation projects nationwide.
- **Build local expertise** by establishing regional knowledge hubs, training State agencies in new technologies, and incorporating traditional and Indigenous knowledge to enhance resilience to climate and water risks. Empowering communities and local authorities with knowledge and skills will ensure effective adaptation at the grassroots level. Ensure active involvement of local communities, Indigenous groups, women, and youth in water resource planning and management through participatory decision-making, capacity-building, and monitoring initiatives.
- **Prioritize upgrading hydropower plants** and increasing turbine capacity to maximize generation during wetter periods and buffer against declines during dry spells, ensuring reliable renewable energy as climate conditions shift. Strategic investments in hydropower will support Malaysia's energy security and climate goals in the decades ahead.

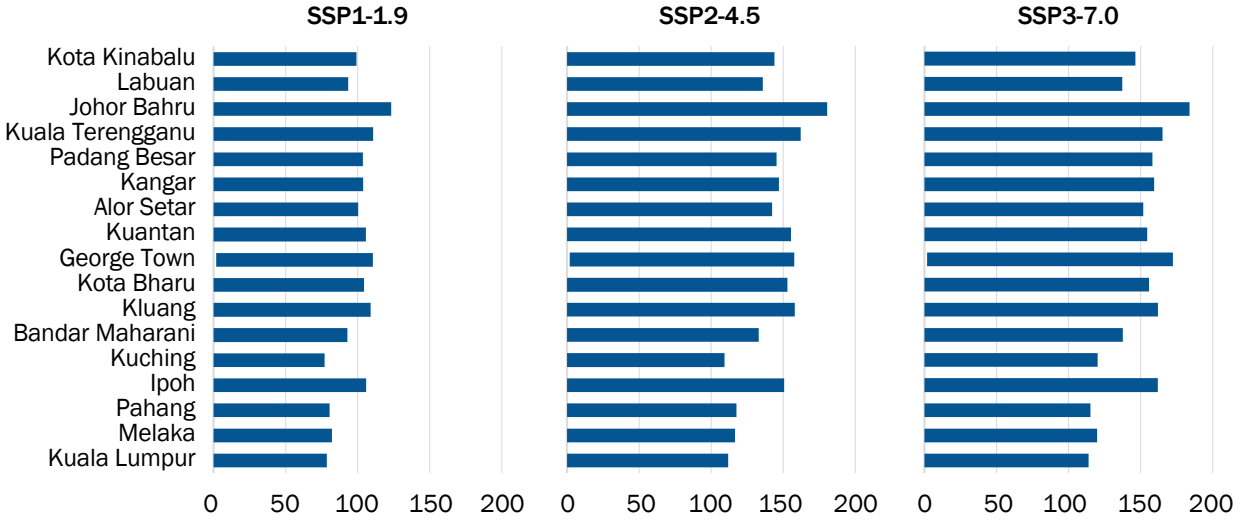
2.4. Impacts on people

2.4.1. Impacts of extreme heat

Heat stress will become an increasingly critical social and economic issue in coming decades. As a hot and humid country already, conditions in Malaysia are already often close to Wet Bulb Globe Temperatures (WBGT). Further temperature rises could mean that the threshold is crossed more often. Under WBGT conditions, it becomes unsafe to undertake strenuous activity in non-controlled climate conditions. Common activities, including sports, may become impossible in the daytime. Certain types of outdoor work, notably in agriculture and construction, may also become unsafe during hot spells. Under a pessimistic climate scenario, the analysis suggests that annual labor productivity in agriculture could fall by 5 percent by 2050, compared to today's conditions, while industrial labor productivity could drop by 2 percent, and productivity in services by 1.5 percent.

Climate change will worsen urban heat and the UHI effect. Heat stress will become even more problematic in cities because of the UHI effect. All 17 cities analyzed for this report[10] are projected to experience mean temperature increases of approximately 0.75–1.5°C by 2040–59. As shown in Figure 2.4, by 2059 Malaysian cities could experience 100–150 days annually with temperatures exceeding their current top 10 percent hottest days (GFDRR 2025). The Extreme Heat Vulnerability Index (EHVI)[11] suggests that 10 of the urban districts listed in Figure 2.4 could account for 3.8 million people being exposed to strong heat stress by 2040. Map 2.2 shows how extreme heat could affect Peninsular Malaysia.

Figure 2.4. Projected Extreme Heat Vulnerability Index anomaly: change in number of days for 2040–59 with temperatures exceeding top 10 percent of hottest days in 1995–2014



Source: GFDRR (2025)
Note: Shared Socioeconomic Pathways (SSPs) describe alternative future trajectories of global social and economic development used to assess climate change risks, emissions, and adaptation capacity.

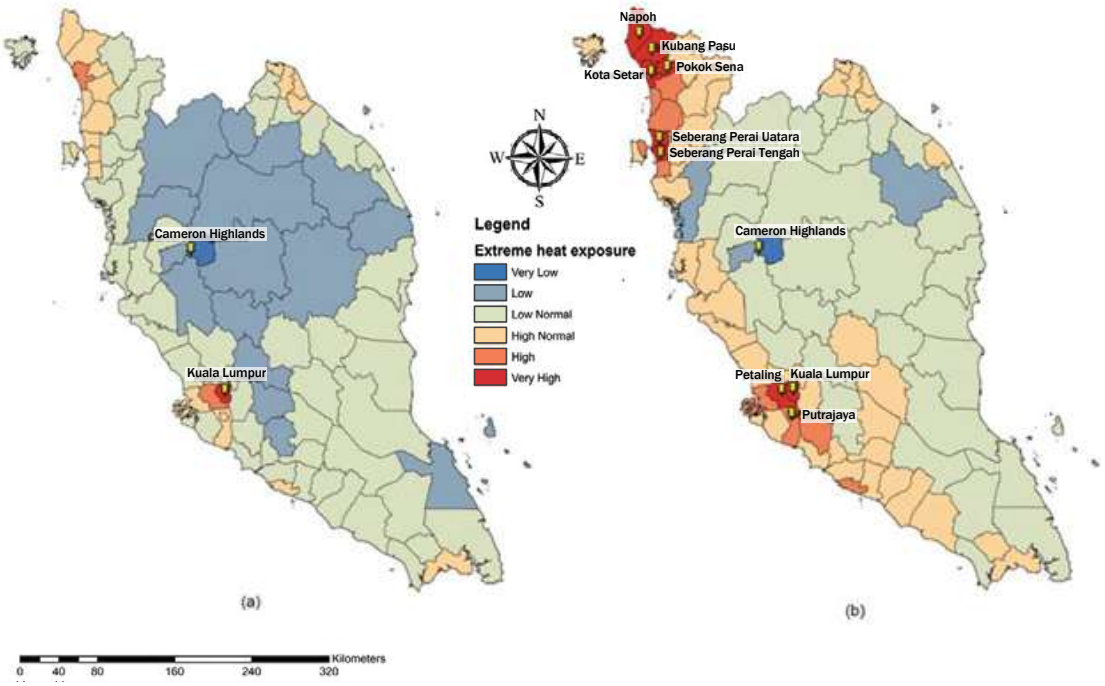
Rising temperatures and more frequent heat waves are already impacting public health in Malaysia. This has prompted the Ministry of Health to introduce targeted action plans and clinical guidelines. As the World Health Organization warns, climate change is expected to further intensify heat-related illnesses – including heat exhaustion, respiratory issues, and heat stroke – while exacerbating chronic conditions like heart disease and diabetes, especially among vulnerable groups such as the elderly, children, and those with pre-existing health issues. Urban areas face heightened risks not only from heat stress, but also from the increased spread of vector-borne diseases like dengue and malaria, as warmer, wetter conditions and higher population density create ideal environments for disease transmission. Flooding compounds these dangers, as seen in past outbreaks of leptospirosis and typhoid fever in densely populated cities of Malaysia, underscoring the urgent need for integrated health, urban planning, and climate resilience strategies to protect most at-risk communities.

[10] The Global Facility for Disaster Reduction and Recovery (GFDRR) prepared the Malaysia Urban Climate Risk Analysis 2025 for this report. The GFDRR analysis assessed climate hazards across 17 urban and peri-urban extents. The area boundaries are derived from Malaysia's Fourth National Physical Plan (NPP4) for four major conurbations (George Town, Johor Bahru, Kuala Lumpur, Kuantan), two additional cities (Kuching, Kota Kinabalu), and 11 development promotion zones (Alor Setar, Bandar Maharani, Ipoh, Kangar, Kluang, Kuala Terengganu, Kota Bharu, Labuan, Melaka, Padang Besar and Pahang).

[11] The district-level EHVI was developed by analyzing land surface temperatures at a district level throughout Peninsular Malaysia from 2003 to 2018 and assessing the vulnerability of districts based on exposure, sensitivity, and adaptive capacity (source: Kamal et al, 2021).

Map 2.2. Extreme heat exposure in Peninsular Malaysia

(a) Reference year *(b) Extreme heat year*

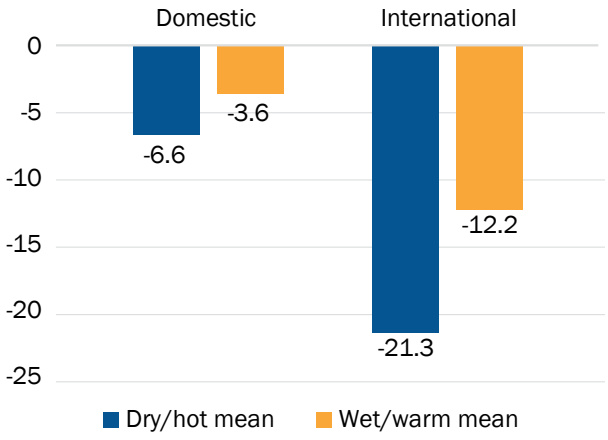


Source: Kamal et al. (2021)

Devoting land in urban spaces for parks and green areas could alleviate some of the UHI effect. Green spaces can reduce the UHI effect both by providing breaks between concrete spaces and incorporating the cooling effects of trees, while also offering some protection against floods. Parks like Bukit Kiara in Kuala Lumpur exemplify the benefits to local communities, but also the pressures on available land from economic development. Better planning and implementation of planning rules is required to maintain and protect such green spaces. A stronger valuation of the eco-system services benefits offered by parks would also help to make the case for their maintenance.

Climate change is projected to reduce significantly tourism revenues by the 2040s, driven by two interrelated trends. First, rising temperatures will make the country less attractive to international leisure travelers, who may avoid destinations perceived as uncomfortably hot. Second, domestic tourists are likely to travel abroad more frequently to escape local heat, redirecting spending away from the domestic economy. These shifts are estimated to reduce international tourism revenues by 12.2 to 21.3 percent and domestic tourism revenues by 3.6 to 6.6 percent by the 2040s, depending on the severity of climate conditions (Figure 2.5). The hotter and drier the climate scenario, the steeper the decline, as it will amplify losses due to extreme heat, degraded natural attractions, and heightened

Figure 2.5. Shock to tourism revenues from leisure travelers, 2041–50



Source: World Bank staff estimates

health risks for visitors. The decline in tourism revenue would also ripple through related sectors such as hospitality, transportation, and retail, leading to job losses and reduced investment. Without urgent adaptive planning, projected revenue losses could undermine the economic stability of tourism-dependent communities and industries by mid-century.

This report recommends:

- **Expand tree-planting programs and green infrastructure** in cities such as Kuala Lumpur, Johor Bahru, and Penang, including urban parks, green roofs, and vertical gardens, to counteract UHI effects and improve public comfort. Pilot reflective "cool pavements" in high-traffic areas and prioritize shaded pedestrian walkways and retrofitting of public buildings with heat-resilient materials, especially in densely built-up city centers.
- **Update Malaysia's occupational safety regulations** to mandate rest periods, hydration breaks, and heat-protective gear for outdoor workers in sectors, such as agriculture and construction, that are highly vulnerable to heatwaves. Encourage flexible work hours and mechanization during peak heat and integrate heatwave alerts from the Malaysian Meteorological Department into workplace safety protocols.
- **Expand heat-health early warning systems** and deploy mobile clinics targeting high-risk groups such as the elderly, children, and those with chronic illnesses, particularly in rural and low-income urban communities. Train healthcare workers in heat-related illness management and integrate climate risks into disease surveillance, focusing on rising threats like dengue and leptospirosis linked to Malaysia's changing climate.
- **Use AI tools to track Aedes mosquitoes**, predict dengue outbreaks, and support community clean-ups alongside innovative steps such as special mosquito releases to curb transmission. This integrated approach can help target resources effectively, reduce disease risk in high-incidence areas and build resilient, mosquito-safe communities.
- **Establish neighborhood cooling centers in high-risk areas**, such as Klang Valley and Melaka, in step with training local leaders to be "heat resilience champions" to coordinate emergency response and public education. Integrate heat-risk awareness into school and workplace programs, emphasizing hydration, symptom recognition and early warnings, while providing targeted support for SMEs and vulnerable populations during extreme heat events.
- **Encourage off-season tourism**, diversify attractions to include cultural and indoor activities as well as invest in climate-resilient infrastructure at major destinations like Langkawi, Penang, and Redang Island. Market cooler highland regions and support sustainable tourism practices to help retain visitors and protect local economies from the impacts of extreme heat and shifting weather patterns.

2.4.2. Distributional implications

As the risks of climate-induced hazards rise, social inequality could become more pronounced. Malaysia ranked 132nd out of 168 countries in terms of population exposed to climate shocks, with 23 percent of the population exposed (Doan et al. 2024), mainly to coastal and river floods. Most districts at high risk to climate hazards are wealthier, but pockets of elevated risk and low living standards exist. For example, the heightened exposure to floods in Sarawak state's Kanowit, Kapit, Sibu and Song districts dovetails with high rates of poverty.[12] Similarly for coastal floods, the highest confluence of exposure and poverty is found in

[12] Unlike droughts and heat stress which have larger spatial footprints, flood risks are localized. Hence, the footprint is likely to be heterogeneous within spatial units at which the aggregation is presented. As such, district level correlations may understate the true extent of correlation between exposure and poverty. For example, within cities, it is often the relatively poorer segments that typically reside in flood-exposed areas.

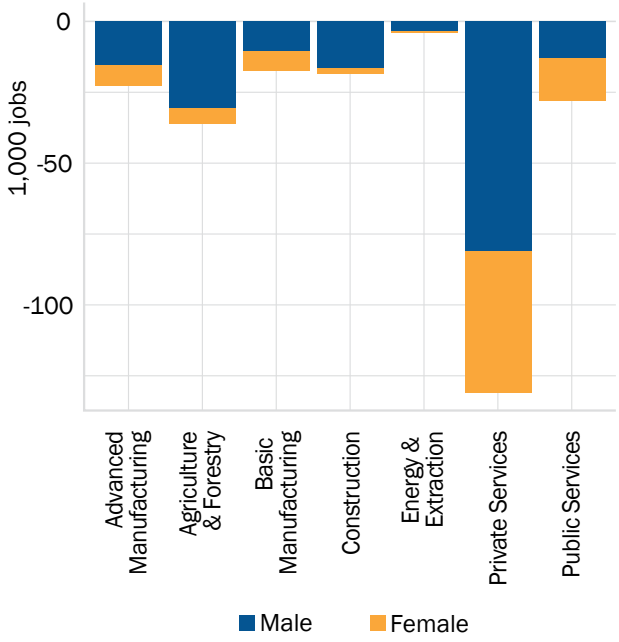
Sabak Bernam and Batu Pahat (peninsular region) and Sandakan and Semporna (Borneo region). Exposure to landslides and heat stress are generally more severe in the relatively more prosperous regions.

Within exposed areas and for any given level of exposure, poorer households are more vulnerable to climate hazards. Poorer households are more likely to have less durable housing, be reliant on outdoor work for livelihoods and not have financial insurance or access to savings and wealth to generate resources to rebuild in the aftermath of shocks. Thus, the way in which Malaysia addresses climate change and intensifying risks from multiple climate hazards will have profound impacts on future inequality.

Low-income jobs will be more affected by climate change. By 2030, jobs in every sector will be exposed, with agriculture and construction impacted heavily, but private services are forecast to see the absolute largest number of jobs lost by 2030 (Figure 2.6a). Men will be affected disproportionately by the loss of jobs in outdoor work. There is a slight tendency for low-income jobs to be most affected, again reflecting the sectoral composition and types of work that take place outdoors (Figure 2.6b). Employment effects could slightly worsen inequality beyond the direct impacts of climate change.

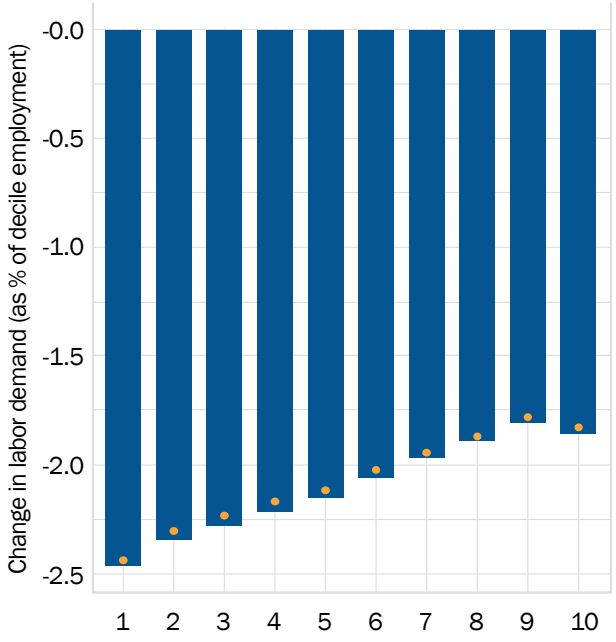
Figure 2.6. Job impacts of climate change (2030, RCP7.0)

2.6a. *Loss of jobs by sector and gender (000)*



Source: World Bank staff calculations based on MINDSET

2.6b. *Loss of jobs by income decile (%)*



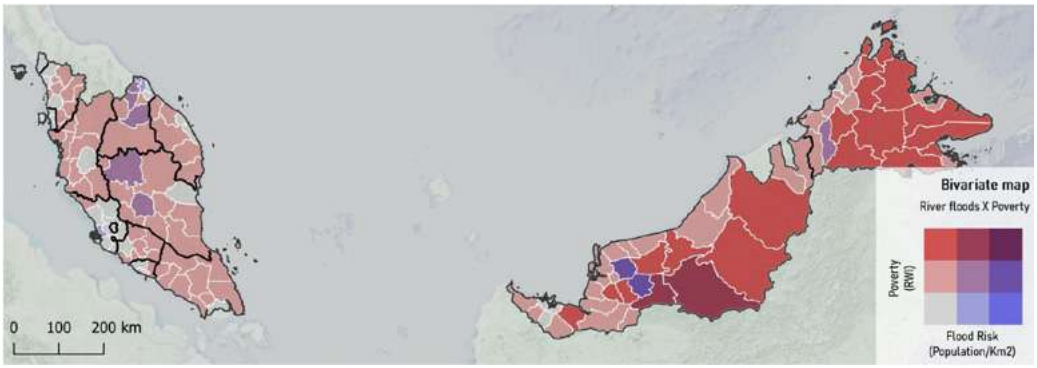
Source: World Bank staff calculations based on MINDSET

While some high-risk districts are relatively wealthy, others like Kanowit, Kapit and Sibu in Sarawak and Batu Pahat and Sebak Bernam in Peninsular Malaysia face the dual burden of poverty and climate hazard exposure. Spatial differences in climate exposure and vulnerability to riverine floods, coastal floods and heat stress closely mirror—and risk reinforcing—existing disparities in subnational economic growth, with climate-vulnerable regions potentially falling further behind if targeted investments and adaptation measures are not prioritized. Poorer households are more vulnerable due to less durable housing, outdoor-dependent livelihoods, and limited access to savings or insurance (Figure 2.7). This makes them less able to recover from shocks, thereby deepening long-term inequality.

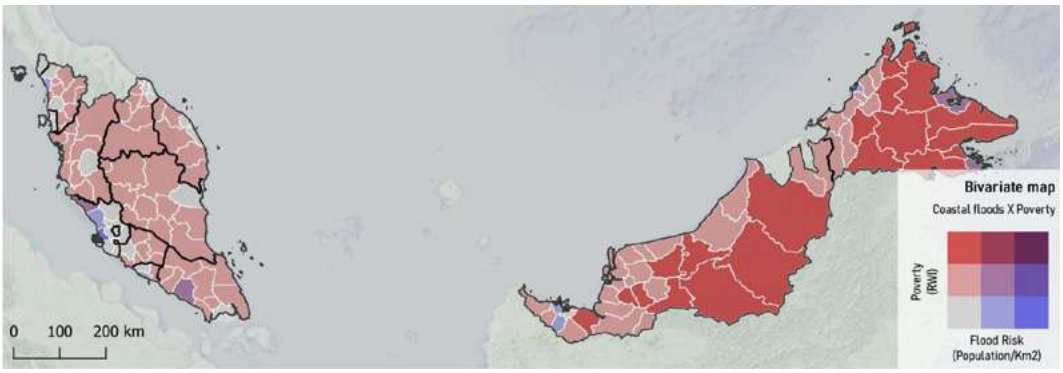
Climate action will be difficult because poorer groups face disproportionately higher risks, while low participation, weak trust, and unequal social norms can undermine collective efforts. Weak social cohesion and resilience, coupled with relatively low levels of climate knowledge (YPCCC et al, 2023) are considerable challenges in Malaysia. Although service access boosts inclusion, concerns about corruption and abuse persist, despite trust in elections. These challenges will make it difficult to engage citizens and build support for climate action. Climate interventions that build broad participation and are seen as legitimate, transparent, and efficient will be more likely to succeed by negating mistrust and resistance.

Figure 2.7. Hazard exposure and poverty overlaid with riverine floods, coastal floods and heat stress

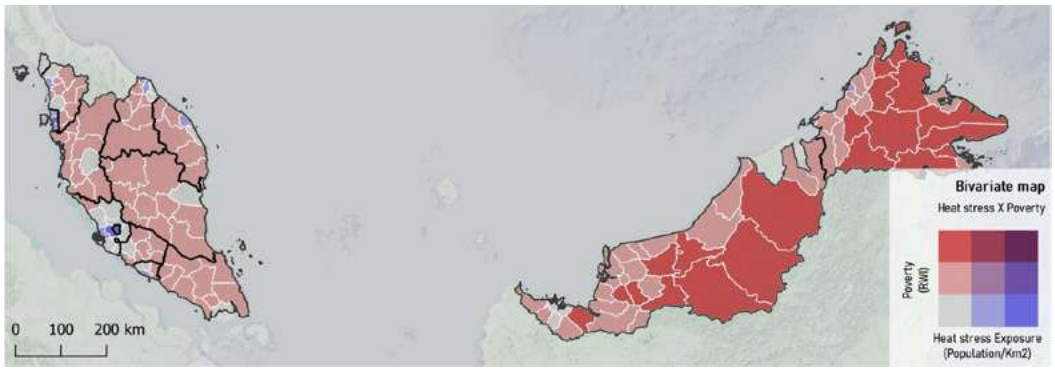
Riverine floods



Coastal floods



Heat stress



Source: World Bank staff visualization as a part of Climate & Disaster Risk Analytics – Standard Approach for Informing Country Climate and Development Reports (February 2024)

This report recommends:

- **Target support to Malaysia's poorest households**—especially in flood-prone states like Kelantan, Sabah and Terengganu—by improving access to durable housing, enhancing livelihood security for those in agriculture and fisheries, and expanding financial protection tools such as micro-insurance, savings programs, and adaptive social assistance schemes tailored for low-income ("B40" – bottom 40 percent) communities.
- **Actively involve marginalized groups**—including low-income communities, women, youth, Orang Asli and other Indigenous peoples—in climate strategy design through community consultations, participatory budgeting, and partnership with local municipalities and local authorities, to ensure policies are credible, locally relevant, and widely trusted.
- **Support flood-proofing of infrastructure**, upgrading informal settlements, and improving access to health and education in vulnerable districts such as Kuala Krai or coastal Sabah, while promoting income diversification programs for communities heavily dependent on climate-sensitive sectors.
- **Establish open data platforms for climate and disaster response.** Ensure clear communication of decision-making processes, and provide robust grievance redress systems—such as accessible complaint channels for infrastructure investment projects—to build public confidence and reduce any perceptions of corruption or exclusion, especially in high-risk and marginalized areas.
- **Strengthen state-level capacity**—especially in Kelantan, Sabah, Sarawak, and Terengganu—by equipping district offices, JPS, DID, and local councils with dedicated climate adaptation budgets, modern planning tools (e.g., LiDAR flood mapping, digital asset registries) and performance-linked grants to ensure that frontline agencies have the resources, autonomy, and incentives to implement resilient infrastructure, enforce land-use regulations, and maintain critical assets effectively.

2.4.3. Adaptive social protection

Adaptive social protection is vital for helping poor and vulnerable households withstand floods and other climate-induced shocks. These groups, often reliant on agriculture and lacking financial safety nets, are forced into negative coping strategies—such as reducing food intake or withdrawing children from school—when disasters strike. Adaptive social protection strengthens household resilience through timely information, financial tools like pooled savings and insurance as well as responsive social programs, enabling better preparedness, coping, and long-term adaptation, including livelihood changes or relocation from high-risk areas.

Malaysia's social protection system is extensive. Already, more than 122 programs reach more than 90 percent of households (see Figure 2.8a). However, the system suffers from fragmentation, mis-targeting, and insufficient benefit adequacy, as many benefits inadvertently reach higher-income groups rather than those most in need (see Figure 2.8a and 2.8b). To make adaptive social protection effective, Malaysia must address these structural issues, ensuring that assistance is well-targeted and robust enough to support vulnerable households when disasters strike, ultimately preventing them from falling deeper into poverty.

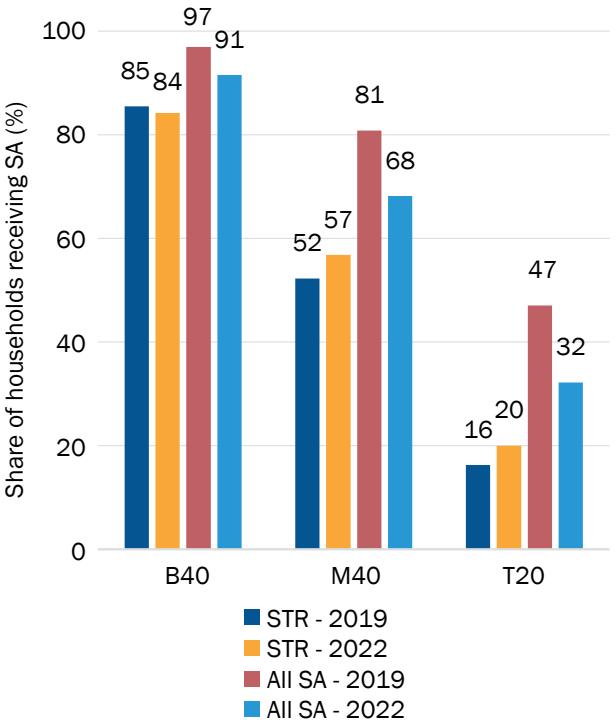
While Malaysia's rapid expansion of social protection during the COVID-19 crisis demonstrated its capacity to respond swiftly in times of shock, these efforts encountered persistent challenges. Despite fiscal stimulus packages and programs like Bantuan Prihatin Nasional and expanded unemployment support, weak targeting and the inclusion of unintended beneficiaries were apparent. Addressing such inefficiencies remains critical as the country faces future climate-related disasters. A key limitation is the lack of integration between social protection and disaster response systems, with flagship programs like Sumbangan Tunai Rahmah (STR) which provides financial assistance to the B40 community and disaster aid operating in silos.

Improving coordination and linking comprehensive beneficiary databases with disaster assistance would enable more efficient identification and support for vulnerable households.

Fragmented data systems and outdated registries further hinder Malaysia's ability to deliver timely, targeted aid during crises. While the launch of the centralized Pangkalan Data Utama (PADU) is a step forward, it must be regularly updated and integrated with disaster risk management platforms to be truly effective. Financial preparedness is equally vital. While Malaysia's bold fiscal measures during the pandemic and ongoing investments in disaster relief and flood mitigation reflect a strong crisis response, long-term adaptive social protection requires sustained coordination between fiscal planning, disaster risk financing, and social assistance programs to ensure resilience against future climate shocks (see Figure 2.9).

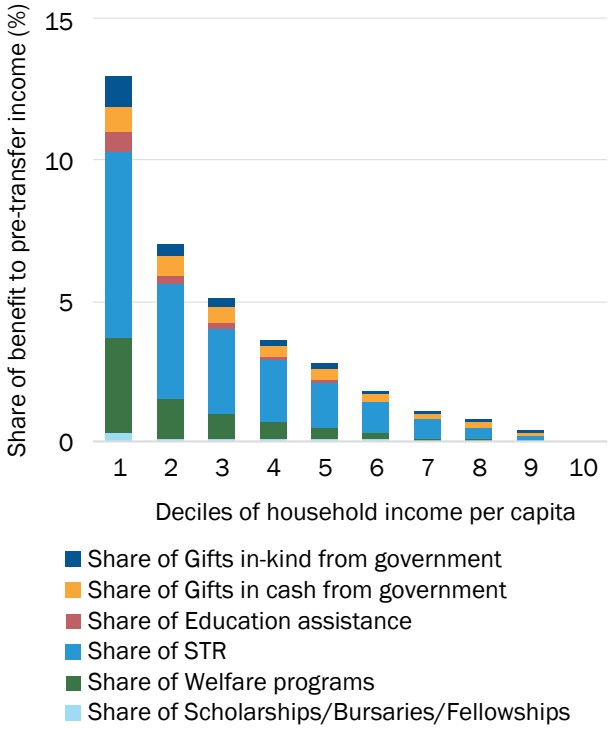
Figure 2.8. Coverage and adequacy of social assistance

2.8a. *Share of B40, M40 and T20 receiving STR and all SA, 2019 and 2022*



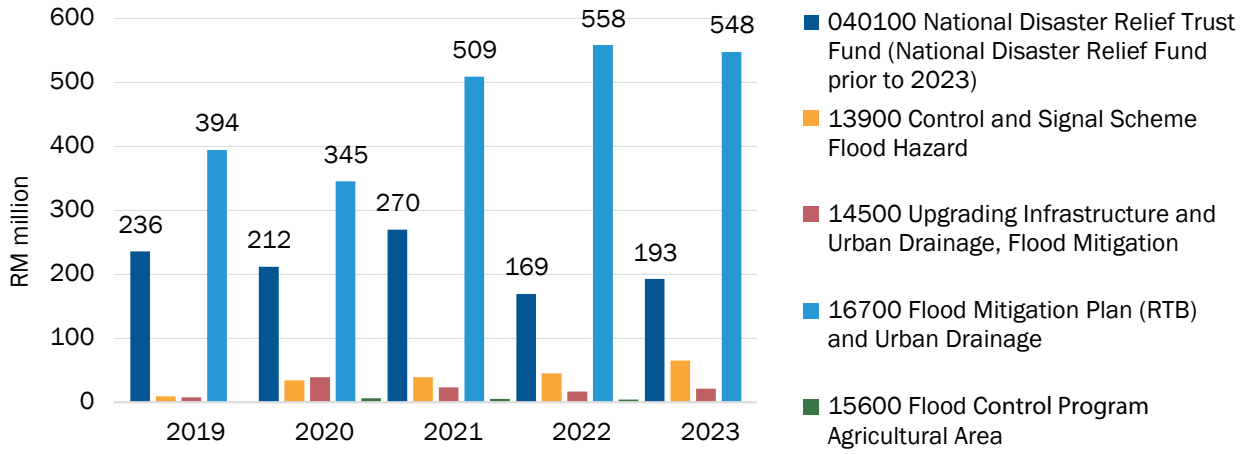
Source: Adapted from Wan and Cheng, 2025, forthcoming, based on HIS 2019, 2022 (DOSM).
Note: Income deciles are calculated based on per capita household pre-transfer income.
B40 (Bottom 40%): Those with the lowest income levels, representing the bottom 40% of earners.
M40 (Middle 40%): Those are middle-income earners, comprising the middle 40% of households.
T20 (Top 20%): Those with the highest-income level, representing the top 20% of households.

2.8b. *Value of benefits relative to pre-transfer income by program of social assistance and household income decile, 2022*



Source: Adapted from Wan and Cheng, 2025, forthcoming, based on HIS 2019 and 2022 (DOSM).
Note: Income deciles are calculated based on per capita household pre-transfer income.

Figure 2.9. Expenditure on disaster relief and flood mitigation, 2019–23



Source: Estimated federal expenditure 2021–25 and Federal Government Financial Statement 2020–23

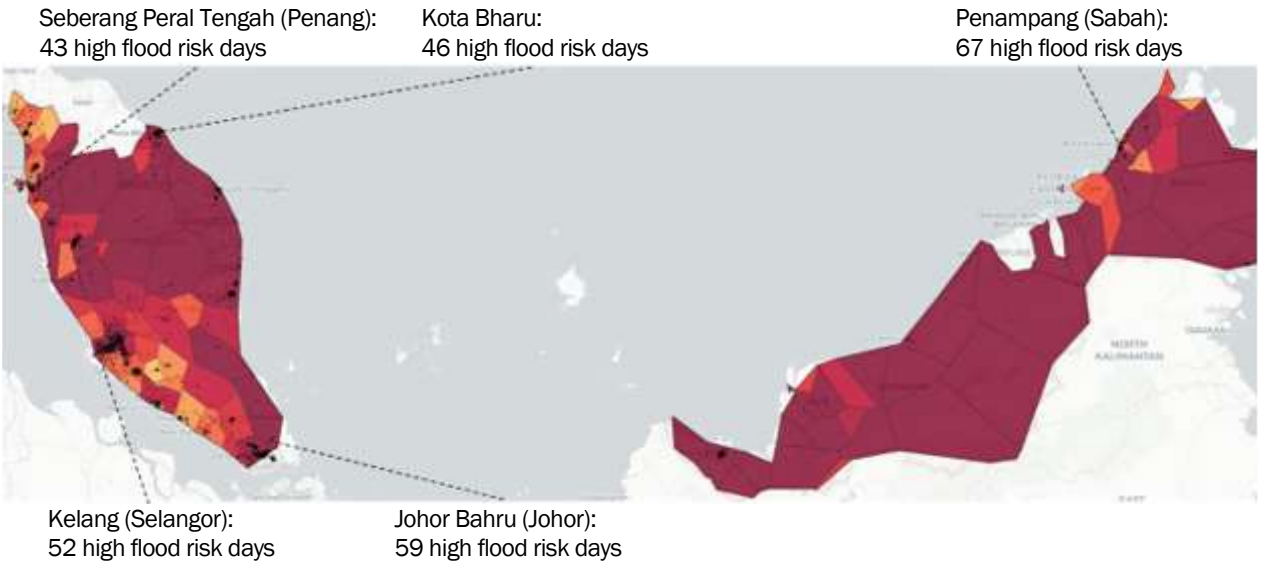
This report recommends:

- **Leverage existing social payment infrastructure for rapid disaster aid** by embedding disaster management protocols and enabling automatic support to vulnerable households during crises. Establish joint task forces to synchronize payment schedules with disaster triggers, using poverty data to prioritize high-risk areas. This approach will ensure timely assistance without rebuilding systems from scratch.
- **Expedite cross-ministerial policy alignment** with clear climate adaptation targets in social programs. Formalize the alignment between social protection programs and disaster risk management to foster collaboration and enhance coordination in relief and assistance efforts. Setting clear deadlines drives accountability across institutions.
- **Clearly define the roles and responsibilities of all relevant stakeholders, including NGOs, the community, and private sector.** This ensures coordinated resource deployment by combining government situational reports with NGO field assets. Structured collaboration maximizes emergency response effectiveness.
- **Merge social protection databases with disaster risk maps** to auto-enroll vulnerable communities into adaptive assistance programs. Pilot shock-responsive financing with dedicated funds for climate-contingent payouts triggered by early warnings. This shifts systems from reactive to proactive support.

2.5. Impacts on businesses

Malaysia's private sector faces mounting risks from climate change, as the confluence of recurring floods and intensifying heat is reshaping business performance and economic resilience. Higher temperature and increased precipitation trends are not uniform nationwide: major urban centers—such as Johor Bahru, Klang and Penang—have seen the number of high flood risk days double from 20 to more than 40 per year. This spatial variation drives local vulnerabilities, especially for areas with high densities of manufacturing and service firms (see Figure 2.10). World Bank empirical analysis, matching geocoded weather data with firm-level surveys, confirmed that from 2015 to 2024, the prevalence of heavy rainfall undermined revenues and labor productivity in key sectors by 3 percent on average, equating to US$7 billion in GDP losses and demonstrating that climate impacts are already occurring and sizable.

Figure 2.10. Firms in major economic centers face high exposure to recurring flood risks

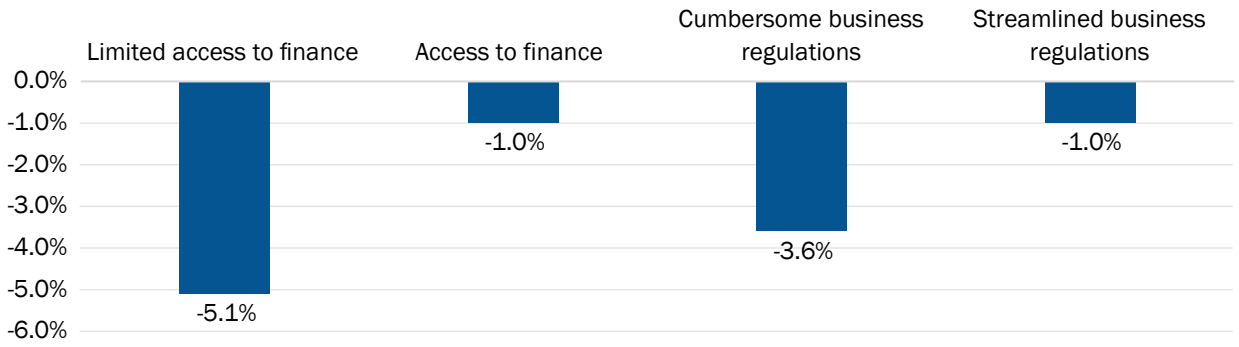


Source: World Bank Firms and Climate Adaptation Policy Toolkit as part of the Climate Support Facility
Note: Days in 2023 with flood risks in the area across Malaysian districts and location of World Bank Enterprise Surveys firms as black dots.
Geocoded satellite hourly weather data on precipitation aggregated at district-level. The figure shows the distribution of the number of days with high flood risks measured as precipitation per square meter exceeding 20mm, from few (light yellow) to many (dark red). Black dots indicate the location of firms based on survey data.

Climate disruptions to business materialize through several operational channels, amplifying economic costs beyond the obvious environmental damage. Firms face lower labor productivity due to heat-related health impacts, absenteeism, and reduced cognitive performance, while floods impose direct infrastructure damage, higher maintenance costs, and prolonged local supply chain disruptions. The CCDR analysis reveals a stark asymmetry: startups and SMEs in Malaysia struggle the most, experiencing revenue and productivity declines up to eight times higher than larger established firms. Abnormally high precipitation can cause new firms to lose up to 4 percent in sales compared to just 0.5 percent for large enterprises. Additionally, recurring floods raise the frequency of power outages and repair costs for physical capital, compounding the economic drag.

The local business environment plays a pivotal role in shaping company resilience to climate shocks. Analysis suggests that firms with easier access to finance, agile management structures, and streamlined regulatory processes tend to recover faster and suffer lower output losses than those burdened by cumbersome procedures or financing constraints (see Figure 2.11). Empirical evidence shows that with each additional climate shock, revenues fall by 5 percent among financially constrained firms—compared to just 1 percent for those with adequate access to finance. Similarly, regulatory friction increases vulnerability to longer permitting delays or licensing, often resulting in postponed or abandoned adaptation investments, such as resilient buildings or flood defenses. These findings underscore that resilience is not only about exposure, but also about how effectively the business environment enables adaptive investments and reduces transaction costs.

Figure 2.11. Improving access to finance and streamlined local business regulations mediate firms' vulnerabilities to costs of raising precipitation



Source: World Bank Group staff estimates

Building a resilient private sector requires a comprehensive policy toolkit. As described in Section 2.2, strategic public and private investments in resilient infrastructure can significantly reduce high climate exposure and minimize business disruptions. At the same time, regulatory reform is critical: streamlining construction permits or adopting risk-based licensing can lower costs for firms in climate-vulnerable areas. Additional tools include targeted awareness campaigns, municipal incentives for resilience-focused investments, and dedicated online platforms offering localized climate data and adaptation resources. State support for supply chain diversification and risk-based health and safety inspections can further enhance operational continuity.

This report recommends:

- **Accelerate and simplify the construction permitting process in municipalities with high climate exposure** and a dense concentration of SMEs or startups. Reducing these transaction costs will unlock timely investments in resilient infrastructure and adaptation measures. This can be achieved through digital permitting systems and decentralized approval authority at the local level.
- **Adapt health and safety standards, licensing, and inspection frequency to reflect each firm's climate risk profile.** This ensures protection is concentrated where vulnerabilities are highest, while avoiding unnecessary burdens on lower-risk firms. Piloting this approach in high-risk sectors can demonstrate cost-effectiveness and build stakeholder support. Enhance industrial resilience and awareness by strengthening the i-ESG Framework, prioritizing introductory ESG capacity-building and low-carbon transition programs for manufacturers.
- **Promote programs, including digital tools, that enable businesses to diversify their supplier base across locations.** A broader, more resilient supply network helps mitigate climate-related disruptions and enhances operational continuity. Incentivizing local sourcing from less exposed regions can also strengthen regional economic resilience.
- **Mandate that investment promotion agencies integrate climate resilience and local vulnerability** into project assessments. Strengthen supplier standards on sustainability and resilience to improve labor productivity, job quality, and supply chain robustness. Clear, sector-specific resilience criteria will also enhance transparency and investor confidence.
- **Remove restrictive land use policies that hinder company relocation to safer areas.** Scale-up targeted financial instruments—such as credit guarantees for firms—to support investments in resilient technologies, particularly for startups and firms in high-risk zones. Bundling financial support with technical assistance can accelerate uptake and improve outcomes.

2.6. Macroeconomic consequences and adaptation investment needs

Heat stress is becoming an increasing concern at macro level, alongside floods. Figures 2.12a and 2.12b show the estimated average impacts of climate change in Malaysia in 2030 and 2050, compared to an average year during the period 1995–2020, using two macroeconomic models. Strikingly, the total losses could reach 3.9 percent of GDP by 2030 and 8.3 percent by 2050 in a pessimistic future climate scenario. The impact of heat stress on labor productivity dominates the overall effects in both macroeconomic models used. However, the differences in results between the two models highlight two important issues. First, in assessing flood damages, the MINDSET simulations assume that all damaged infrastructure can be repaired, while MFMod simulations place supply-side constraints on the extent of repairs. Ensuring available capacity to rebuild after floods could thus be an important measure to reduce long-term economic impacts. Second, the MFMod simulations assume that capital is unaffected by absent workers, whereas MINDSET simulations include loss of production from machinery and offices too. Finding ways to maintain some production in the absence of workers would therefore reduce impacts. Agriculture is particularly affected in these scenarios, with potential production losses of 18 percent by 2050, in part because of the outdoor nature of agricultural work, but also the direct susceptibility of crops to heat (Figure 2.12c). However, heat stress affects productivity in all economic sectors. The average effects presented in Figure 2.12 downplay the risks of extreme events, which could include severe weather, increasing heat stress events and large floods. Climate risks are discussed further in Section 2.7.

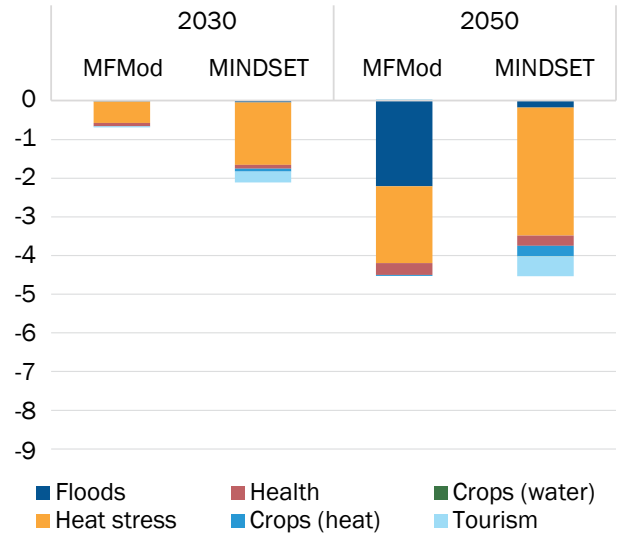
Adaptation measures could offset up to half of Malaysia's economic costs of climate change, specifically targeting heat stress. The overwhelmingly critical adaptation measure is the installation of cooling systems to allow indoor work to continue as per the 1995–2020 period. In a scenario where the penetration of air conditioning units increases in workplaces from 41.6 to 75 percent by 2050, up to half of climate costs are offset (Figure 2.12d). Furthermore, the cost of this measure is relatively low (US$40 million annually by 2050). However, further measures may be needed to maintain rates of labor productivity. Air conditioning units would also need to be installed in homes to ensure workers can sleep properly, while adequate cooling transport systems and public spaces would entail further costs. Overall, the total financial cost of controlling indoor temperatures in such venues could be six times the estimate for workplaces alone. Finally, without decarbonizing the power sector (Section 3.1), increased use of air conditioning could elevate Malaysia's emissions.

The investment needs for climate change adaptation up to 2050 are substantial. The total estimated cost of climate adaptation ranges from US$852 billion to US$1134 billion in nominal terms, depending on assumptions about asset vulnerability and sectoral requirements (Table 2.1). These estimates encompass key areas such as asset upgrades, public infrastructure, flood mitigation and disaster response, early warning systems, climate-smart agriculture, and heat stress prevention. The Net Present Value (NPV) of these investments, using a 6 percent discount rate, is US$356 billion to US$501 billion (see Figure 2.13).

The largest share of adaptation investment in Malaysia is directed toward upgrading and retrofitting public infrastructure. This is in line with International Monetary Fund (IMF) benchmarks of 3–4 percent of GDP, reflecting the essential role of resilient public systems as climate events become more frequent and severe. Upgrading private assets will require an estimated US$38.3 billion (discounted), while the IMF's 2024 Article IV report projects the value of private assets to reach US$67.2 billion in 2025 (16.8 percent of GDP), with an annual financing need of US$2.01 billion using a 3 percent investment proxy—corresponding to a nominal cost of US$85.6 billion. Beyond infrastructure needs, Malaysia is projected to require US$32.56 billion for disaster risk reduction and resilience activities, including improved land use planning, stricter building standards, more flood-resilient infrastructure, and enhanced natural ecosystems that help retain water. In addition, substantial financing is needed for other adaptation priorities, such as water supply infrastructure (US$69.8 billion) and irrigation (US$33.5 billion) over the next 25 years.

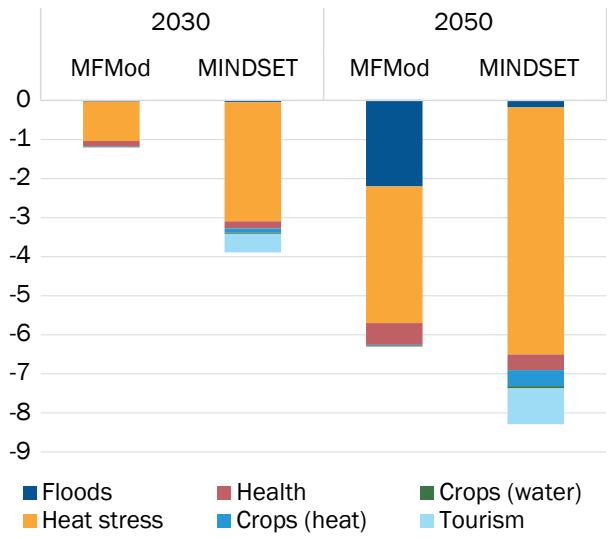
Figure 2.12. Economic impacts of climate change in Malaysia (%)

2.12a: *GDP impacts in RCP4.5 Scenario*



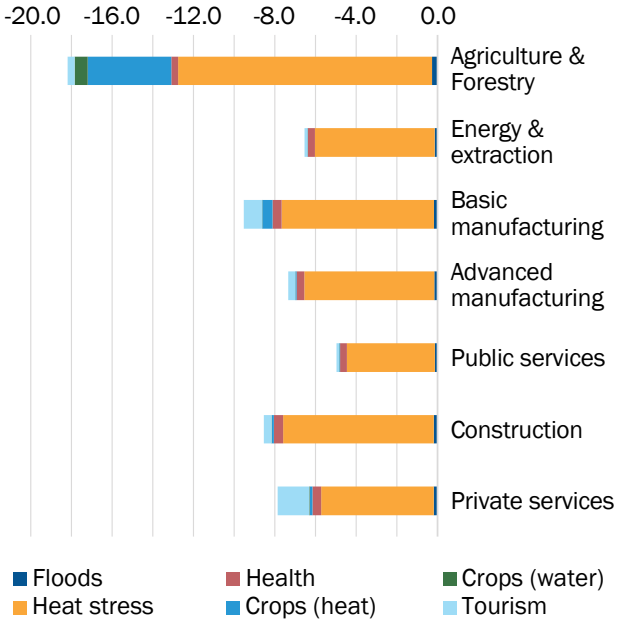
Source: World Bank staff calculations using MFMod and MINDSET models

2.12b: *GDP impacts in RCP7.0 Scenario*



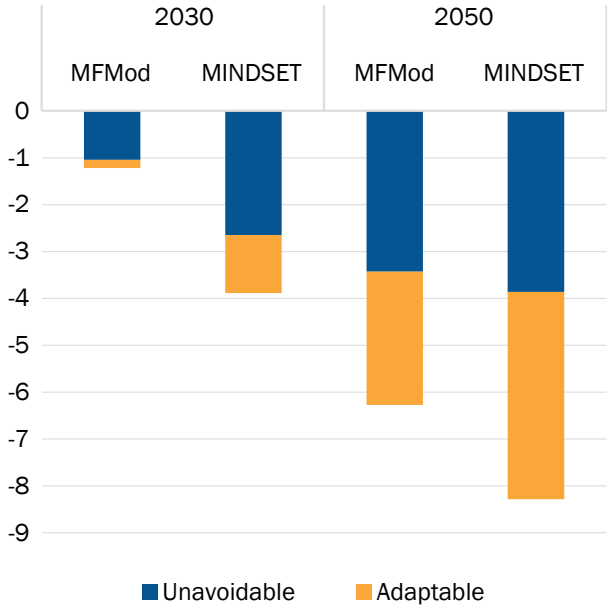
Source: World Bank staff calculations using MFMod and MINDSET models

2.12c: *Sectoral impacts of the different climate channels in 2050 (RCP7.0)*



Source: World Bank staff calculations using MINDSET model

2.12d: *Potential to reduce climate impacts through adaptation (RCP7.0)*



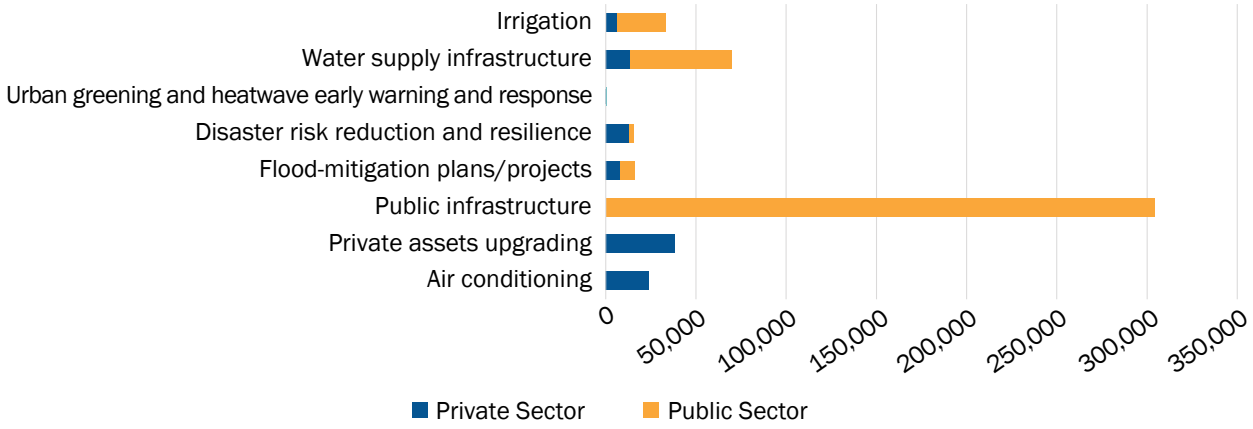
Source: World Bank staff calculations using MFMod and MINDSET models

Table 2.1. Adaptation investment needs by 2050

Sector	Nominal Cost (US$ billion)	Discounted NPV (US$ billion)
Private assets upgrading	85.6	38.3
Public infrastructure (new investment)	11.1-66.5	5.9-35.2
Public infrastructure (upgrading & retrofitting)	498.1-612.5	222.3-269.0
Flood mitigation plans/projects	44.1	15.9
Disaster risk reduction and resilience	32.6	15.2
Urban greening and heatwave early warning and response	0.4-0.5	0.2-0.3
Water supply infrastructure	98.2-169.0	42.2-69.8
Irrigation	37.2-77.9	16.0-33.5
Air conditioning	45.0	23.9
Total	*852.4-1133.6*	*356.2-501.2*

Source: World Bank staff estimates
Note: We present these figures as ranges to reflect uncertainty around future climate conditions, income growth, technology costs, behavioral responses, and policy choices, all of which will influence the pace and extent of adaptation by 2050.

Figure 2.13. Investment needs for climate adaptation by sector over 25 years (2025–50), NPV (US$ million)



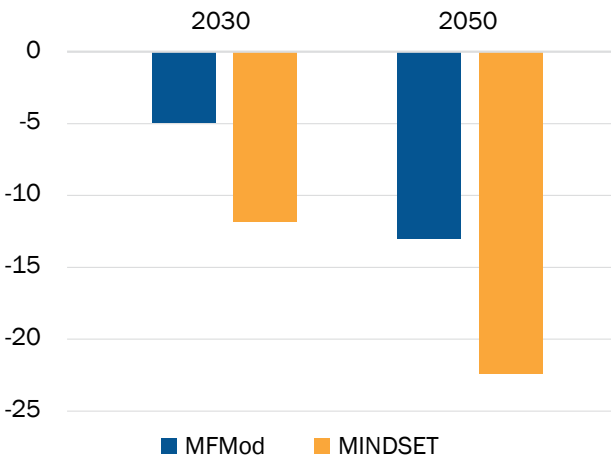
Source: World Bank staff estimates

2.7. Potential worst-case scenarios

The risks of climate change to Malaysia's economy are greater than the current average losses suggest, and the importance of adaptation measures should be viewed in this context (see Figure 2.14). Malaysia is already a hot and humid country, meaning that only small changes in weather patterns could substantially increase the frequency of WBGT conditions. The stark reality is heat stress impacts could considerably worsen in years with above average temperature increases. To underscore this reality, in a year when the effects are particularly bad (95th percentile), production losses could be as high as 16 percent by 2050 compared to the 1995–2020 average.[13] If a spell of severe heat ending in heavy rainfall led to a one-

[13] As noted in Section 2.6, the difference between results for the two models reflects assumptions about whether equipment can still be used at full capacity while people are unable to work. The MINDSET model results include losses of production from machinery as well as people during times of heat stress, leading to larger production losses.

Figure 2.14. Physical risk scenario impacts on GDP (%)



Source: World Bank staff estimates based on MFMod and MINDSET models

in-20-year flood taking place, the losses could increase by at least another 4.6 percent of GDP (World Bank, 2024).[14] Such a large reduction in domestic production capacity would place a severe strain on Malaysia's economy and cause knock-on effects like financial instability. The importance of adaptation measures should be viewed in this context. Providing indoor cooling in homes, workplaces, and transport systems would allow economic production to continue and potentially avoid high levels of economic stress. Berg et al. (2025) found that rising temperatures in middle-income countries reduced firms' revenues, labor productivity, and the wages they pay—ultimately lowering demand for good, well-paying jobs. A one standard deviation increase in temperature relative to historical norms (about 0.75°C) is associated with a 3 percent decline in wages in large firms in upper middle-income countries. The impact is more pronounced in firms with limited access to finance and those facing burdensome local regulations—such as long delays in obtaining construction permits needed for climate-resilient infrastructure.

[14] The flood in World Bank (2024) was for 2030. According to the WRI Aqueduct model, flood severity will further increase by 16 percent by 2050. For other impact channels, the scenario assumes the same average values as in Figure 2.12.

3

Navigating Malaysia's Path to High-Income and Sustainable Development through Decarbonization

Photo: © World Bank.

3. Navigating Malaysia's Path to High-Income and Sustainable Development through Decarbonization

Key message #3: It makes strong economic sense for Malaysia to achieve net-zero, but a range of investments and reforms beyond carbon pricing will be needed.

Realizing Malaysia's high-income and sustainability aspirations means reducing emissions, while maintaining economic growth. Such growth since the 1950s was accompanied by a rapid increase in CO_2 emissions, reflecting Malaysia's resource-intensive development model (Figure 3.1a). It is now the 25th largest global emitter, contributing 0.8 percent of global and 15 percent of Southeast Asia's CO_2 emissions. Per capita emissions are more than double the world average and one of the highest in the region (Figure 3.1c). The bulk of these emissions come from the power, land use, and transport sectors (Figure 3.1b).

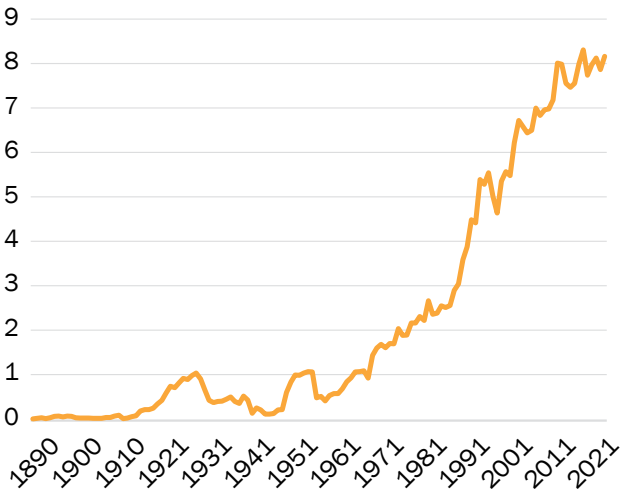
Malaysia must break its reliance on fossil fuels to meet its climate goals and, while plans exist, implementation is key. While fossil fuels constitute more than 90 percent of Malaysia's energy supply, it currently aims to reduce emissions intensity by 45 percent by 2030 (compared to 2005) and reach net-zero emissions by 2050. These targets are supported by the 13th Malaysia Plan and the National Energy Policy 2022–40, with sector-specific plans and the national Long-Term Low Emissions Strategy (LT-LEDS), as well as the Nationally Determined Contribution (NDC) Roadmap. Malaysia's NETR adds further detail on expanding renewable energy, developing green hydrogen and bioenergy, improving energy efficiency, promoting EVs and adopting carbon capture, utilization, and storage (CCUS). A range of sector-specific roadmaps elaborate further on plans for emissions reductions. The electricity industry, particularly fossil fuel power plants, is the primary potential user of CCUS services. Nevertheless, implementation of this technology must be rigorously analyzed to ensure that the cost implications will not burden domestic electricity consumers. Attracting private investment through blended finance and carbon markets will be important. Balancing energy security, affordability, and sustainability will help the country address climate challenges, while creating opportunities for growth and regional collaboration in sustainable industries.

Decarbonization plans must start with the power sector, but all sectors will need to contribute to meeting long-term targets. As the largest source of emissions, and with alternative technologies available, decarbonizing the power sector should be a priority for Malaysia (Section 3.1). Zero-carbon renewable electricity then opens possibilities for electrification in other sectors. Transport remains a major contributor of emissions, driven by fossil fuel-dependent vehicles and inefficient urban mobility systems. A shift toward EVs with a decarbonized grid, robust public transit, and non-motorized infrastructure is needed (Section 3.2). To reach net-zero emissions, it will also be necessary to improve agricultural practices, particularly addressing methane emissions from rice cultivation and livestock, and nitrous oxide from fertilizer use (Section 3.3). Equally vital is addressing emissions from land use, land-use change, and forestry (LULUCF), where deforestation, peatland degradation, and unsustainable land conversion have led to significant carbon loss (Section 3.4). The manufacturing sector faces its own challenges (Section 4), but emissions from construction and building materials could be reduced through improved regulations (Section 3.5). Some sectors face specific challenges (Section 3.6).

The decarbonization scenarios developed for this CCDR underscore the need for substantial investments in power generation, transport, agriculture, land use change and forestry, buildings and waste. The High Ambition (HA) scenario shows one potential route to achieving deep emission reductions. By coupling sector-specific policies with an economy-wide carbon tax, it gets close to meeting the net-zero target (Section 3.7). It finds that frontloading investments in renewables, grid upgrades, and sectoral reforms will be critical to minimizing long-term economic risks and locking in sustainable growth. There need not be negative effects on people (Section 3.8) and the risks of taking action to reduce emissions are much smaller than those of not taking action (Section 3.9).

Figure 3.1. Malaysia's emission challenge

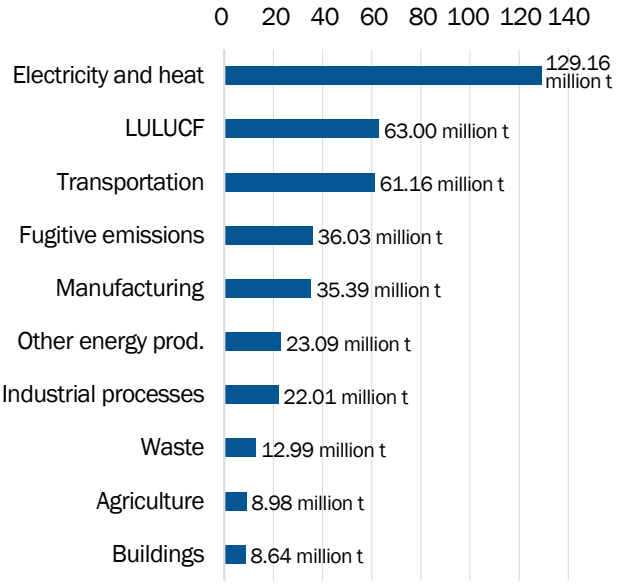
3.1a. *Per capita CO_2 emissions (tCO_2/person)*



Note: Carbon dioxide (CO_2) emissions from fossil fuels and industry. Land-use change is not included.

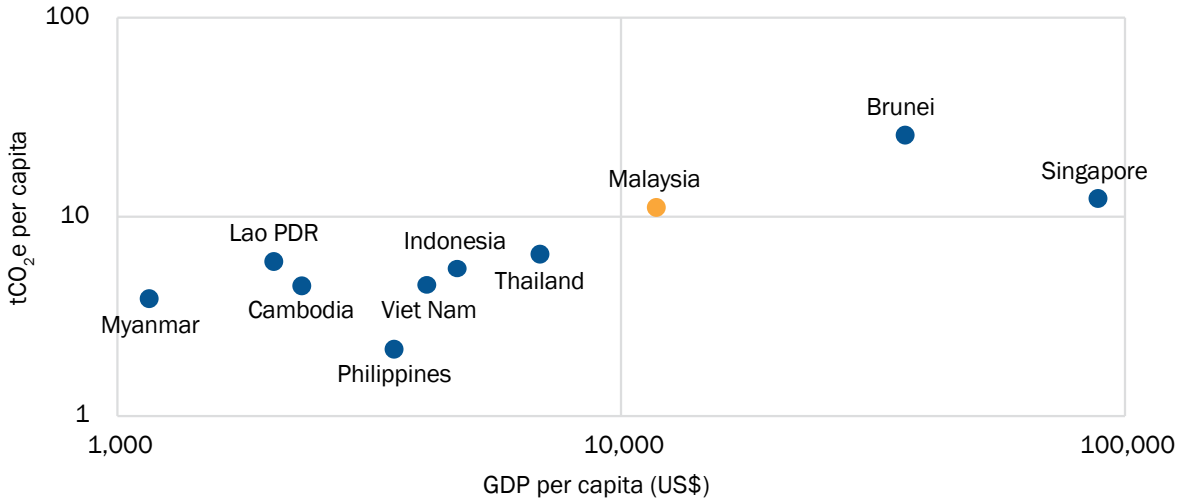
Source: Global Carbon Budget (2024). Population based on various sources (2024)

3.1b. *Greenhouse gas emissions by sector ($MtCO_2e$/year)*



Source: Climate Watch (2023)
Note: t = tons

3.1c. *Malaysia's emission intensity compared to ASEAN peers (2022)*



Source: WDI and ClimateWatch database

3.1. Power sector

Malaysia's power sector faces a dual challenge: surging industrial demand—driven by energy-intensive sectors—amid a heavy reliance on imported fossil fuels that leave the country vulnerable to global price volatility and supply shocks. Policy uncertainty, slow renewable uptake, and regional grid constraints further raise costs, deter investment, and threaten industrial competitiveness at a time when Malaysia is striving to attract high-value industries and meet its climate goals. Without faster grid modernization and a decisive

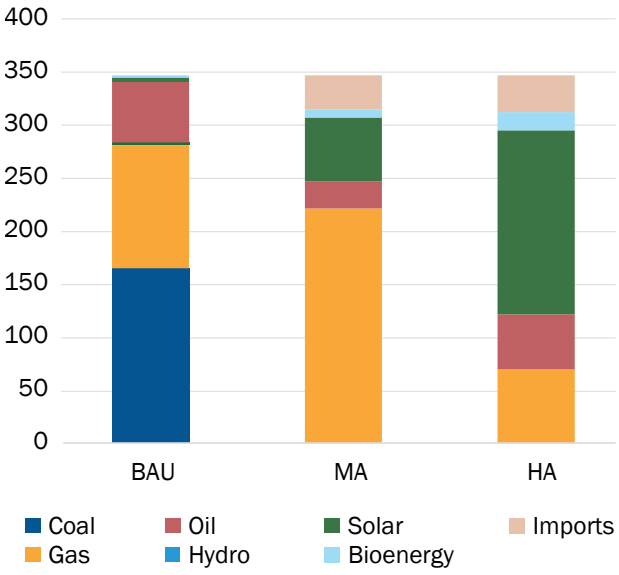
renewable energy rollout, electricity costs will rise and undermine both economic resilience and Malaysia's position in the global energy transition.

Electricity demand is set to expand rapidly with increased electrification of end-uses. While the power sector is already Malaysia's largest CO_2 emitter, annual electricity consumption could double by 2050 in part driven by data centers (Box 3.1), with the country also exporting electricity (mainly to Singapore). Electricity demand is primarily concentrated in Peninsular (West) Malaysia, where most of the nation's population and industries are located, and existing interconnections with neighboring countries are established. Malaysia faces a critical choice between maintaining its reliance on fossil fuels or embracing a cleaner energy pathway that offers long-term economic and environmental benefits. Analyses by the World Bank and other institutions have highlighted the viability of a renewable-led transition, which could boost economic growth if supported by robust policy frameworks and infrastructure investments. Building on this work, the CCDR outlines three scenarios for the power sector (see Figure 3.2):

- **BAU scenario** maintains Malaysia's current electricity generation mix, meeting rising demand through a mix of fossil fuels and limited renewables. Power sector emissions increase from 114 $mtCO_2$ in 2023 to 194 $mtCO_2$ by 2050, reflecting continued dependence on coal and gas.
- **Moderate Ambition (MA) scenario** is aligned with Malaysia's NETR and LT-LEDS. It reaches 70 percent renewable capacity (but only 27 percent generation) by 2050. It features gradual emissions reductions, emphasizing grid upgrades and phased coal retirement.
- **High Ambition (HA) scenario** reaches 90 percent renewable capacity and 70 percent generation by 2050. It prioritizes rapid scaling of solar, wind, and hydropower, alongside energy storage and grid flexibility.

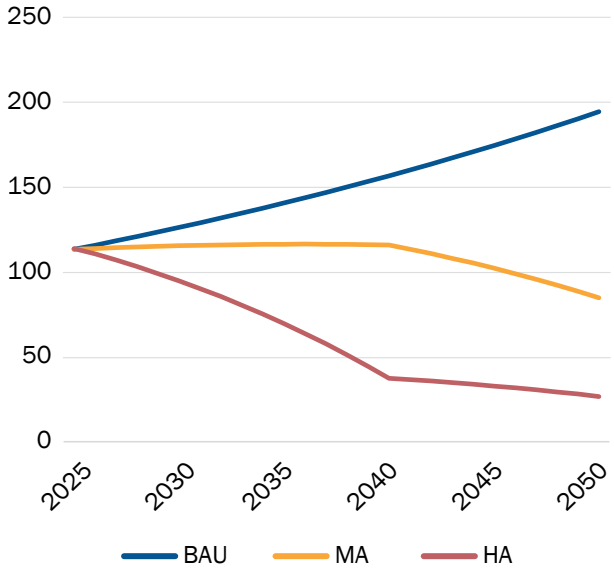
Figure 3.2. Power sector generation and emissions in each scenario, 2050

3.2a. *Generation (TWh)*



Source: World Bank staff calculations

3.2b. *Emissions ($mtCO_2$)*



Source: World Bank staff calculations

A successful transition hinges on policy consistency, financing mechanisms, and cross-sector collaboration. Under the MA scenario, Malaysia's energy transition hinges on phasing out coal-fired power by 2040 (Figure 3.2b). Natural gas retains a significant role, evolving into a flexible backup source for renewables. Although there is a high renewable share of capacity, intermittency means that gas provides 64 percent of generation. By 2050 there is a 25 percent reduction in power sector emissions, but use of gas limits further emissions reductions. In contrast, the HA scenario represents a bold leap in Malaysia's clean energy ambitions. Solar photovoltaics (PV) are the cornerstone of the transition, leveraging Malaysia's abundant solar resources and declining technology costs. Solar farms and rooftop installations are complemented by hydropower and biomass generation. Potential wind or geothermal projects could further diversify the renewables portfolio. Large-scale battery storage systems are deployed to ensure grid stability and reliability. Investments in new transmission or upgraded transmission lines will also be needed to integrate the renewable energy outputs with the grid. Coal is phased out completely and there is a minimized role for gas. While requiring substantial upfront investments in infrastructure and storage, the HA scenario allows Malaysia to reduce power sector emissions by 74 percent by 2050.

Any national oil, gas, and coal transition strategy must balance robust domestic energy transition policies with a pragmatic approach to export strategies, recognizing the complex fiscal and resilience challenges posed by fossil fuel dependence. Domestically, Malaysian policies should focus on up-scaling renewables and establishing clear timelines for phasing-out coal, capitalizing on the upcoming expiration of numerous coal power purchase agreements over the next decade as a strategic window to accelerate the adoption of clean technologies. Internationally, export strategies should navigate volatile global markets, while prioritizing the maximization of fiscal returns from ongoing fossil fuel sales. Revenues from these exports can be deployed to fund economic diversification, spur catalytic investment into green sectors and enhance climate adaptation, thereby strengthening Malaysia's long-term fiscal resilience.

Malaysia's electrical grid is currently a bottleneck for renewable energy ambitions. Grid congestion, which is already delaying large-scale solar projects, could derail plans to expand renewable capacity (WWF-Malaysia and BCG Malaysia, 2021). Increasing capacity and modernizing transmission infrastructure is urgently needed to support higher renewable energy integration in Peninsular Malaysia, the country's main demand center. In parallel, strengthening interconnection infrastructure and enabling cross-border electricity trading would create additional opportunities to balance supply and enhance system flexibility through regional partnerships. Additionally, cross-border electricity trading infrastructure could be further developed to allow more opportunities to balance supply through regional partnerships. Ensuring that near-term grid enhancement can take place is, therefore, a priority to support the low-carbon transition. Malaysia's rapid data center expansion is set to drive a surge in electricity demand, potentially putting significant pressure on the national grid and requiring major investments in generation capacity and infrastructure upgrades to avoid disruptions and rising costs for other users (see Box 3.1).

More than US$100 billion will be needed to finance the full transition, but total costs could fall. Estimates prepared for this report suggest that renewable energy investment needs during 2025–50 would be US$41.8 billion (BAU), US$59.8 billion (MA) and US$140.9 billion (HA).[15] According to the NETR, a further US$39 billion will be required in grid investment under all scenarios. Other NETR investments in hydrogen (US$50 billion) and CCUS (US$38 billion, see Box 3.2) may also be partly attributable to the power sector, while energy efficiency investment (US$19 billion) will be required in the HA scenario to keep electricity demand in line with projections. However, despite high investment costs, total system costs are lower in the HA scenario than MA scenario due to greatly reduced fuel consumption. The overarching challenge now is access to finance to enable future cost reductions (Section 6).

[15] Figures are non-discounted. The MA scenario results closely match NETR estimates. At a 6 percent discount rate, the respective figures are US$23.5 billion, US$28.8 billion, and US$70.4 billion.

Box 3.1. Emerging challenges and opportunities in Malaysia's data center landscape

Malaysia's data center industry is expanding rapidly, positioning the country as a leading digital hub in Southeast Asia. Backed by initiatives such as MyDIGITAL, strong tax incentives, high digital readiness, and a strategic geographic location, Malaysia attracted more than US$23 billion in private investment in 2024, led by major cloud and AI players including AWS, Google, and Microsoft. Johor and Selangor have emerged as key hubs, driving digital infrastructure growth nationwide.

Government support through investment allowances, fast-track approvals, and emerging planning frameworks has further boosted investor confidence. Malaysia's competitive edge lies in affordable energy tariffs, land availability, and infrastructure readiness, with new facilities showcasing world-class energy efficiency.

Yet, the sector's rapid growth is straining power and water infrastructure and heightening environmental pressures. Transmission constraints—especially in Johor—and high water use for cooling (around 40 percent of operating costs) highlight the need for a more sustainable growth model.

To sustain momentum, there is a critical need for predictable regulation, stronger inter-agency coordination, and sustainability-linked incentives. Developing an integrated green data center strategy—aligned with international best practices such as Singapore's Green Data Centre Roadmap and the EU's Energy Performance Standards—could harmonize policies, enhance transparency, and promote lifecycle environmental management.

With sustainability-linked financing, green loans, and ESG disclosures gaining traction, Malaysia can leverage this transition to balance digital expansion with environmental stewardship, consolidating its position as a regional leader in the data-driven and low-carbon economy.

Sources: Technavio (2025), Maybank (2024) and Research and Markets (2024). Green Data Centers: Toward a Sustainable Digital Transformation. A Practitioner's Guide (World Bank, 2023).

Energy efficiency is widely recognized as the 'first fuel' in an energy transition. As such, it provides a cost-effective and immediate way to reduce energy demand, lower GHG emissions, and improve system reliability. Enhancing efficiency across industrial, commercial, and residential sectors can also reduce operational costs, defer the need for new generation capacity, and complement investments in renewable energy and low-carbon technologies. Policy measures should include mandatory efficiency standards, incentives for retrofits and clean technologies, capacity-building programs, and public awareness campaigns. By prioritizing energy efficiency, Malaysia can achieve faster, more affordable, and more resilient decarbonization outcomes.

Malaysia's green hydrogen ambitions will not become commercially viable without addressing cost and infrastructure barriers. Current production costs, ranging from US$10–15/kg, remain significantly higher than fossil-based alternatives, largely due to high electrolyzer costs, electricity prices, and lack of transport and storage infrastructure. While flagship projects in Perak, Sabah and Sarawak are advancing, sustained progress will depend on securing competitively priced renewable energy, building long-term offtake contracts, and implementing a Guarantee of Origin certification aligned with global standards. Without these enablers, Malaysia may struggle to meet its production target of 2.5 MTPA by 2050 as stipulated under the Hydrogen Economy Transition Roadmap or compete in export markets increasingly driven by carbon accountability.

Box 3.2. Malaysia's CCUS ambitions

Malaysia is positioning itself as a regional leader in carbon capture, utilization, and storage (CCUS), supported by the passage of the CCUS Act 2025, generous investment tax incentives, and ambitious targets to develop multiple CCUS hubs leveraging offshore geology and existing oil and gas infrastructure. These efforts align with the NETR, are supported by regional partnerships and planned carbon pricing reforms, and aim to store up to 80 MTPA of CO_2 and decarbonize key sectors by 2050, as exemplified by the Petronas Kasawari project, which reduces emissions from the hydrocarbon sector while advancing the energy transition.

Despite its potential, private sector investment in CCUS remains limited due to weak financial incentives and opaque revenue streams. Unlike renewable energy projects, which benefit from feed-in tariffs, tax credits, and declining costs, CCUS lacks a strong economic case without government-backed incentives.

Another financial challenge is the uncertain market demand for captured CO_2. Unlike in some regions where captured carbon is used for synthetic fuels, chemicals, or carbonated materials, Malaysia's primary commercial use case for CO_2 remains Enhanced Oil Recovery. This limits the economic viability of CCUS, as industries lack alternative revenue-generating applications for the captured emissions. To improve the business case, Malaysia must explore new CO_2 utilization pathways, such as producing low-carbon fuels, sustainable building materials or advanced industrial applications. Expanding these markets will be crucial to making CCUS a financially sustainable decarbonization solution.

However, the scalability of CCUS includes technological uncertainty, high capital costs – particularly in the capture of CO_2 – underdeveloped transport and storage infrastructure as well as fragmented regulatory frameworks, including full alignment with international standards on transboundary CO_2 transport and storage. Sabah and Sarawak are excluded from the national bill, complicating national coordination and cross-border investment. Environmental and social impacts from potential leakages are substantial. Various studies indicate a high likelihood of such events and even measures to mitigate these risks—such as insurance coverage—entail significant costs. This underscores the need for careful risk assessment and robust preventative strategies.

Source: Background note, dated April 2025, for the Malaysia Country Climate & Development Report

This report recommends:

- **Accelerate an orderly and low-cost energy transition** by proactively upgrading transmission networks—especially in peninsular Malaysia as the country's demand center—with digital monitoring, battery storage, and flexible demand management, while shifting from reactive project approvals to holistic grid mapping that resolves congestion before it emerges. In parallel, undertake a structured plan to manage the rise in stranded asset coal-fired power plants through mechanisms such as early retirement pathways, securitization or blended-finance instruments, contract renegotiation, and repowering options, supported by deeper integration with the ASEAN power grid to lower balancing costs, improve system flexibility, and maintain long-term energy security.
- **Liberalize power markets via third-party access and corporate PPAs** to attract private renewables investments. Phase-out fossil fuel subsidies in favor of targeted assistance for vulnerable groups, implement cost-reflective tariffs, and set a clear coal exit roadmap with carbon pricing to signal long-term decarbonization.

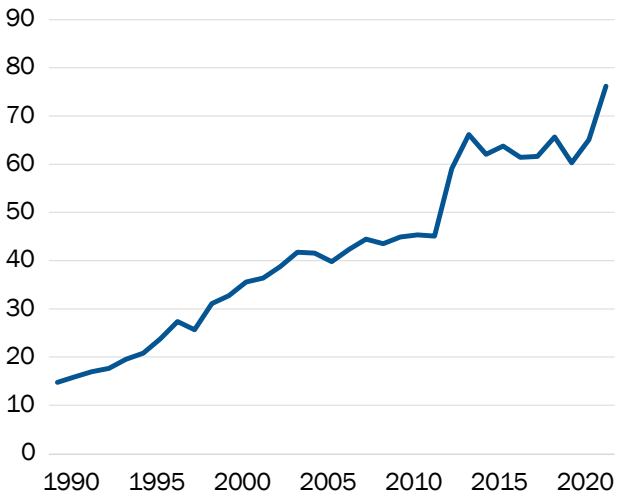
- **Establish a sovereign fund or targeted fiscal mechanism to channel windfall revenues from fossil-fuel exports into priority areas that enable structural economic transformation** — especially green infrastructure, workforce upskilling, and technology innovation. Redirecting temporary gains from oil, gas, and coal into a permanent, transparent vehicle ensures those resources are strategically reinvested to build long-term resilience, diversify the economy, and scale low-carbon sectors. Malaysia's NETR provides a strong foundation for this approach as it combines grants, incentives, and dedicated transition funds to attract private capital, create green jobs, and finance strategic reskilling — positioning the country to capture both climate and economic benefits as it advances its energy transition.
- **Establish a prime minister-led inter-agency task force** to break jurisdictional bottlenecks and align policies with NETR or a more ambitious transition. Build regulator and utility capacity in renewables integration and deploy an energy transition dashboard with robust monitoring, reporting, and verification frameworks for data-driven accountability.

3.2. Transport sector

Malaysia's transport sector is undergoing modernization through expanded public transit and the adoption of digital and green innovations, improving efficiency and inclusiveness. Nonetheless, challenges persist with urban congestion, limited mobility access in peri-urban and rural areas, and the gradual adoption of climate-friendly vehicles continuing to constrain development objectives. Sustained investment in digital fleet management, smart ticketing, alternative fuels, and integrated transport planning are essential to achieve more sustainable and equitable transport outcomes nationwide.

Malaysia's transport sector is a significant contributor (14 percent) to national emissions, mostly from road transport. To underscore the point, Malaysia's per capita transport emissions not only exceed both global and regional averages, they have also exhibited a sustained annual growth rate of 2.6 percent since 2000 that highlights the sector's disproportionate and persistent contribution to the country's overall emissions trajectory (Figure 3.3). This sustained rise underlines the urgent need for targeted policies and investments to decouple mobility demand from emissions and position the sector for low-carbon transformation. Heavy reliance on cars and motorcycles has led to one of the world's highest motorization rates (1,021 vehicles per 1,000 people) and road transport accounting for 89 percent of total transport emissions (Asian Transport Outlook, 2024). This dependency highlights systemic issues in urban planning, public transit accessibility, and sustainable mobility infrastructure.

Figure 3.3. Transport GHG emissions ($mtCO_2e$)



Source: EDGAR database

Decarbonizing the transport sector requires the systematic implementation of 'Avoid-Shift-Improve' (ASI) principles. '*Avoid*' strategies eliminate or reduce travel distances and frequency through transit-oriented development, transport demand management, and compact urban growth to create dense, mixed-use neighborhoods that encourage walking and public transport. '*Shift*' focuses on moving people and goods to lower-emission modes like public transit, cycling and rail, supported by integrated, multimodal transport

planning. '*Improve*' aims to cut emissions per kilometer by boosting fuel efficiency and adopting low- or zero-emission vehicles. For Malaysia—with high transport emissions, a high motorization rate and ambitious EV and public transport targets—this CCDR emphasizes '*Improve*' strategies, exploring scenarios based on different rates of EV adoption and fuel efficiency improvements.

EV adoption rates in Malaysia lag behind regional leaders, such as Thailand and Viet Nam. EV sales in 2023 rose by 286 percent to 10,159 units, driven by government incentives like tax exemptions and the Low Carbon Mobility Blueprint (LCMB) (MGTC, 2024). However, the share of EVs in four-wheeled vehicle sales was just 4.9 percent (18.4 percent including hybrids). Persistent challenges include range anxiety and underdeveloped charging infrastructure. Malaysia's vehicle-to-public-charge-point ratio of 20.7 exceeds the global average (15.3) and is well behind peers like Singapore (2.9) and China (7.5). Closing this gap requires accelerated charging network expansion, affordability measures, and policies to boost consumer confidence in battery EVs (Roland Berger, 2023).

Malaysia has published ambitious plans to support the transition to green mobility. The LCMB assesses energy and GHG mitigation options in the transport sector and outlines strategies across four focus areas to support the decarbonization of land transportation: (i) vehicle fuel economy and emission improvement, (ii) EV adoption, (iii) alternative fuel adoption and (iv) mode shift to public transport (MGTC, 2021). The National Energy Policy 2022–40 puts forward a Low Carbon Nation Aspiration 2040, which includes various sectoral targets, including on urban public transport modal share, EV penetration, and alternative lower carbon fuel in heavy vehicles (Economic Planning Unit, 2022). The NETR also has a focus on green transport.

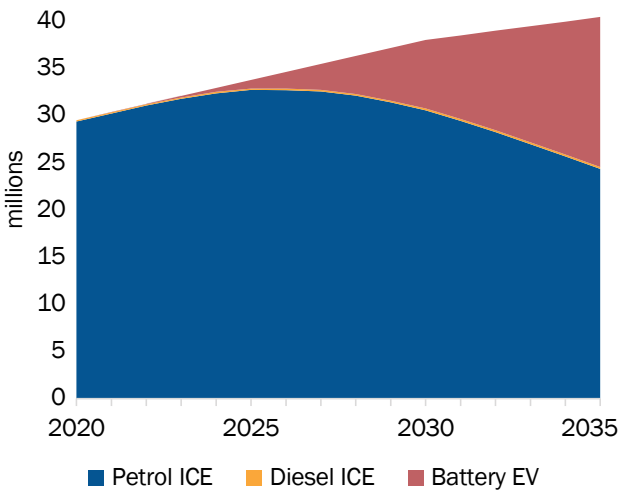
Malaysia has also introduced a phased, multi-tiered tax incentive framework to accelerate EV manufacturing and adoption. Tax exemptions for investment in EVs, energy-efficient vehicles, and charging equipment are evident, while EV owners will receive road tax exemptions in 2026 and income tax relief for home charging installations or subscriptions until 2027. Imported completely-built-unit (CBU) EVs were exempt from import and excise duties until the end of 2025, while domestically-produced EVs retain full exemptions from import/excise duties and sales tax until 2027. Starting in 2026, Malaysia is implementing a staggered tax structure, with EV tax rates set 85 percent lower than fossil fuel powered vehicles. This policy is designed to sustain long-term affordability and competitiveness.

The three scenarios include the following transport sector measures:

- **BAU scenario assumes no major policy changes.** Current trends continue and there is no active government intervention in electrification or fuel economy. There is minimal EV adoption and marginal fuel efficiency gains, driven solely by market or technological inertia.
- **Moderate Ambition (MA) scenario** aligns with Malaysia's NDC commitment and strategic plans (DTN, LCMB, NETR). Active government intervention accelerates electrification and fuel efficiency. It enforces CO_2 emissions standards of 95g/km by 2030. The scenario prioritizes regulatory measures, like stringent fuel economy standards.
- **High Ambition (HA) scenario** introduces much higher electrification rates. Public procurement drives early EV adoption and stringent fuel economy standards reduce emissions from other vehicles. The scenario depends on rapid scaling of charging infrastructure, grid modernization, and cross-sector collaboration.

Even under the HA scenario, petrol cars will dominate the fleet up to 2035. While the total vehicle stock grows in all scenarios, under the BAU scenario, EVs show minimal penetration. In contrast, under the HA scenario, the share of EVs in new vehicle sales reaches 18 percent for four-wheelers, 16 percent for buses, and 20 percent for two- and three-wheelers by 2030. By 2050, EVs account for 83 percent of new sales of four-wheelers, and 90 percent of two- and three-wheelers (see Figure 3.4). All new buses are electric, which is a substantial increase against the MA scenario.

Figure 3.4. Vehicle stock, HA scenario



Source: World Bank staff estimates

Emissions from vehicle manufacturing and use could be reduced by 68 percent compared to the BAU scenario. The BAU and HA scenarios show modest reductions in GHG emissions by 2030, with the latter's slightly larger. However, by 2040, emission reductions under the HA scenario are more significant. By 2050, total emissions from vehicle manufacturing and use could be cut by more than 50 percent (see Table 3.1).

Table 3.1. Reduction in GHG emissions compared to BAU (% decrease)

	2030	2040	2050
MA scenario	7.5	27.8	51.8
HA scenario	8.1	44.7	68.1

Note: Figures include emissions from both vehicle manufacturing and use
Source: World Bank staff calculations

Measured by total cost of ownership (TCO), which includes fuel and maintenance costs, EVs are already cheaper to buy than Internal Combustion Engine (ICE) counterparts – even more so if externalities are included. It is already economic for many drivers to buy EVs. For cars, existing tax incentives further lower EV costs, and declining capital costs will continue to strengthen this advantage, even with petrol cars becoming more efficient. According to model estimates, electric buses are expected to reach TCO parity by 2030 and become cheaper by 2035. EV adoption in Malaysia also yields substantial air quality gains. EV adoption reduces local NOx and PM2.5 emissions. If these externalities are added into TCO calculations, from a societal perspective, the benefits of electrifying transport become even greater.

By 2030, most public sector investment required to drive Malaysia's EV transition will focus on expanding public charging infrastructure for three- and four-wheelers. Under the HA scenario, additional investment of US$2.4 billion would be needed by 2030 and from 2025 to 2030, total cumulative investment would be US$7.5 billion. Most costs lie in charging infrastructure, with a large public share (US$1.6 billion). Fiscal balances will also be impacted by reductions in vehicle tax revenues and changes in fuel and electricity subsidies.

This report recommends:

- **Fast-track public-private partnerships** to close the 3,300-station gap and achieve 10,000 EV chargers by 2035. Prioritize DC fast chargers along highways and AC chargers in urban hubs, leveraging RM81.3 million in recent investments and tax incentives for home installations. Private sector participation through PPP arrangements can be explored to mitigate the impact on State fiscal balances arising from expanding charging infrastructure nationwide.

- **Set strict efficiency standards** to retire inefficient internal combustion engine (ICE) vehicles, potentially cutting 16.2 billion liters of petrol and 37.6 million tons of CO_2 by 2030, and combine with penalties for non-compliance to drive automakers' transition.
- **Use RM4 billion in annual national savings from diesel subsidy reforms** to scale EV purchase rebates, charging infrastructure, and targeted support for low-income households. Level the playing field for EVs against artificially cheap liquid fuels.
- **Replace diesel buses with electric models on high-frequency routes,** supported by grid upgrades and depot charging. Align with Prasarana's fleet electrification plans and leverage procurement policies so EVs comprise half of public sector vehicles by 2035. [16]
- **Extend tax rebates,** import duty waivers, and RM2,500 per year home charger subsidies beyond 2027. Publish a 10-year roadmap aligning incentives with manufacturing goals to attract investors and stabilize the EV market.

3.3. Agriculture sector

While agriculture accounts for only 2.2 percent of Malaysia's GHG emissions, reductions are possible through adoption of precision technologies and nitrogen-smart practices. Within the agriculture sector, rice cultivation is the largest source, accounting for 2,499.50 Gg CO_2-eq or 34.2 percent of agricultural emissions, followed by direct N_2O emissions from managed soils, which contributed 2,201.35 Gg CO_2-eq or 30.1 percent.[17] The largest share of agricultural emissions comes from synthetic fertilizers and soil practices, whose use grew substantially in the early 2000s. Since then, emissions from fertilizers and livestock have been broadly constant. Digital tools like Internet of Things (IoT) sensors and AI analytics enable precise input application, while alternate wetting and drying (AWD) irrigation in rice cuts methane by 50 percent.[18] Drone-based nutrient mapping in oil palm reduces N_2O by 20–30 percent[19] and shifting to neem-coated urea (proven to lower N_2O by 35 percent in Selangor), biochar soils, or leguminous cover crops curbs synthetic dependency and enhances nitrogen efficiency.

Efforts to reduce national agricultural emissions must also address food security concerns. The National Agrofood Policy 2021–30 provides a vision for the agriculture sector with its primary focus points being food security and economic growth. However, it also aims for a sustainable, resilient and technologically advanced sector. The climate segment of this policy could be strengthened to incorporate binding GHG reduction targets or carbon pricing mechanisms for high-emission inputs like fertilizers. This integration is critical for ensuring that climate goals align with other national priorities like food security.

Agricultural waste represents both a GHG liability and an untapped resource for Malaysia. Diverting organic waste (from oil palm biomass, rice straw, and livestock manure) away from open burning (which produces GHG and local air pollutants) toward anaerobic digestion or composting could reduce emissions, while generating economic value. For example, palm oil mill effluent (POME), traditionally a methane-emitting

[16] Prasarana Malaysia Berhad is a government-owned company responsible for owning and operating Malaysia's major urban public transport systems, including rail networks (LRT, MRT, monorail) and stage bus services in Kuala Lumpur, Selangor, Penang, and Pahang. As a leader in public transportation, Prasarana is advancing mobility by integrating, modernizing, and expanding both rail and bus services nationwide to provide seamless, reliable transit for millions of daily commuters.

[17] Malaysia's First Biennial Transparency Report submitted to the United Nations Framework Convention on Climate Change (UNFCCC).

[18] The Alternate Wetting and Drying (AWD) technique is already being promoted in Malaysia as a CSA practice for rice cultivation. It has been shown to reduce methane (GHG) emissions and water use, while maintaining yields.

[19] As documented by the Intergovernmental Panel on Climate Change and confirmed in extensive field studies across Asia.

waste, can be processed in biogas digesters to produce renewable energy, potentially offsetting 5–7 percent of Malaysia's fossil fuel needs. Similarly, converting rice husks into biochar for soil amendment sequesters carbon and could reduce N_2O emissions by 12–15 percent. Scaling such circular models requires public-private partnerships like Sime Darby's pilot projects converting plantation waste into bioenergy, which have reduced emissions by 10 percent in participating estates.[20]

Malaysia's biomass sector offers a strategic pathway to scale renewable energy and circular industries. The sector takes 94.7 million tons of annual agricultural residues according to the National Biomass Action Plan 2023, primarily palm oil byproducts like Palm Oil Mill Effluent (POME) and Empty Fruit Bunches (EFBs). Current initiatives, including biogas plants and coal co-firing trials, align with the National Biomass Action Plan's 2030 targets to expand capacity to 1.4GW and diversify into high-value products like sustainable aviation fuel. However, fragmented supply chains, opaque pricing, and capital barriers hinder progress. Prioritizing policy coherence, clustered development in resource-rich states (such as Sabah), and revitalized incentives like Feed-in Tariffs could unlock biomass's role in a resilient, low-carbon transition.

This report recommends:

- **Codify emission reductions and resilience criteria in the National Agrofood Policy 2021–30**, mandating sector-specific climate benchmarks for rice, oil palm, and livestock to align food security with decarbonization.
- **Promote rice straw management as a key mitigation strategy** to reduce GHG emissions from rice cultivation, enhancing both environmental sustainability and climate resilience in the sector.
- **Deploy targeted training and extension services** to equip 500,000 farmers with IoT sensors, drone mapping, and AI-driven irrigation knowledge by 2030, slashing fertilizer and water waste by 30 percent while maintaining yields.
- **Subsidize slow-release and neem-coated urea for smallholders** and integrate these into paddy subsidies, cutting N_2O emissions by 35 percent without yield losses. Expanding farmer education and demonstration plots will accelerate adoption and reduce input costs.
- **Launch a national roadmap to convert crop residues and livestock waste into bioenergy and compost by 2030**, reducing methane emissions and generating RM200 million in rural incomes annually from waste valorization. Replicate successful pilot programs in Malaysia for enhanced-efficiency fertilizers and strengthen farmer capacity-building initiatives to reduce nitrogen losses while maintaining yields, particularly in the rice and oil palm sectors.

3.4. Land use, land use change and forestry sector

Malaysia's land use and forestry sector plays a critical role in supporting economic development, providing timber, palm oil and other commodities, while contributing to livelihoods and rural incomes. However, land use changes, deforestation, and unsustainable agricultural practices pose significant environmental and economic risks, including biodiversity loss, carbon emissions, and soil degradation.

Malaysia's LULUCF sector is also a major source of GHG emissions, primarily due to deforestation and peatland degradation driven by agricultural expansion, especially oil palm cultivation. Between 2001 and 2021, the country lost 29 percent of its primary forests, largely to logging, palm oil, and infrastructure. Tropical peatlands—which store 20 times more carbon per hectare than mineral soils—are critically threatened, while drainage and conversion release large amounts of CO_2 through oxidation and methane from

[20] Sime Darby is one of Malaysia's largest multinational conglomerates, primarily engaged in the automotive and industrial equipment sectors and operates across Asia-Pacific, with its headquarters in Kuala Lumpur.

decomposition.[21] Peatland degradation alone contributes 50–60 percent of Malaysia's LULUCF emissions, releasing 55–65 mtCO_2q annually. Oil palm plantations, covering 19 percent of agricultural land, drive more than 80 percent of deforestation-linked emissions, causing 90–95 percent carbon loss in converted forests and biodiversity declines.[22] Fires for land clearance in peat-rich regions like Sabah and Sarawak further exacerbate emissions and air pollution. In line with government policy, a national directive announced in 2023 stipulates that there will be no new land clearing or deforestation for oil palm plantations, reinforcing Malaysia's commitment to sustainable production and protecting existing forests.

The government has outlined ambitious targets to curb emissions, including maintaining 50 percent forest cover under the National Forestry Policy 2021–30 and rewetting 100,000 hectares of degraded peatlands by 2030. The area for palm oil cultivation has been capped at 6.5 million hectares as of 2019. Obtaining Malaysian Sustainable Palm Oil (MSPO) certification is now compulsory for all palm oil activities in Malaysia, including those conducted by smallholders, as mandated by the government since 2020. Initiatives like the REDD+ Strategy aim to monetize conservation through carbon credits, while MSPO certification mandates protection of high-carbon forests and peatlands. However, weak enforcement of logging moratoria, limited funding, and jurisdictional complexities have stalled progress. Only 15 percent of degraded peatlands have been restored since 2016, and MSPO's potential 35 percent emission reduction by 2030 hinges on rigorous adoption. Despite commitments like the Glasgow Leaders' Declaration on Forests and Land Use to halt forest loss by 2030, institutional fragmentation and inadequate monitoring persist.[23]

Land tenure insecurity for Indigenous communities—particularly in Sabah and Sarawak—undermines forest governance and conservation efforts.[24] Customary land rights remain contested, with State policies often prioritizing plantations and logging over Indigenous sovereignty, exacerbating deforestation. Addressing this requires participatory land surveys and legal recognition of Indigenous territories to align conservation with community rights. Concurrently, scaling climate-smart interventions—like phased deforestation elimination, the System of Rice Intensification methodology (reducing methane by 8–10 percent), and rehabilitating 100,000 hectares of degraded land—could offset 110 mtCO_2 annually by 2050. These measures would preserve carbon sinks, enhance ecosystem services, and support long-term climate resilience while advancing equity.

A mix of land use reforms could save 2.5 billion tCO_2 by 2050 and boost GDP. For this CCDR, a scenario with the following policies was modelled: a gradual elimination of deforestation, a boost to rice productivity through the System of Rice Intensification, and the establishment of 100,000ha of forest plantations. The result is a large reduction in forest loss (Figure 3.5a) and potential large potential emission savings (Figure 3.5). Key ecosystem services—including climate regulation, erosion mitigation, water regulation, and crop pollination—would be substantially improved, especially in ecologically sensitive states like Kelantan, Sabah and Terengganu. Cumulative GDP and wealth would also be boosted by US$44.5 billion and US$45.3 billion, respectively, with forest plantation investments offering the highest returns.

[21] Global Forest Watch (GFW) data for Malaysia.

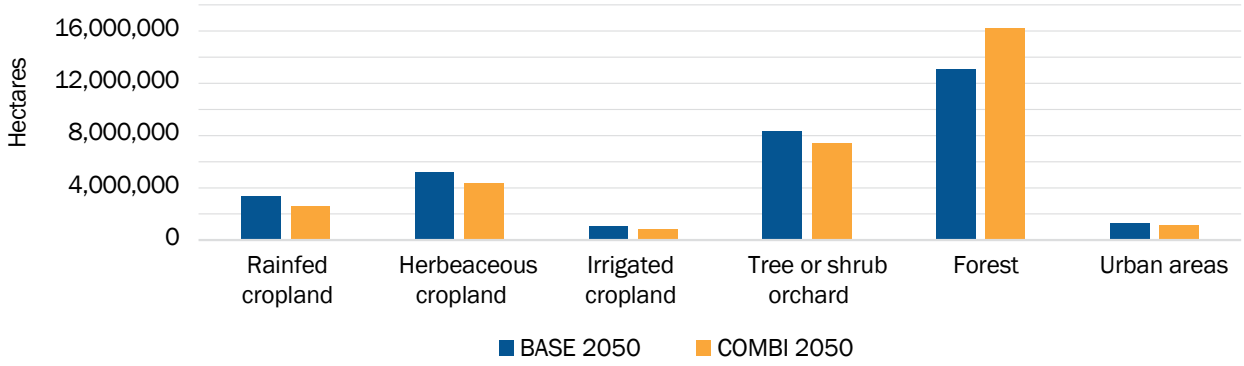
[22] In 2023, the government reaffirmed its no-new-land-clearing or deforestation policy for oil palm, with the Deputy Prime Minister stating that Malaysia would not permit any further expansion of palm oil cultivation into forested areas.

[23] Convention on Wetlands. (2021). Restoring drained peatlands: A necessary step to achieve global climate goals. Ramsar Policy Brief No. 5. Gland, Switzerland: Secretariat of the Convention on Wetlands.

[24] The World Bank has undertaken a Subnational-level Climate Change Institutional Assessment (CCIA) for the states of Sabah and Sarawak, covering these issues in more detail. World Bank (2026).

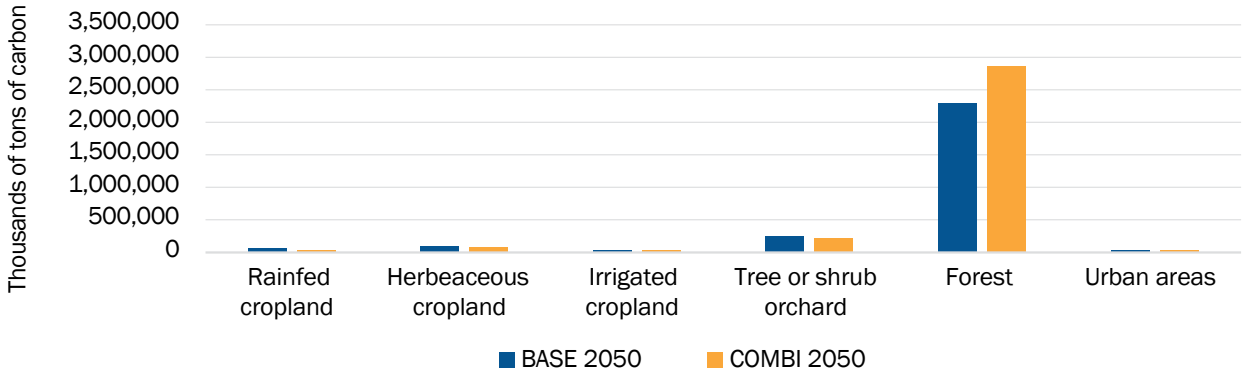
Figure 3.5. Changes in land use land cover and carbon storage by 2050

3.5a. *Land use land cover, hectare*



Source: IEEM+ESM model results

3.5b. *Carbon storage, thousand tCO_2*



Source: IEEM+ESM model results

This report recommends:

- **Strengthening forest governance** through strict enforcement of anti-logging laws, real-time satellite monitoring (e.g., Global Forest Watch), and legal protection for primary forests and high-carbon ecosystems. Strengthen Indigenous peoples' communities via participatory or co-management forest schemes to reduce deforestation and support social inclusion and equity.
- **Require GHG accounting for all MSPO-certified plantations by 2030** with premium pricing for methane capture, peatland conservation, and agroforestry.
- **Scale restoration by rehabilitating 200,000 hectares of degraded forests** and rewetting 500,000 hectares of peatlands by 2030, mitigating 55–65 Mt CO_2eq annually. Integrate these goals into State plans with public-private funding for scalability.
- **Adopt landscape planning to block plantations from high-carbon zones.** Expand MSPO certification to 100 percent of plantations (35 percent emissions cut) and promote agroforestry (e.g., cocoa-oil palm systems) to boost carbon sequestration by 20–30 percent and diversify incomes.
- **Accelerate climate finance by finalizing REDD+ strategies**, developing carbon projects (e.g., Sarawak), and taxing deforestation-linked agribusinesses to fund peatland restoration. Build Tier 3 emissions tracking and a National LULUCF Registry to strengthen carbon market credibility.

- **Fully register Indigenous forest land tenure and fund community-led agroforestry, eco-tourism**, and AI-driven deforestation monitoring. Public data sharing on peat drainage and forest health will ensure accountability and align climate action with social equity.[25]
- **Institutionalize ecosystem service valuations in national planning** to better reflect the true value of nature in economic decision-making.

3.5. Buildings sector

Malaysia's buildings sector is a key driver of economic growth, supporting construction, real estate, and urban development. Resilient, climate-smart infrastructure boosts economic growth by reducing disaster costs and improving efficiency, while enhancing social well-being through safety, health, and equitable access to services.

Malaysia's buildings contribute 27 percent of national emissions, with 24 percent from embodied carbon in cement and steel production. While operational emissions from buildings are less, they have grown by 104 percent since 2005 to outpace national emissions growth. This trend is compounded by the construction sector's rapid expansion (22.9 percent growth in 2024), driven by residential and commercial demand. Without intervention, projected 9 percent annual growth in the construction sector to 2034 will intensify emissions, exposing regulatory gaps and market hesitancy.[26]

The absence of mandatory performance disclosure stifles progress, while adoption of green certification frameworks remains limited. The Energy Efficiency and Conservation Act 2023 was enacted to require designated facilities to conduct regular energy audits and implement mandatory energy-efficiency improvement plans. However, there is no unified emissions accounting framework for construction materials, and manufacturer incentives for sustainable alternatives (e.g., recycled concrete). Limited awareness persists due to opaque building performance data and no national registry, hindering peer learning and policy accountability. Multiple voluntary standards confuse developers and the absence of nationally adopted or recognized certification for green buildings has resulted in only 4.5 percent of buildings being certified as "green". High upfront costs of green certification often deter small-scale projects, while financing focuses on new buildings. The Climate Change and Principle-based Taxonomy is still underdeveloped, and Uniform Building By-Law regulations exclude buildings under 4,000sqm, leaving smaller developments without efficiency mandates or support.[27]

A holistic policy overhaul is critical to slash emissions from buildings. For the construction phase, Malaysia must mandate low-carbon material innovation (e.g., recycled concrete, bamboo), circular design principles, and rigorous emissions accounting across the building lifecycle. This requires financial incentives for sustainable materials and manufacturer support for green technologies—currently absent, stifling green supply chains, despite rising demand (Box 3.3).

[25] See World Bank (2025) and recent World Bank-financed projects such as Indonesia Integrated Land Administration and Spatial Planning Project (P180860) and Lao PDR Enhancing Systematic Land Registration Project (P169669).
[26] GHG Emissions for Construction Industry by Malaysia, CIDB, 2020.
[27] A systematic review on green practices in the Malaysian construction industry: status, challenges, key motivations, rating systems and technology evolution, Masyhur et al. (2024).

Box 3.3. Green offices in Malaysia: a rising asset class driven by climate commitments

Kuala Lumpur's office market is pivoting toward sustainability, fueled by corporate net-zero pledges and tightening climate regulations. With 78 of the city's top 100 occupiers committed to science-based targets, demand for green-certified Grade A offices has soared and 41 percent of stock now holds certifications (up from 16 percent in 2019). Yet, a severe gap looms: JLL forecasts that net-zero carbon office demand will outstrip supply by 91 percent by 2028.

Developers and landlords could capitalize by prioritizing premium green projects like Merdeka 118 and Tun Razak Exchange (TRX), which command rental premiums of 60–90 percent. Retrofitting older buildings is equally critical because 60 percent of Kuala Lumpur's Grade A offices are more than 15 years old. Upgrading energy systems and securing certifications can future-proof assets, aligning with tenant demands and enhancing long-term value.

Bridging the supply-demand mismatch requires stronger retrofit incentives, transparent ROI data, and regulatory mandates. Collaboration among developers, tenants, and policymakers will be key to scaling green offices, while addressing cost concerns and maintaining market growth.

Source: JLL (2024). Rising Tenant Demand for Green Office Buildings: An Opportunity for Commercial Assets in Kuala Lumpur.

This report recommends:

- **Strengthen the Energy Efficiency and Conservation Act** to mandate Building Energy Intensity (BEI) certification for all commercial buildings more than 4,000sqm, with annual renewal tied to minimum two-star ratings. Consolidate fragmented certifications (GBI, GreenRE) into a unified national framework to eliminate market confusion and accelerate compliance.
- **Extend the Green Technology Financing Scheme (GTFS 5.0) to prioritize retrofits**, offering RM25 million loans for energy-efficient upgrades alongside new construction incentives. Launch green REITs and sustainability-linked bonds—modeled after Sunway REIT's Green Lease Partnership—to attract private capital and de-risk investments for SMEs.
- **Require all new government projects to achieve net-zero operational emissions using industrialized building systems and renewable energy.** Retrofit existing public assets with GTFS-funded energy-efficient systems, setting a market signal and building supply chains for broader private adoption. Furthermore, financial institutions must provide flexible, low-interest loan schemes to support building owners in implementing retrofits and energy efficiency measures, thereby accelerating the adoption of low-carbon and energy-saving technologies.
- **Enforce annual energy/emissions disclosures for commercial buildings** via the BEI registry, enabling benchmarking and ROI transparency. Publicly share anonymized data to guide policy design, counter high-cost perceptions, and empower financial institutions to develop tailored green products.
- **Expand Cagamas' (National Mortgage Corporation) offerings for sustainable affordable housing, including green mortgage guarantees**, funding and risk-sharing mechanisms for green assets and upgrades. These offerings should also target female-headed households. Align affordable housing PPPs with PETRA's ZEB targets, using tax breaks for developers who adopt sustainable materials and energy-efficient designs.

3.6. Specific challenges of reducing emissions in Malaysia

All sectors will need to decarbonize to meet the national net-zero target. The previous sections assessed the most significant contributors to Malaysia's GHG emissions, where policy action is most urgent. However, other sectors will also need to reduce emissions and early policy action is key to preparing them for the transition.

There is a need for targeted support for hard-to-abate sectors—such as the metal, cement, chemical, and petroleum industries—as outlined in NIMP 2030's industrial decarbonization agenda. The Ministry of Investment, Trade and Industry (MITI) also recently underscored the Integrated Waste Management scheme—recognized as a qualifying activity under the Green Investment Tax Allowance—as an important lever for encouraging investments in low-emission material recovery and waste-to-resource technologies that advance Malaysia's circular economy transition.

Managing e-waste will become a critical issue that cuts across all sectors. E-waste contributes to emissions both directly—through the release of potent gases like HFCs and methane from improper disposal—and indirectly, via the high carbon intensity of mining and processing metals used in electronics. Rapid digitalization, growing electronics consumption, and a push toward electric mobility and solar energy will all increase e-waste. Although currently small, solar PV alone could generate up to 481,000 tons of e-waste by 2050 (Yu et al, 2024). Further, recovery of precious minerals and metals from e-waste provides an opportunity for circularity and mitigating GHG emissions. Currently, private sector engagement in this sector is limited due to inadequate financial returns, insufficient feedstock supply, weak regulatory framework, enforcement and a large informal sector. Addressing e-waste through formal recycling systems, enactment of the extended producer responsibility (EPR) framework, adoption of international benchmarks on e-waste management systems, clearer inter-agency coordination, and investment in low-emission material recovery technologies are among the key recommendations essential for aligning Malaysia's future digital and green economy pathways with managing the potential climate-related risks from their increased use (Annex C).

Addressing barriers to decarbonize SMEs is crucial. Despite growing awareness and interest, key barriers for SME decarbonization include limited technical expertise, high upfront investment costs, fragmented ESG frameworks, limited access to green financing due to eligibility constraints and scant information. While manufacturing sector SMEs are more advanced with some adopting solar energy, biofuels and circular economy models, most remain in early to intermediate stages. In the construction sector, SMEs are primarily motivated by client requirements and energy savings but remain constrained by cost and technical limitations (i.e. expertise, technology), particularly in sustainable material sourcing. Service sector SMEs show the lowest level of readiness due to a lack of awareness, tools, and sector-specific guidance. The financial sector can play a role to support SME decarbonization through targeted interventions that address key barriers, risk, capacity and product misalignment.

3.7. Macro-level consequences of the low-carbon transition

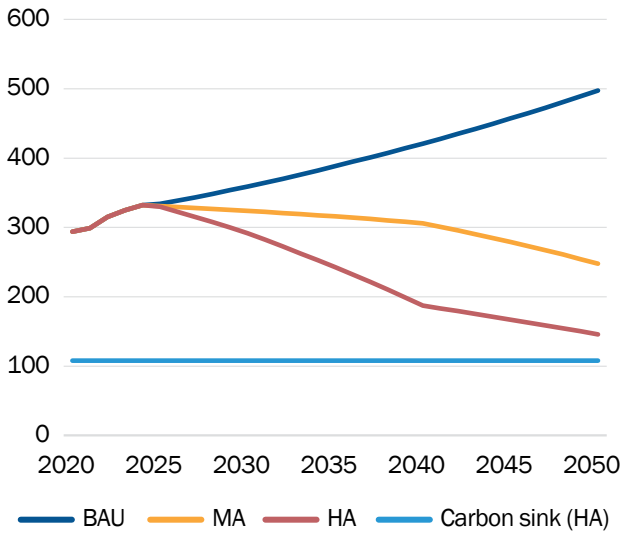
The low-carbon transition need not have substantial macroeconomic costs due to the availability of low-cost technologies. Two macroeconomic models were used by the CCDR to assess the overall impact of reducing emissions. The assessed scenarios include power sector transitions (Section 3.1), transport sector transitions (Section 3.2), and modest carbon prices (Box 1.1). In the HA scenario, GHG emissions fall toward the level of absorptions by carbon sinks, but the scenario does not reach net-zero emissions by 2050 (Figure 3.6a). The target could be met if the power sector reached net-zero emissions by 2050 and specific measures were taken to reduce emissions from oil extraction and refining (not considered in this CCDR). The models find that GDP in both scenarios could be higher than in the BAU case by 2050, although there may be short-term costs as the economy adjusts (Figure 3.6b). Higher investment and lower electricity prices

drive most of the positive GDP impacts. Of note, differences between results of the two models highlight key issues. In 2030, the negative disruption impacts in MFMod results could be avoided if measures are taken to allow businesses to quickly transition. In 2050, results differences depend on whether the oil and gas sector can maintain production levels, even as domestic consumption falls. The MINDSET simulations assume that all excess oil and gas production is exported, while MFMod allows production to fall. In the HA scenario, the MINDSET results thus show the largest GDP impacts as Malaysia benefits from both lower electricity prices and higher oil and gas exports.

However, sectoral impacts must be monitored closely, particularly in the extraction sector. As with any transition, there are winners and losers. The modelling results suggest that the construction and advanced manufacturing sectors will benefit from the transition, with construction output increasing by 5.4 percent compared to BAU by 2050 in the MA scenario, as the economy moves to a more capital-intensive production model. Some carbon-intensive basic manufacturing sectors could lose out. Nevertheless, for most sectors the impact is small. What happens in the extraction sector will be critical to determining macro-level impacts. As described above, as long as global demand for oil and gas remains strong, Malaysia's domestic climate ambitions need not impact the sector. However, if global demand for oil and gas falls, there could be a substantial impact on Malaysia's economy that could make macro-level outcomes much worse.

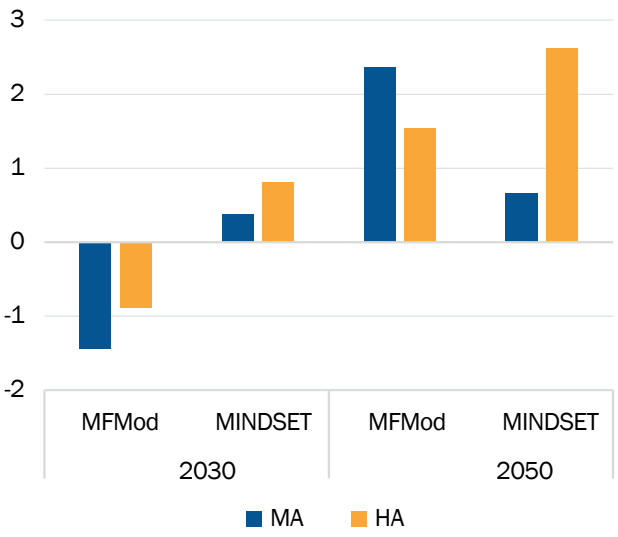
Figure 3.6. Emissions and GDP levels in the MA and HA scenarios

3.6a. *GHG emissions, $mtCO_2e$*



Source: World Bank staff calculations

3.6b. *GDP impacts of the MA and HA scenarios (% from BAU)*



Source: World Bank staff calculations based on MFMod and MINDSET macroeconomic models

3.7.1. Investment needs

Malaysia's transition to a low-carbon economy will require substantial investment through 2050, with estimated Net Present Value (NPV) costs totaling US$198.9 billion. Any mitigation strategy would focus on high-emitting sectors—power, industry, transport, and LULUCF. This total represents incremental costs above a BAU trajectory and does not account for potential cost savings, for example resulting from improved air quality, fuel savings, or technology spillovers (see Table 3.2).

The power sector dominates Malaysia's mitigation needs, requiring US$140.9 billion in discounted investment. This reflects capital expenditure (capex) needed for a fundamental transformation of the country's electricity generation mix to phase-out fossil fuel assets, scale-up renewable energy, enhance grid reliability, and modernize transmission infrastructure. With growing electricity demand, further investments will be essential in energy storage and system flexibility to manage variable renewable sources.

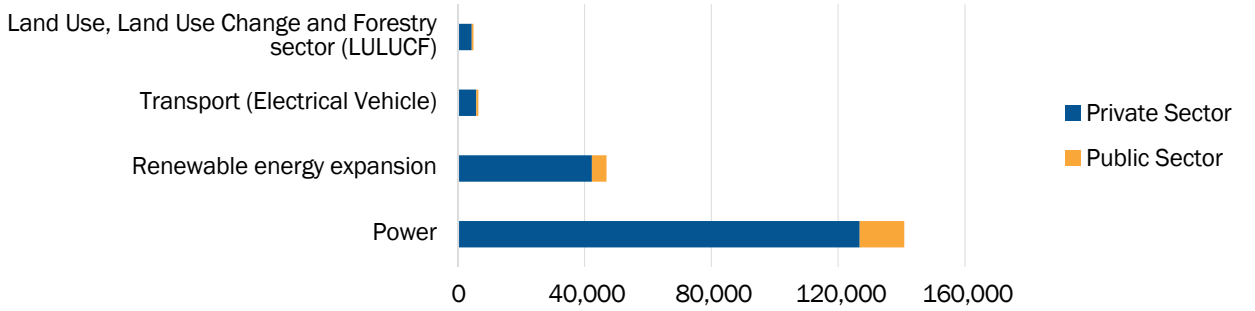
Complementing this, Malaysia is expected to invest US$46.9 billion in renewable energy. This includes solar, wind, bioenergy and hydropower, alongside supporting infrastructure such as interconnections and storage. The transport sector accounts for an additional US$6.4 billion, targeting the electrification of private and public vehicles. Though comparatively modest, LULUCF investments total US$4.9 billion, covering deforestation prevention and forest reforestation and management (see Figure 3.7).

Table 3.2. Investment needs for mitigation

Sector	Nominal Investment (US$ billion)	Discounted NPV (US$ billion)
Power sector	265.7	140.9
Renewable energy	98.0	46.9
Transport (EVs)	19.5	6.37
LULUCF sector	9.2	4.9
Total	*392.4*	*199.07*

Source: World Bank staff calculations

Figure 3.7. Investment needs for climate change mitigation by sectors 2025–50 (NPV, US$ million)



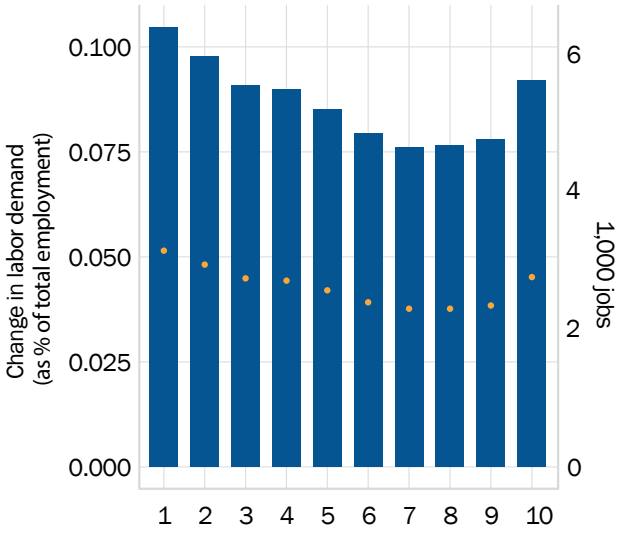
Source: World Bank staff calculations

3.8. Impacts of the transition on people

The low-carbon transition could create additional jobs for low-income households. The net employment effect of the transition under the HA scenario is modest, but positive (0.4 percent by 2030 compared to BAU). These jobs are created across all income groups, with a slightly higher concentration among the poorest segments (Figure 3.8a). Most jobs are created either in construction or private services, contributing to new infrastructure or its knock-on effects to the wider economy. These sectors generate strong spillovers by stimulating local supply chains, boosting demand for supporting services, and creating a wide range of semi-skilled and skilled employment opportunities. There is a natural favoring toward male workers (Figure 3.8b). The pattern of job creation largely mirrors that of job destruction from climate change (Section 2.4.2).

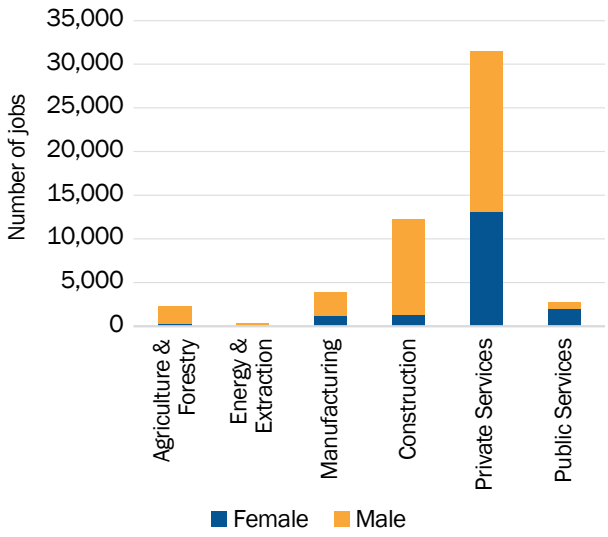
Figure 3.8. Distribution of new jobs across income group, occupation, and gender (HA scenario, 2030)

3.8a. *Income distribution of new jobs*



Source: World Bank staff calculations based on MINDSET

3.8b. *Gender distribution of new jobs*



Source: World Bank staff calculations based on MINDSET

3.9. What are the key risks?

Malaysia's energy sector, particularly oil and gas, provides high-paying jobs commonly held by foreign nationals due to skills shortages. The potential for displaced workers from the oil and gas sector is not large, but these high-paying positions are at risk. An analysis of skills requirements (see Figure 3.9a & 3.9b) suggests that finding jobs for displaced workers may not be difficult, but managing income losses of displaced workers will be a challenge. For example, transitioning from a refining operator to an air conditioning mechanic could result in a 55 percent wage cut. Without targeted reskilling and upskilling, Malaysia may miss opportunities to localize green industry employment. A strategic response is essential to ensure Malaysian workers benefit from emerging opportunities in fields like solar, grid modernization, hydrogen, and carbon capture.[28]

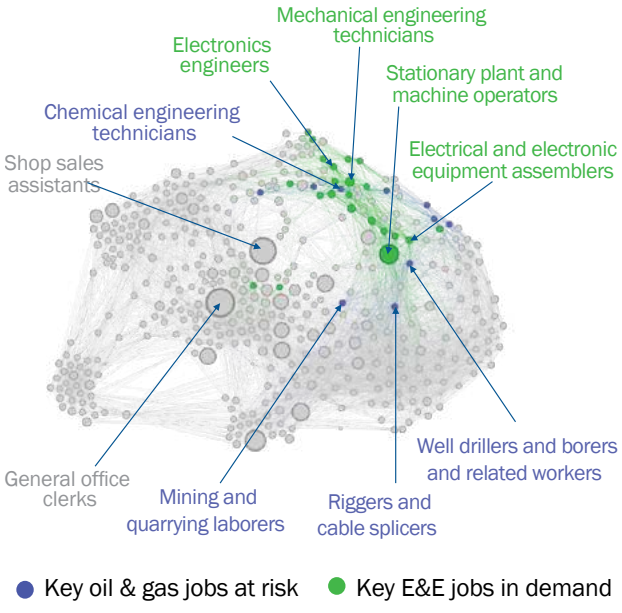
Decarbonization could lead to some loss of competitiveness, but even in a worst-case scenario macro-level impacts would be modest. The risks to Malaysia come from being out of step with the rest of the world on climate action. If Malaysia implements HA scenario climate policies in isolation from the remainder of the world, it could face a loss of competitiveness in sectors that are energy intensive and highly traded. In a worst-case scenario[29] GDP could fall by 5.5 percent (Figure 3.10a). Difficulties for heavy industry in switching from fossil fuels would also lead to some GDP losses, but by a smaller amount (Figure 3.10b). Overall, the risk of taking climate action is much smaller than the risk of not taking climate action (Section 4.3). Furthermore, targeted support to the specific sectors impacted, including the possibility of a Malaysian Carbon Border Adjustment Mechanism (CBAM) for basic materials, could reduce localized impacts.

[28] Mohr (2023). Malaysia's Green Job's Roadmap.

[29] All trade price elasticities in the model are set to -2.5, based on a short review of potential values (see e.g. Boehm and others, 2020; Adao and others, 2022).

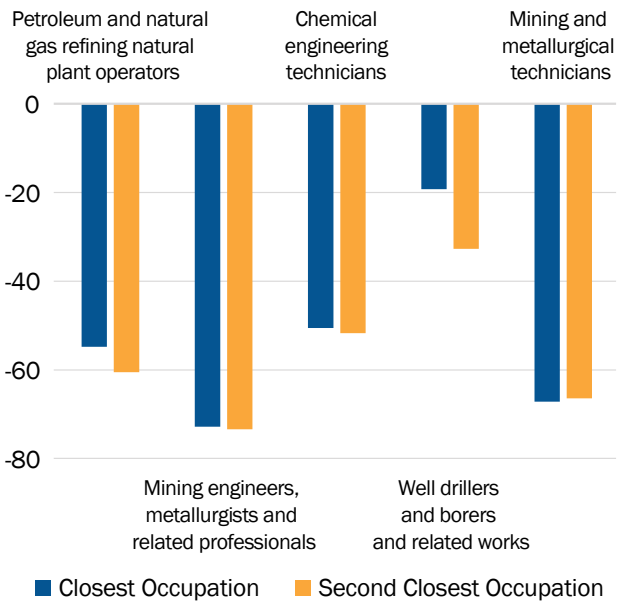
Figure 3.9. Labor transition in the HA scenario

3.9a. *Mapping of occupations at risk to growing occupations*[30]



Source: World Bank staff calculations

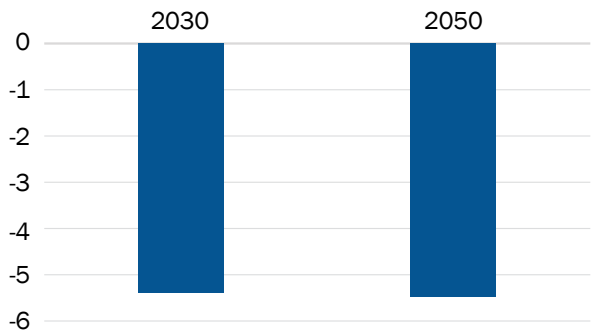
3.9b. *Potential loss of wage income (%)*



Source: World Bank staff calculations

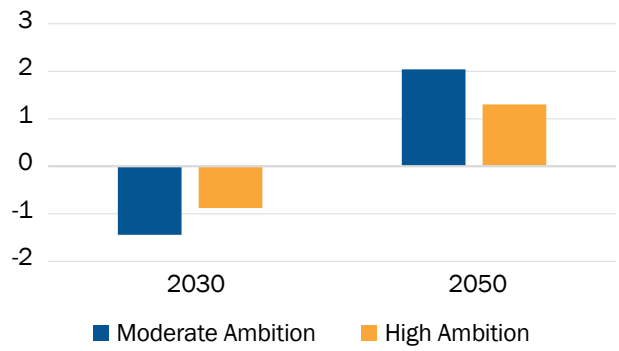
Figure 3.10. Transition risk scenarios worst case outcomes on GDP (%)

3.10a. *If trade is sensitive to price changes (HA scenario)*



Source: World Bank staff calculations based on MINDSET

3.10b. *If substitution away from carbon-intensive production is difficult*



Source: World Bank staff calculations based on MINDSET

[30] Nodes represent occupations and are linked in the network based on task similarly, with similar occupations positioned closer together. Node size indicates employment levels.

Photo: © World Bank.

4

Global Climate Shifts – Risks and Opportunities for Malaysia

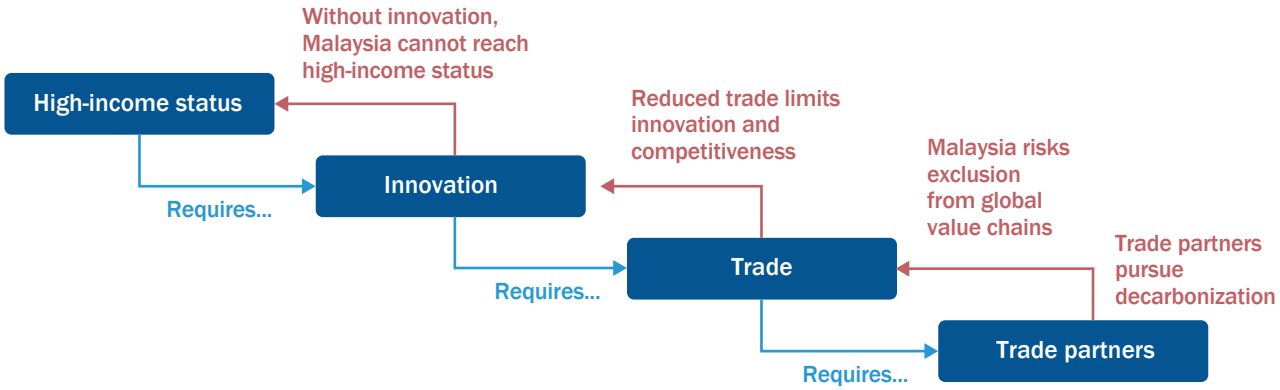
Photo: © World Bank.

4. Global Climate Shifts – Risks and Opportunities for Malaysia

Key message #4: Malaysia should move swiftly to seize the economic opportunities associated with a global shift toward sustainability, as delaying climate action risks impeding economic growth.

Enhanced participation in global value chains (GVCs) is a critical part of Malaysia's vision. An historic open trade policy, anchored by WTO membership and ASEAN's ATIGA, has solidified the country's role as a regional trade hub. Tariff reductions, regulatory harmonization, and participation in major agreements like RCEP, CPTPP, and IPEF have all boosted trade (WTO, 2022). Bilateral FTAs with Australia, India, Japan and others have further expanded market access, while frameworks like the CPTPP and IPEF prioritize supply chain resilience and sustainability. The link between TFP and international trade is now well established, and trade is essential to driving a productivity-driven growth model. Trade increases competition between firms, encouraging them to innovate and improve TFP. Spillover effects from sharing ideas across borders are also a key factor in long-term productivity. With Malaysia's recent economic growth concentrated in highly traded sectors like electronics, moving up value chains, for example to semi-conductors, is essential for driving future growth.

Figure 4.1. Links between global trade and innovation



Source: World Bank staff estimates

Trade dynamics are increasingly linked to climate action, creating both risks and opportunities. The global shift toward environmental sustainability—marked by rigorous green standards, evolving consumer preferences, and rapid technological advancements—threatens to disrupt Malaysia's export-oriented economy. Exporters risk encountering three primary hurdles: (i) exclusion from markets enforcing strict environmental regulations, (ii) declining demand for non-sustainable products as consumers and corporations prioritize eco-friendly alternatives, and (iii) obsolescence of traditional business models due to innovations in green technologies. In the future, climate change may be invoked as a justification for increasing trade barriers. However, the opportunities are substantial too and by positioning itself as a regional leader in sustainable practices and green technologies, Malaysia could attract increased FDI in key sectors. Prioritizing solar power, smart grid systems, and water conservation technologies could alleviate economic bottlenecks, while aligning with global sustainability benchmarks. This dual focus on risk mitigation and opportunity capture will be critical for Malaysia's future development.

Malaysia's path to balancing global competitiveness with climate resilience hinges on addressing critical challenges already outlined in this CCDR. This section examines how Malaysia must address sector-specific vulnerabilities—particularly in carbon-intensive industries and among SMEs—by implementing targeted green policies, overcoming regulatory fragmentation, and aligning skills development with emerging green sectors. At the same time, the financing, industrial transformation, and cohesive labor market policies that link economic and climate objectives are essential to unlock green value chains, secure market access, and ensure a just transition that enhances competitiveness and climate resilience.

4.1. Opportunities for a green export future

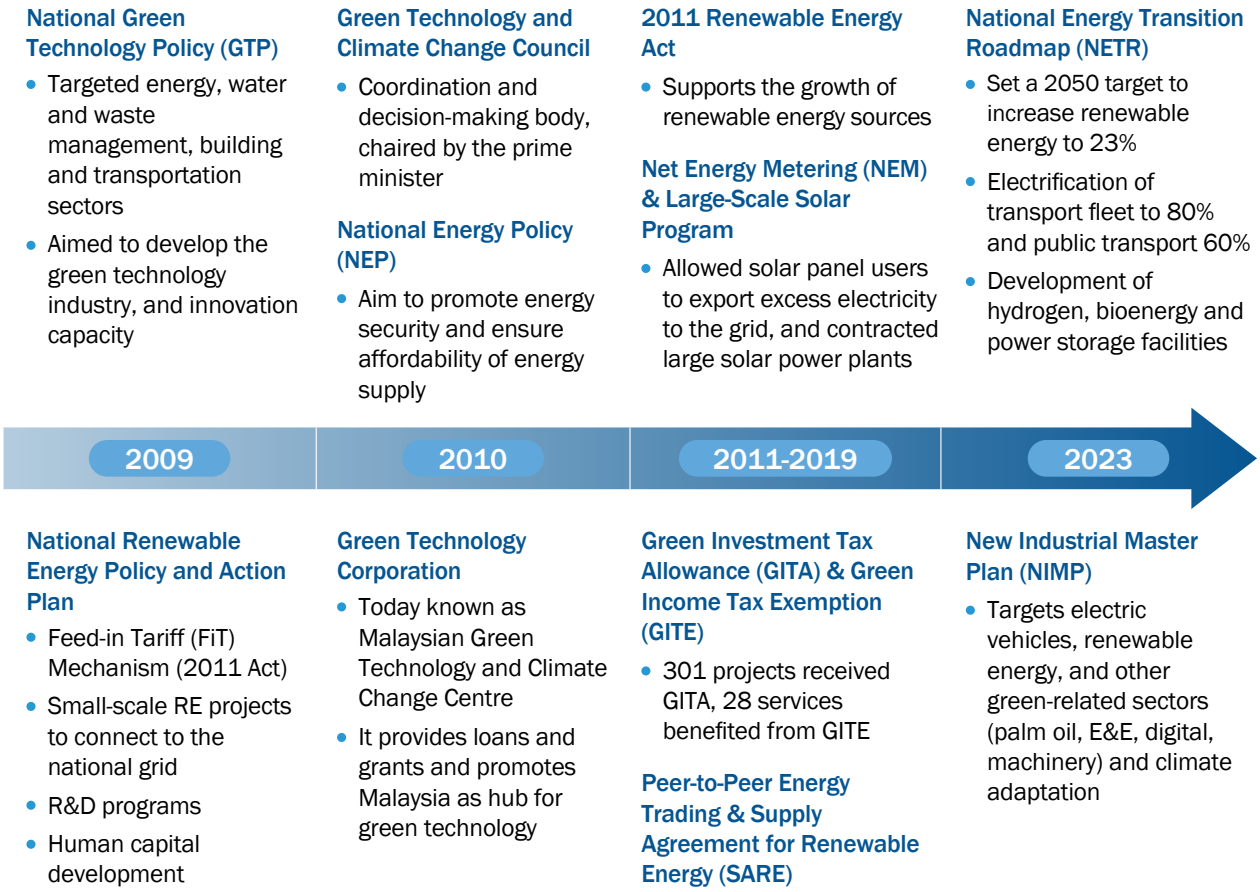
Malaysia's industrial sector benefits from a robust regulatory framework anchored by green policies.[31] These successive policies since 2009 have helped create demand for renewable energy and other clean technologies in Malaysia (see Figure 4.2), complemented by measures to guide green innovation and develop production capacity. Malaysia has also strengthened efforts to green both energy and material inputs across its industrial ecosystem. PETRA's initiatives including the Corporate Renewable Energy Supply Scheme (CRESS), the Corporate Renewable Energy Aggregation Mechanism (CREAM), and the Green Electricity Tariff (GET) are supporting cleaner energy use and accelerating industrial energy transitions, while MITI's i-ESG Framework and Circular Economy initiatives are advancing more efficient and sustainable material flows. Most recently, the NIMP 2030 aligned manufacturing growth with sustainability goals, embedding low-carbon and resource-efficient production into sectoral strategies. Complementing these policy shifts, financial incentives such as the Green Investment Tax Allowance and Green Income Tax Exemption are catalyzing green technology adoption and providing tax relief for renewable energy systems, battery storage, EV infrastructure, and waste management solutions.

Together, these policies and fiscal measures aim to position Malaysia as a regional leader in sustainable industrial development. The MITI, through the Malaysian Investment Development Authority (MIDA), is also promoting the Smart Logistics Complex Incentive, which supports the development of logistics facilities that incorporate Industry 4.0 technologies and sustainable practices. This initiative complements Malaysia's ambition to establish green logistics hubs, improve energy efficiency in freight transport, and reinforce the country's role as a regional distribution center, in line with the objectives of the NIMP 2030 and NETR.

Malaysia outperforms its Asian peers in key enablers for manufacturing investments, with strengths in modern industrial parks and efficient logistics. Ranked as one of the most business-friendly environments in Asia with business-friendly policies for local and foreign companies, along with strong intellectual property protections (Dezan Shira & Associates, 2024), Malaysia ranked 12th globally in ease of doing business and is second only to Singapore in ASEAN (World Bank, 2020). In addition, Malaysia has strong industrial infrastructure, with reliable access to energy and water, low fuel costs, and well-enforced environmental regulations. It also ranks highly among flexible labor market and workforce quality, with strong education levels, high labor productivity, and good English proficiency. Well-developed Customs infrastructure and trade openness have led to growing exports, especially in electronics. Resource-based industries like palm oil, petroleum, and rubber have further boosted exports.

[31] Malaysia's Green Industry Framework, 2023.

Figure 4.2. Green industrial policies launched after creation of the Ministry of Energy, Green Technology, and Water

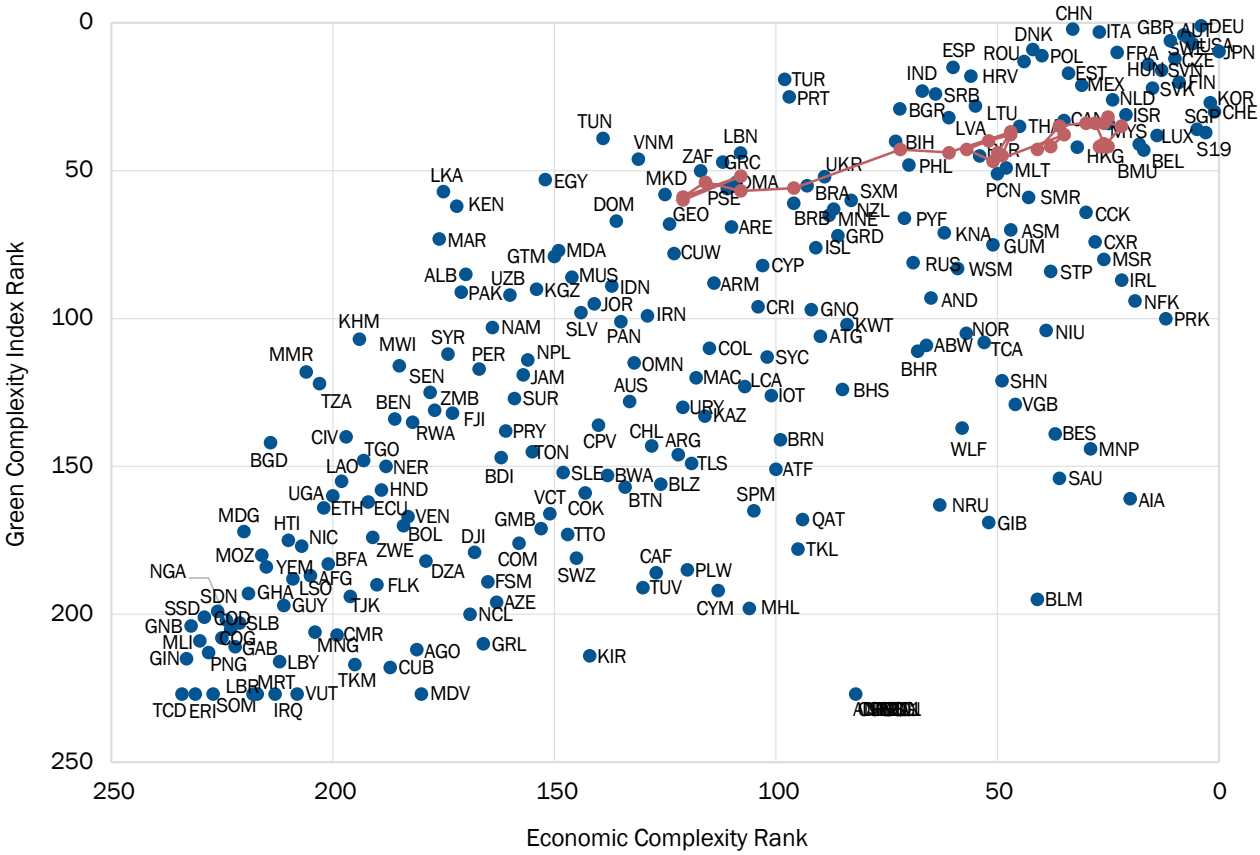


Source: Compilation by World Bank staff

On the back of recently strong export performance, Malaysia has the capability to further develop its export potential, especially in green products. As global competition intensifies, diversifying into products that are more sophisticated and less widely produced offers a path toward higher value-added growth. With the Economic Complexity Index (ECI) analyzing the diversity and sophistication of goods a country can competitively export, Malaysia ranked 26th globally in economic complexity in 2022, a sharp rise from 121st in 1995 (see Figure 4.3). This progress reflects sustained diversification into higher-value manufacturing, particularly in electronics and machinery.

Green exports are growing rapidly, but productive capabilities remain limited. Between 1995 and 2022, Malaysia's green exports jumped from US$3 billion to US$37 billion, outpacing fast global growth (Figure 4.4a). While green products now account for 10 percent of total exports, progress in developing new capabilities in green sectors has lagged compared to other sectors. Malaysia's ranking in economic complexity for green products improved from 60th to 36th between 1995 and 2022, although the gains were smaller than those observed for other product categories. The country shows comparative advantages in only 61 out of 293 green products (Figure 4.4b), largely concentrated in machinery and electronics—sectors where it was already competitive—including items such as bicycle components and instruments for measuring radiation and electrical currents.

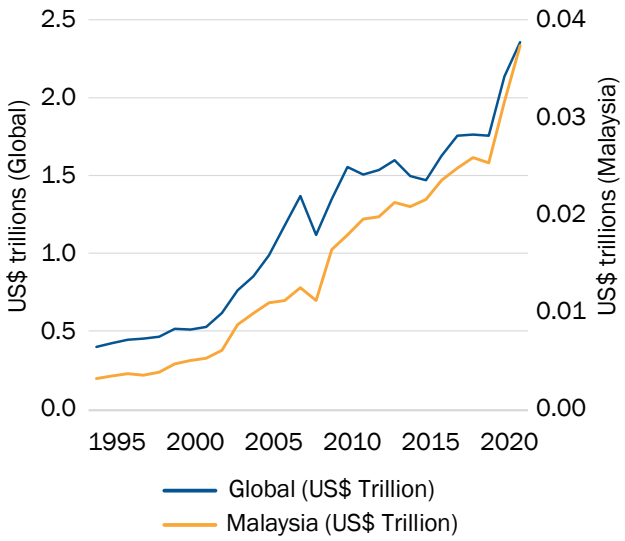
Figure 4.3. Malaysia's ranking in Green Complexity and Economic Complexity indexes, 1995-2022



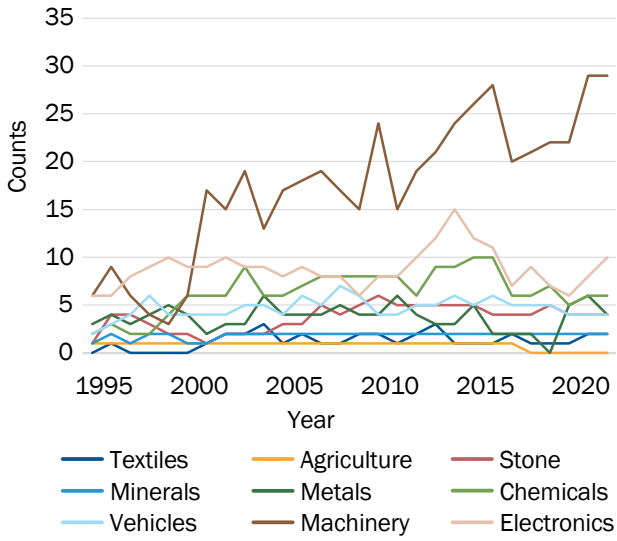
Source: World Bank (2025)

Figure 4.4. Malaysia's green export position in the world

4.4a. *Value of green exports*



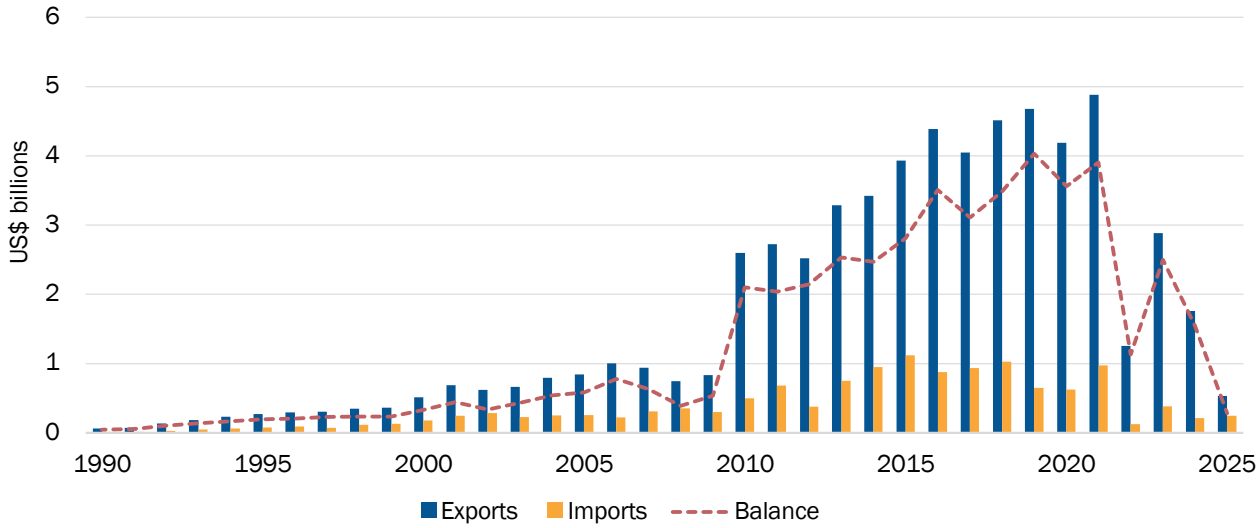
4.4b. *Malaysian green products with a comparative advantage*



Source: World Bank Group staff calculations

There has been sustained export growth of renewable energy-related products since 2000 (see Figure 4.5) with more than 250 firms operating in the sector (Khazanah Research Institute, 2024). After the Malaysian Government lifted its ban in 2023, the Cross-Border Electricity Sales Renewable Energy scheme supported growth in exports of electricity generated from renewables (Eco-Business, 2023). The scheme and its accompanying initiatives strengthen Malaysia's cross-border electricity integration and promote regional cooperation in renewable energy (Asian Power, 2024).

Figure 4.5. Malaysia's trade flows of renewable energy products, 2000–23 (US$ billion)



Source: World Bank Group staff calculations based on UN COMTRADE data

Although in its infancy, Malaysia has growing capabilities in EV manufacturing that leverages existing automotive capabilities and is supported by government incentives to boost local production. Several companies are already producing EVs in Malaysia, and EVE Energy is establishing a lithium-ion battery manufacturing base (Emerging Technology News, 2024). The NETR target of 80 percent EV sales by 2050 is spurring domestic market growth, supported by tax exemptions for locally produced EVs until 2027, incentives for manufacturers, and the ongoing rollout of a national charging network (Table 4.1). However, Malaysia's domestic EV market is slow growing and remains small, constrained by limited charging infrastructure and high vehicle costs. Without stronger consumer adoption, domestic EV production is unlikely to scale up (see Section 3.2).

Table 4.1. Government incentives, targets, and policies to strengthen Malaysia's EV ecosystem

Strategy	Policy Description
Full Duty Exemption for the Market	• No import and excise duties for imported EVs until 2025 • No import, excise duties, or sales tax for locally produced EVs until 2027.
Tax Incentives for Local EV Manufacturers	• Income tax allowance or pioneer status for manufacturers of efficient EVs and components • Income tax exemption for companies manufacturing EV charging equipment (2023–32).

Strategy	Policy Description
Tax Relief for Operators and Consumers	• Green Investment Tax Allowance for EV charging point operators (100 percent for five years) • Road tax exemption for EV users until end of 2025 • Up to RM2,500 tax relief for home EV charger installation/ subscriptions until 2027.
EV Infrastructure Development	• 10,000 EV charging bays targeted by 2025 • EV testing centers • Standards for charging systems, battery disposal, and wireless charging for safety.

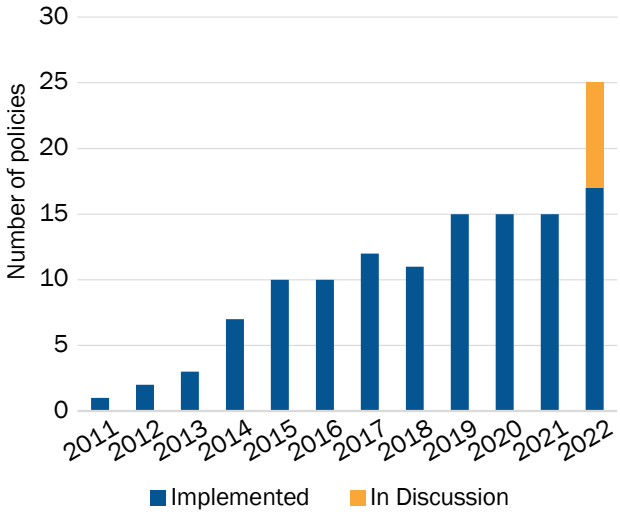
Source: Compilation by World Bank staff

Other opportunities for green export expansion include air compressors, electric converters, and heat exchange units. Malaysia's expertise in machinery and electrical equipment creates many 'low-hanging fruit' opportunities for green export expansion. These products are closely related to existing production capabilities and have strong global demand. Examples include air compressors, electric converters, heat exchange units, liquid purifiers, and hydrometers. In addition, Malaysia could gain higher product complexity gains by diversifying into products requiring only modest upgrades. Examples include optical instruments, lasers, electric furnaces, vacuum pumps, and ion exchangers.

4.2. Global risks to future economic prosperity

While exports have driven economic growth in Malaysia, export-related risks are now growing. For example, global PV trade restrictions surged over 2011–22 (see Figure 4.6), and a 2023 U.S. ruling accused Malaysia, among Southeast Asian nations, of circumventing anti-dumping duties on Chinese solar cells (IEA, 2025 and U.S. Department of Commerce, 2023). Although temporary exemptions have postponed immediate impacts, these measures increase uncertainty for Malaysia's solar exports and supply chains. More generally, rising global trade barriers have increased the levels of volatility for the country's manufactured goods exports, challenging its competitive edge despite strategic trade alliances.

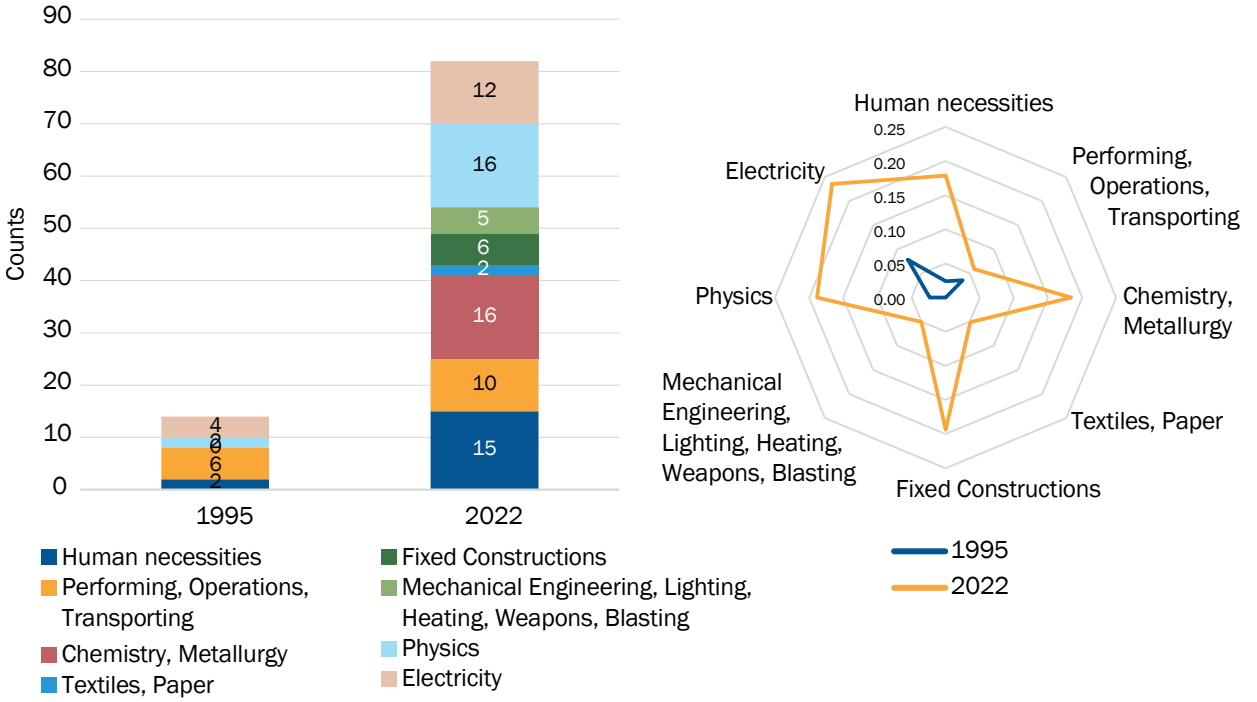
Figure 4.6. Number of anti-dumping, import and countervailing duties on solar PV, 2011–22



Source: IEA. (2025)

Domestic innovation remains a weakness in Malaysia's economy, including in green sectors. In 2022, Malaysia's patent activities outranked global averages in 82 technological fields (compared to 18 in 1995). However, Malaysia continues to trail many of its middle-income peers and remains significantly behind upper-income economies in the rankings. Progress has been strongest in electricity, construction, and physics, in part driven by investments in renewable energy and infrastructure. Yet, lagging critical sectors like mechanical engineering, textiles and transportation reflect a reliance on low-value manufacturing and imported technologies. This uneven specialization underscores Malaysia's struggle to diversify beyond its traditional strengths in electronics and resource-based industries, limiting its competitiveness in high-tech global markets.

Figure 4.7. Malaysia's number of technologies with RTA >=1 by category, 1995 and 2022

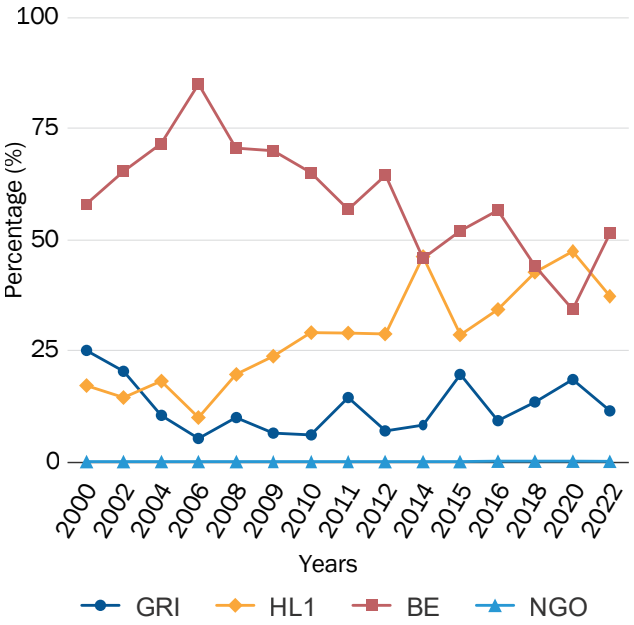


Source: World Bank (2025)

Furthermore, foreign companies dominate innovation-driven industries in Malaysia, while indigenous firms struggle to remain competitive and innovative. Chinese solar manufacturers relocated to Malaysia in response to post-2012 U.S.-EU trade barriers, boosting FDI and positioning the country as a global PV hub (Figure 4.7) (Sunsave, 2025). However, these vertically integrated firms primarily produce low-value components in Malaysia, while sourcing high-value inputs (polysilicon, inverters) from China. Local manufacturers struggle to compete with cheaper imports or integrate into higher-value chains (Khazanah Research Institute, 2024). This reliance stifles domestic innovation and limits opportunities for knowledge spillovers. Although Malaysia accounts for 51 percent of Southeast Asia's green patents, it remains far behind China and Republic of Korea (WIPO, 2024). This limits the share of value available for capture.

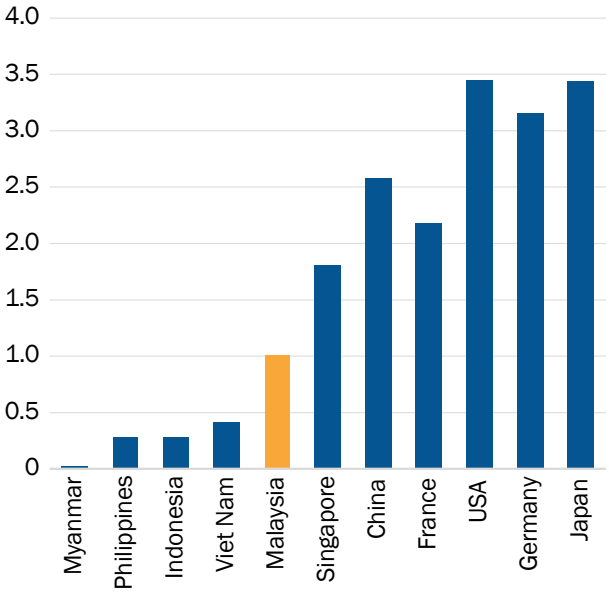
Low levels of domestic private sector R&D leave opportunities out of reach and make Malaysia vulnerable to external shocks. Gross domestic expenditure on R&D (GERD) has stagnated at 1.4 percent of GDP, far below China (2.4 percent), Republic of Korea (4.9 percent), and Singapore (1.8 percent) (see Figure 4.9). Furthermore, the private sector share of R&D is declining (see Figure 4.8). Malaysia's tax policy, which inadvertently incentivizes outsourcing R&D, is likely a contributing factor. Limited collaboration between academia and industry further limits R&D possibilities, although initiatives like Collaborative Research in Engineering, Science & Technology (CREST) could help to address this issue (see Figure 4.10). This underinvestment curtails Malaysia's ability to compete in sectors it seeks to expand. It also pushes the country toward producing commoditized goods, for which production could easily be shifted to other locations.

Figure 4.8. Expenditure on R&D as a % of total expenditure[32]



Source: MASTIC (2025)

Figure 4.9. R&D intensity (GERD as a % of GDP)



Source: UNESCO (2022)[33]

Figure 4.10. CREST is an example of how to overcome coordination failures in R&D

Strategic Partners

- Collaboration between government, industry, and academia
- 80+ members, including SMEs, MNCs, universities, and government agencies
- Board representation ensures alignment of goals
- Members benefit from grants, networking sessions, and access to CREST facilities

Market-driven Leadership

- Industry-led board drives focus on market-relevant R&D priorities
- Government funding support through EPU, MITI, MIDA, and NCIA

Technology Clusters

- Focus on technology clusters, including LED/optoelectronics, IoT, advanced materials, and autonomous vehicles
- Breakthroughs in LED technology and research in gallium nitride positioned Malaysia as a hub for advanced innovation
- Creations of labs in Malaysia with US collaboration

Commercialization Impact

- Supported 146 R&D projects, achieving a 28% commercialization rate
- Generated 11x returns for every Ringgit of R&D spent, showing high efficiency in resource utilization
- Nurtured 20 tech startups, trained 6,000 graduates, and engaged over 500 industry talents and entrepreneurs

Source: World Bank (2020)

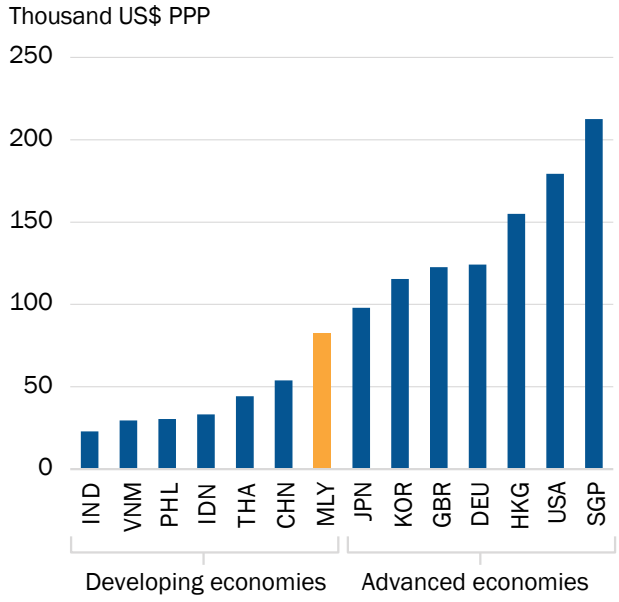
[32] Note: Government research institutes (GRI), higher learning institutions (HLI), business enterprises (BE) and non-governmental organizations (NGO).

[33] Data for 2023 or latest year available. https://databrowser.uis.unesco.org/view#torPaths=&geoMode=countries&geoUnits=CHN%2CIDN%2CMMR%2CMYS%2CPHL%2CSGP%2CVNM%2CDEU%2CFRA%2CUSA%2CJPN&timeMode=range&view=table&chartMode=multiple&chartHighlightSeries=&chartHighlightEnabled=true&indicatorPaths=UIS-SDG9Monitoring%3A0%3AEXPGDP.TOT

A shortage of skilled workers may also expose Malaysia's export-driven economy to climate risks (see Figure 4.11). Malaysia's manufacturing sector is cost-effective because it offers competitive wages and relatively high labor productivity, with output per employee exceeding China's, but still substantially lagging advanced economies like Singapore. Furthermore, productivity growth is slowing. In addition, key export sectors face growing challenges to fill high-skilled positions. This mismatch is driven in part by declining STEM enrollment in universities—from 48.2 percent in 2012 to 41.0 percent in 2021—and a shrinking pool of researchers, both of which reflect declining public and private investment in R&D (see Figure 4.12). In contrast, China has steadily increased its R&D spending and expanded its researcher base. Without reversing current trends in STEM education and research investment, Malaysia risks falling behind in technological capability and losing ground in GVCs. Again, this leaves the economy exposed to sudden shocks if global trade patterns change, including climate change-driven shifts.

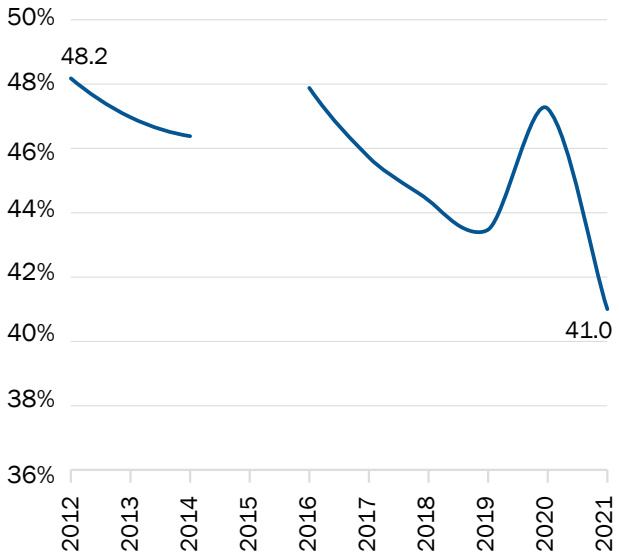
Strengthening green skills development and reskilling frameworks is critical to ensure all Malaysians can benefit from the shift to a low-carbon economy. This includes aligning national skills planning with decarbonization pathways, establishing clear green competency standards, and expanding targeted reskilling programs for workers in emission-intensive sectors. Technical and Vocational Education and Training institutions should integrate climate-relevant curricula and partner with industry to ensure training matches labor demand, while inclusion can be enhanced through support for women, youth, rural communities, and SMEs via targeted incentives and accessible training models. Improved labor market data and skills forecasting will help tailor programs and ensure a just and equitable transition into emerging green industries.

Figure 4.11. Labor productivity level of developing and advanced economies, 2025



Source: The Conference Board Total Economy Database

Figure 4.12. STEM enrolment in Malaysian universities, 2012–21



Source: Khazanah Research Institute (2024)

4.3. How big are the risks?

Malaysia's current development model is at risk. As described in the introduction to this section, the country's transition to high-income status depends on continued access to GVCs. A loss of trade would choke the innovation necessary to drive future productivity growth. While this chapter has discussed many of the factors that determine trade, a lack of climate action could put Malaysia at risk from measures taken by both firms and other countries. The link between trade openness and TFP growth has been studied extensively by economists (such as Alcala and Ciccone, 2004). The effects of reducing trade openness are gradual, but accumulate over time. Quantification depends on factors like current industrial structure and stage of development, but Malaysia's total factor productivity (currently about 60 percent of U.S. levels) could decline by roughly 20 percent by 2050 if trade openness falls to the global median. The impact could be even greater in the event of a sudden trade shock to the electronics sector.

Loss of oil and gas export revenues would have a further negative impact on Malaysia's GDP. Analysis suggests that with declining global demand for fossil fuels—driven, for example, by the electrification of transport—the value of Malaysia's fossil fuel exports, which reached US$83 billion in 2023, would fall in line with global commodity prices. Over the long term, extraction may become economically unviable, leading to lower production volumes. While fossil fuels are likely to play a smaller role in Malaysia's future economic development, model simulations indicate that a loss of oil exports could reduce GDP by around 8.5 percent.

4.4. Reducing risks and maximizing opportunity

This report recommends:

- **Accelerate high-value manufacturing upgrading.** Guided by the World Bank's three-stage framework—Investment, Infusion, and Innovation—the country must recalibrate policies to diversify FDI, enhance technology transfers, and foster industry-led R&D. The 'Investment' phase demands building local capabilities in high-value sectors like polysilicon production, moving beyond low-margin assembly roles in solar and semiconductors. A National Eco-Industrial Parks program could build on existing pilots. Key actions include performance mapping, regulatory reform, and incentives for green investment, paired with risk-informed planning and disaster preparedness.
- **Catalyze Industry 4.0 adoption through STEM partnerships.** Concurrently, the 'Infusion' stage requires incentivizing joint ventures between multinational corporations (MNCs) and domestic firms to adopt Industry 4.0 technologies, supported by Joint Innovation Labs that grant local companies' direct access to global expertise. Finally, the 'Innovation' phase calls for scaling collaborative models like CREST, which has demonstrated success in commercializing R&D projects, while streamlining fragmented funding mechanisms to prioritize market-driven research.
- **Strengthen trade resilience and tech transfer mandates.** Bolster technology transfers through mandates for MNCs to partner with local firms on advanced manufacturing and reduce reliance on imported know-how. Reviving R&D requires boosting gross domestic expenditure to 2.5 percent of GDP via hybrid funding models like the Malaysia Science Endowment, coupled with tax incentives favoring in-house innovation over outsourced projects. Simultaneously, rebuilding STEM pipelines and aligning vocational training with green sector demands will address skills mismatches.
- **Fuel innovation-led growth via strategic investments.** By bridging these gaps, Malaysia can transition from low-value assembly to innovation-driven growth, ensuring local firms and workers capture greater value in global supply chains. Success hinges on cohesive policy coordination, addressing financial product alignment for the needs of different firm needs, strategic public-private partnerships, and a steadfast commitment to nurturing home-grown technological leadership.

Photo: © World Bank.

5

Making it Happen – Policies and Institutions for Climate Action

Photo: © World Bank.

5. Making it Happen – Policies and Institutions for Climate Action[34]

Key Message #5: Robust and well-coordinated institutions are essential for Malaysia to achieve its climate and development ambitions.

Strong, well-coordinated institutions will be essential for Malaysia to realize its climate and development ambitions. As the country moves toward its 2050 net-zero goal, institutional strength will be key to turning strategies into desired outcomes. This chapter explores how institutions enable effective policy delivery and ensure coherence across climate, development, and financial planning. While Malaysia has made progress—through integrated national plans and development of a Climate Change Bill—important gaps remain. These include the absence of a National Adaptation Plan (NAP), limited institutional capacity, and fragmented coordination across government levels. Achieving both climate and development goals requires not only the right policies, but the systems and capabilities to implement them.

While Malaysia has established a multi-layered climate governance framework that encompasses climate-specific, sectoral, and development-based planning, critical gaps persist in its strategic toolkit. Together, Malaysia's NDC Roadmap, the LT-LEDS and NPCC 2.0, the nation's flagship climate policy, establish the strategic framework for a low-carbon, climate-resilient economy and codify Malaysia's 2050 net-zero ambition. Federal coherence is evident through alignment of Malaysia's plans with cross-cutting initiatives like the NETR and NIMP 2030, which integrate climate priorities into core economic and industrial strategies. However, despite these advances, Malaysia has yet to finalize its NAP — a critical instrument for translating resilience objectives into coordinated, time-bound actions. While the NAP is in development, the lack of a finalized plan limits Malaysia's ability to prioritize, operationalize, and integrate its adaptation measures across sectors and levels of government to deliver concrete, measurable outcomes. In addition, Environmental Impact Assessments (EIAs) are legally required for large development projects, but currently assess only general environmental impacts, without explicit consideration of GHG emissions or climate vulnerability.

Despite rising climate risks, Malaysia's strategies and plans remain largely focused on mitigation. While the country has advanced mitigation-focused policies like the NETR, adaptation planning is an evolving area and ongoing efforts are being strengthened through the National Adaptation Plan (MyNAP) to ensure better coordination and integration across sectors. While rising significantly from the late 1990s to 2015, Malaysia's overall adaptation readiness has declined (Figure 5.1a), largely because its economic capacity to plan, invest, and respond to climate impacts has weakened. This drop in economic readiness suggests that resources, infrastructure, and financial mechanisms supporting adaptation are becoming less sufficient, which could limit the country's ability to manage escalating climate risks effectively (Figure 5.1b).[35] A comprehensive NAP, shaped through broad stakeholder engagement, will offer a clear roadmap for embedding climate adaptation into national policies, strengthening policy implementation, and directing funding toward the highest adaptation priorities.

[34] This chapter is drawn from the Malaysia Climate Change Institutional Assessment (CCIA), World Bank.

[35] The ND-Gain score measures a country's capacity to leverage investments for adaptation action, and includes three components: (i) economic readiness, which evaluates the investment climate for private sector mobilization, (ii) governance readiness, which assesses the effectiveness of public institutions in reducing risk and attracting investment, and (iii) social readiness, which looks at society's ability to benefit from climate adaptation investments.

Figure 5.1a. ND-Gain readiness scores: Malaysia vs. EAP peers and HIC countries

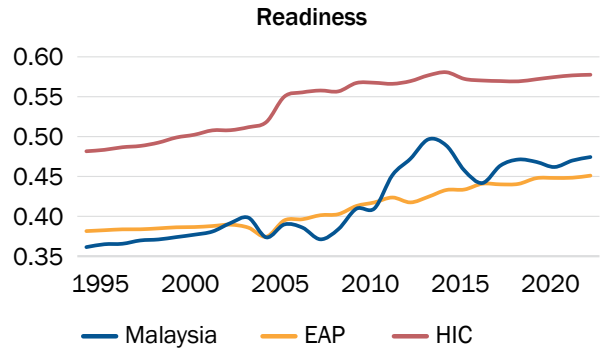
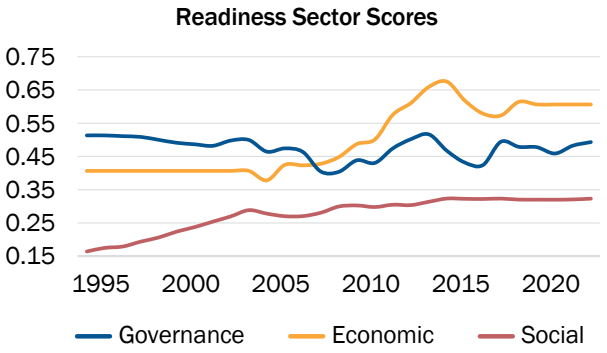


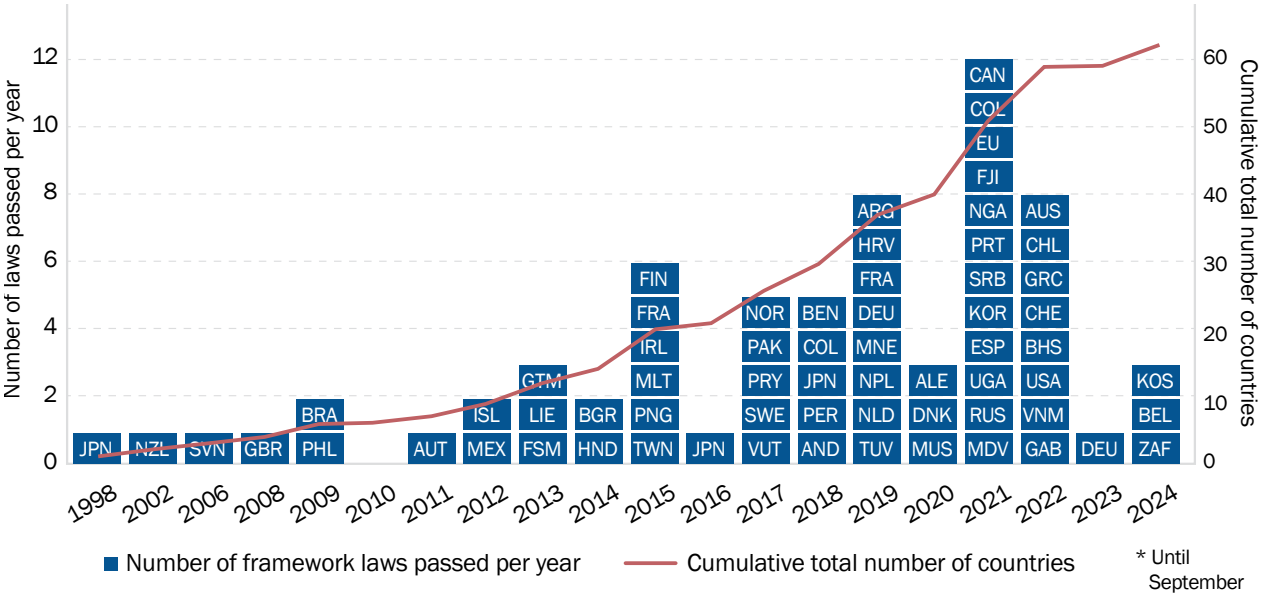
Figure 5.1b. ND-Gain readiness scores: Malaysia's readiness sector scores



Source: Notre Dame Global Adaptation Initiative (2025)

With development of a climate change law, Malaysia is taking a crucial step on the path of more than 60 countries toward more coordinated and accountable climate action (Figure 5.2).[36] The proposed Climate Change Bill is poised to significantly strengthen the institutional framework for climate action. Among other things, it proposes establishment of a new regulatory body and a National Integrated Climate Data Repository for monitoring and reporting. However, the initial draft released in October 2024 omits key elements, including formalizing the 2050 net-zero target, mandating climate risk assessments, clarifying State-government roles, establishing an independent advisory body, and ensuring stakeholder engagement. The bill could also better define the regulatory body's leadership and coordination responsibilities to prevent overlaps with existing coordinating entities.

Figure 5.2. Countries that have adopted climate change framework laws



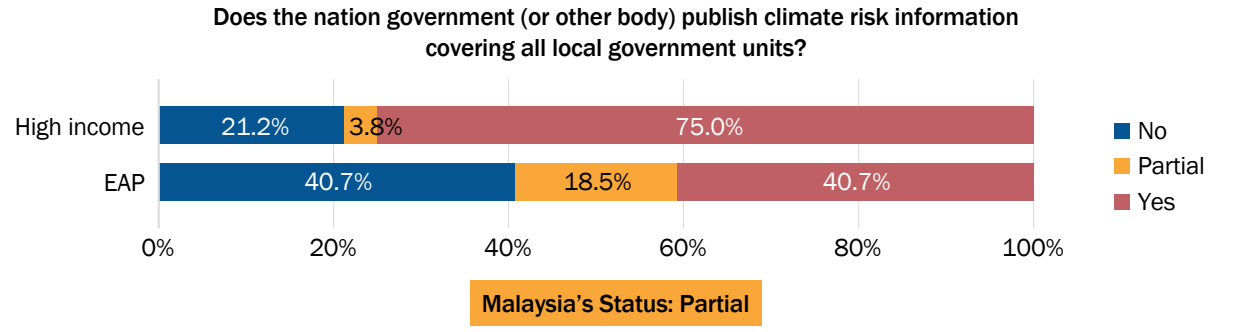
Source: Abdulaziz & Menzies (2024)

[36] The Malaysia National-level Climate Change Institutional Assessment (CCIA), launched in February 2026, provides more detailed analysis of the Climate Change Bill.

Malaysia has also taken decisive steps to assign clear climate mandates across ministries, yet critical capacity gaps threaten to derail progress. Following 2023's restructuring of the then Ministry of Natural Resources, Environment, and Climate Change (NRECC), the newly formed Ministry of Natural Resources and Environmental Sustainability (NRES) and Ministry of Energy Transition and Water Transformation (PETRA) now spearhead climate and environmental governance, and energy transition. However, advancing climate goals requires well-trained personnel equipped to analyze data, manage long-term risks, and coordinate efforts across sectors. The dedicated climate division—within NRES—operates with a modest team, with similar units or climate focal points in the process of being established in other ministries. Key technical shortcomings – including GHG tracking, adaptation planning, and technology assessments – persist across federal and State agencies (NRES, 2024). No government-wide assessment exists to diagnose these gaps or craft targeted strategies for upskilling personnel. A structured audit of climate-related skills gaps can guide a national training roadmap that equips civil servants to integrate climate risks into planning, strengthen cross-ministerial collaboration, enhance policy implementation and national resilience.

A lack of trusted public information about climate risks and vulnerabilities hinders effective planning and undermines public and investor confidence. While rain and storm forecasts exist, information on critical risks like heatwaves, sea level rises, and flood hazards are largely absent or not accessible to large segments of the private sector. This places Malaysia behind 41 percent of East Asia and Pacific countries and 75 percent of high-income nations in sharing climate risk information (see Figure 5.3). Progress is mixed: the NPCC 2.0 proposes a national risk assessment and multi-hazard data hub, and the Department of Irrigation and Drainage's National Flood Forecasting and Warning Program (PRAB) aims to cover 74 river basins. However, so far, the PRAB only encompasses three states and no public agency covers urban floods. National climate projections exist for hazards through 2100, but lack local-level detail. To bridge this gap, Malaysia must accelerate NPCC 2.0 plans, expand PRAB's coverage, and publish localized risk maps. Better data sharing across ministries and with the general public would boost preparedness, attract investment, and protect communities.

Figure 5.3. Climate Change Governance Indicators: climate risk information



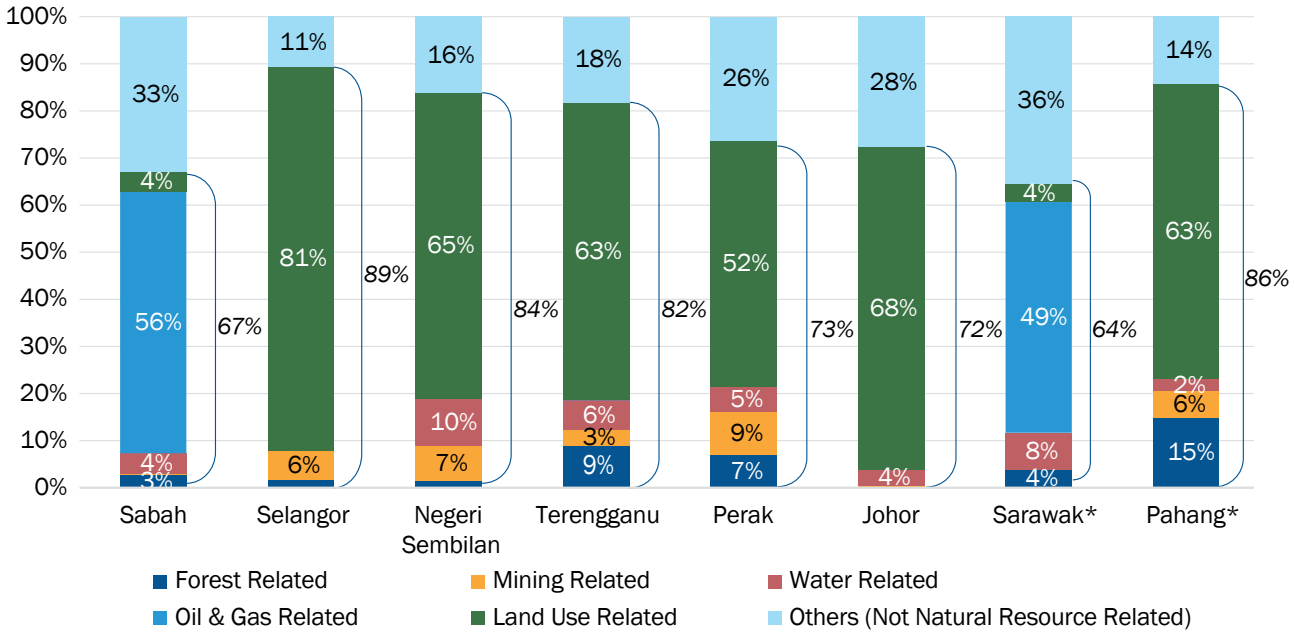
Source: Climate Change Governance Indicators, World Bank

Embedding climate criteria into public financial management is promising, but incomplete. Encouragingly, Malaysia incorporated climate-related criteria into its 2024–25 public investment guidelines, directing ministries to prioritize emissions reductions, environmental protection, and disaster risk management. Sustainability elements like energy efficiency and green infrastructure are now mandated for new projects, although adaptation remains unaddressed. The Government Green Procurement initiative has exceeded interim targets, achieving 27.8 percent by 2021, with a 30 percent goal for 2025, but faces challenges in enforcement, cost management, and technical support. Other key gaps persist (World Bank, 2026). Malaysia does not yet assess climate-related fiscal risks, integrate climate into budget preparation processes, or systematically tag climate-related revenue and expenditure, limiting alignment between public financial management and climate objectives.

The assignment of powers under Malaysia's Constitution enables innovation, but can complicate climate action. States have autonomy over climate-critical areas such as land, water, forests, and agriculture, while the federal government oversees disaster management and energy. While national NRES-led strategies require state alignment, limited capacity often impedes implementation. Some states, like Sabah and Sarawak, are leading innovations such as establishing a Climate Change Action Council and enacting a GHG reduction law, respectively. Johor, Melaka, Penang and Selangor, among others, have launched climate action plans. However, divergent state policies on matters such as carbon credit mechanisms and carbon capture and storage, risk undermining coherence and international credibility. Stronger federal-state coordination will be critical to scaling climate action nationwide.

Fiscal structures constrain federal influence on state-level climate efforts. Federal transfers accounted for only 20 percent of total state funding between 2020 and 2024, with most formula-based or earmarked for specific uses, leaving limited scope to incentivize climate outcomes. Sabah and Sarawak face fiscal decentralization challenges, with limited revenue autonomy and reliance on federal transfers constraining their ability to fund development and climate resilience initiatives. The Ecological Fiscal Transfer (EFT)—Malaysia's only environment-linked grant—represented just 1.1 percent of federal transfers and 0.7 percent of state revenue in 2024, limiting its leverage compared to resource-based income, which still constitutes 64 to 89 percent of state revenues (Figure 5.4). Recent reforms, including expanded eligibility, stronger performance criteria, and alignment with the National Forestry Act (Amendment) 2022 signal progress, but the mechanism remains small, discretionary, and opaque. Broader reforms to institutionalize and scale-up the EFT, improve transparency, and embed climate criteria into other federal–state transfers would strengthen alignment of fiscal incentives with national climate goals, and make conservation a more viable, rewarding choice for states.

Figure 5.4. Natural resources-related revenue as a percentage of state-generated revenue in 2022

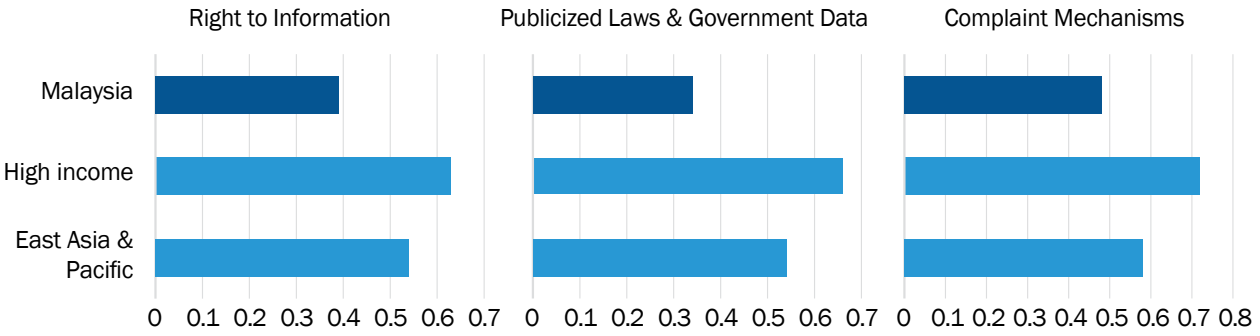


Source: World Bank staff calculations from state budget documents and data from the Sarawak State Financial Secretary's Office.
Note: Limited coverage of states is due to limitations in disaggregation methods used in the original source data.
**For Sarawak and Pahang, the latest data available is 2021.*

Local authorities also face structural and capacity constraints in advancing urban climate action. Central to Malaysia's climate mitigation and adaptation efforts, local authorities often serve as primary actors for planning, enforcement, and implementation at the city level. However, their effectiveness is constrained by limited access to high-resolution climate data, fragmented coordination among federal, state, and local agencies, and shortages in technical capacity and staffing. Persistent financing limitations further hinder long-term investment, as most local authorities' budgets are devoted to operational expenditures. The lack of a centralized climate data platform and slow data-sharing processes also restrict evidence-based planning and timely responses to urban climate risks, underscoring the need for stronger institutional and financial support at the local level.

Limited transparency undermines the trust and legitimacy needed to achieve Malaysia's climate ambitions. Despite government efforts, public confidence in national climate commitments remains low, with just 21 percent of Malaysians believing climate change was treated as a national priority, below the regional average (ISEAS, 2024). This trust gap is reinforced by limited access to information, publicized laws, government data, and effective complaint mechanisms, where Malaysia lags both its East Asia and Pacific peers and high-income countries (Figure 5.5). For example, climate coordination bodies lack transparency, with no dedicated platforms for public access to meeting details or follow-up actions. Surveys indicate that Malaysians—particularly young people—primarily turn to social media for climate information, presenting the government with opportunities to improve outreach and combat misinformation. Enhancing transparency, broadening access to data, and encouraging open dialogue will be crucial for building public trust and reinforcing the credibility of climate policies. Ensuring fair and participatory policy processes will also be key to securing public support and enabling effective implementation (World Bank, 2017).

Figure 5.5. CLIAR - Malaysia's transparency and accountability mechanisms benchmarked against East Asia and Pacific peers and high-income countries



Source: Country Level Institutional Assessment and Review (CLIAR) Database, World Bank (2024)
Note: 0–1 normalized scale, representing the strength, effectiveness, or quality of transparency and accountability mechanisms.

This report recommends:

- **Strengthen the upcoming Climate Change Bill by providing clearer mandates and enforcement mechanisms.**[37] Embed the 2050 net-zero target into law, alongside mandatory national climate risk assessments and anti-backsliding provisions. The regulatory body should be granted clear,

[37] Based on international experience, the World Bank's Reference Guide to Climate Change Framework Legislation lays out 12 key principles for developing a national framework legislation on climate change: (i) long-term targets, (ii) intermediate and sectoral targets, (iii) risk and vulnerability assessments, (iv) climate change strategies and plans, (v) policy instruments, (vi) independent expert advice, (vii) coordination mechanisms, (viii) stakeholder engagement, (ix) subnational governments, (x) financing implementation, (xi) measurement, reporting and verification, and (xii) oversight.

enforceable powers, including authority over emissions reporting, cross-agency coordination, and participatory decision-making. It should have the mandate to conduct independent scientific reviews, engage stakeholders, and guide state-level climate action plans in line with national objectives, ensuring coherence, accountability, and long-term political resilience.

- **Conduct a nationwide audit of climate-related skills and resources across ministries, led by NRES and the Public Services Department.** Use results to develop a targeted roadmap for recruiting, upskilling, and retaining talent in climate finance, science, and adaptation planning. This will ensure Malaysia's climate ambitions are matched by a skilled, future-ready public sector.
- **Integrate climate mitigation and adaptation into EIAs.** Update EIA guidelines to systematically assess both GHG emissions and climate resilience from the outset of the project design stage. This includes evaluating emissions and reduction options, considering future climate scenarios, and identifying vulnerabilities to extreme weather, flooding, or sea level rises. Embedding these analyses into EIA processes will ensure projects incorporate climate-resilient design measures—such as green infrastructure and adaptive materials—making EIAs a key tool for low-carbon, climate-resilient development.
- **Institutionalize regular climate risk and vulnerability assessments to inform adaptation strategies.** Establish a permanent, multisectoral mechanism for national climate risk assessments and institutionalize five-yearly national climate risk assessments, co-led by NRES, NADMA, and NAHRIM, with structured inputs from academia, the private sector, and civil society. Mirroring the United Kingdom's Climate Change Risk Assessment model, these exercises should be evidence-based, transparent, and directly linked to adaptation budgets, infrastructure investment priorities, and state-level resilience plans.
- **Expand SDG budget tagging to require mandatory climate-specific tagging across all ministries and agencies.** Enable the Ministry of Finance to systematically track green expenditures, assess alignment, and redirect misaligned funds. This transparency will boost domestic accountability and improve access to global climate finance.
- **Institutionalize and strengthen the EFT to reward conservation and climate performance.** Formalize the EFT within Malaysia's fiscal framework through a clear policy or legal instrument to provide permanence, transparency, and accountability in rewarding state-led conservation. Establish defined allocation criteria, monitoring systems, and public disclosure of data and formulas to strengthen trust. To enhance impact, gradually increase allocations to reflect opportunity costs, supported by revenues from carbon pricing or green taxes, and integrate climate resilience criteria as capacity improves—turning fiscal transfers into a powerful incentive for state-driven environmental and climate leadership.
- **Integrate climate and biodiversity criteria into broader fiscal transfers.** Beyond the EFT, incorporate climate and conservation performance indicators into the design of existing federal–state transfers to strengthen policy alignment and accountability. Constitutionally protected grants may require longer-term legal changes, but non-constitutional transfers can be adjusted more flexibly through administrative or policy measures. Gradually embedding performance-based incentives and conditionalities across Malaysia's fiscal system would ensure that public funds consistently reinforce, rather than offset, the country's climate and conservation commitments.
- **Strengthen local authorities' capacity and financing for urban climate action.** Expand National Spatial Data Infrastructure to provide high-resolution climate data to local authorities for evidence-based planning. Improve coordination and representation through dedicated climate units and networks and build technical capacity via specialist roles and training. Establish a Malaysia Urban Green Project Preparation Facility to support project development and access to concessional finance. These measures will enable local authorities to shift from reactive disaster responses to proactive, integrated climate governance to strengthen urban resilience and sustainability.

Photo: © World Bank.

6

From Ambition to Action: Securing the Financing for Climate Action

Photo: © World Bank.

6. From Ambition to Action: Securing the Financing for Climate Action

Key Message #6: Substantial climate financing needs can be met with carbon pricing and the mobilization of additional public revenue and private capital.

6.1. Climate investment needs

Addressing the climate challenge demands action that is both ambitious and achievable, recognizing the scale of transformation required to ensure a resilient and sustainable future. Malaysia's total climate investment needs for mitigation and adaptation from 2025 to 2050 are estimated at US$1,229.11 billion to US$1,525.94 billion at today's prices.[38] This represents 3.02–3.65 percent of estimated cumulative GDP over the period at a discounted rate. Of the total, climate adaptation accounts for the majority, from US$379.95 billion to US$501.16 billion (Table 6.1), at the discounted rate. Investment will mostly be public, encompassing infrastructure, irrigation and water supply projects, flood mitigation and adaptation, disaster risk and resilience solutions and heat stress prevention. Private investments are expected to complement public efforts, covering private asset upgrades, climate-smart agriculture and irrigation, among others. Mitigation investments are estimated at US$376.76 billion nominal (or US$198.98 billion NPV), with major financing allocations toward decarbonization of the power sector, low-carbon transport such as electrical vehicles, and LULUCF emissions reductions. The private sector would need to account for the bulk of investment. These figures reflect the additional resources required to implement priority climate actions relative to a BAU pathway and underscore the significance of aligning climate and development finance strategies.

Table 6.1. Incremental investments and costs relative to BAU scenario (US$ million)

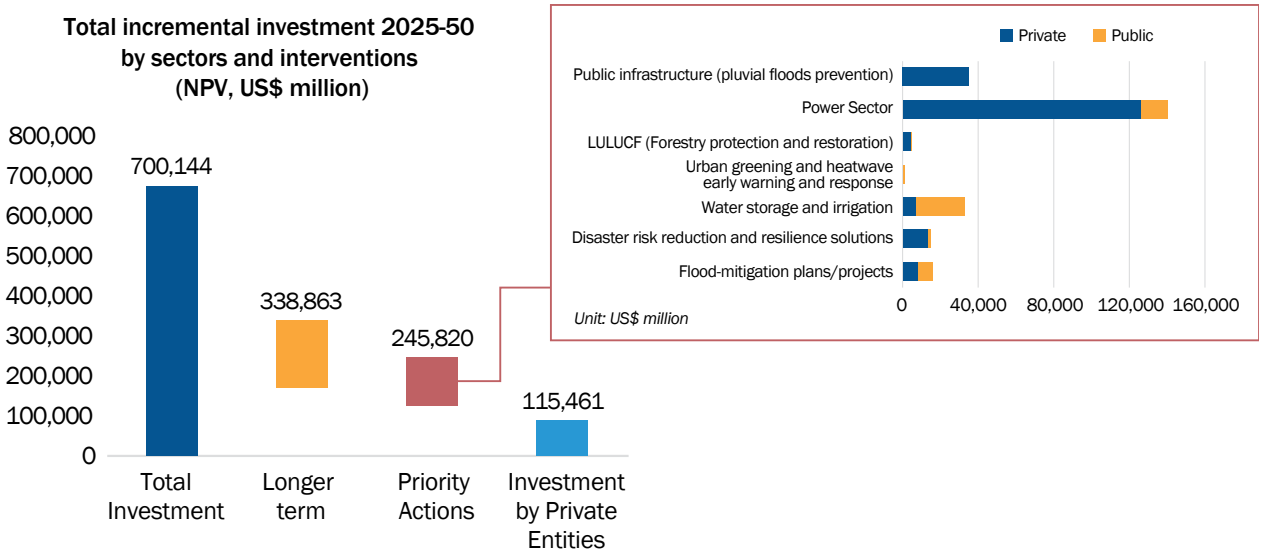
New Investment	Undiscounted totals, 2025–50	NPV of totals, 2025–50
Category 1: Investments expected to be made by private firms and individuals		
Renewable energy expansion	98,000	46,900
Transport (electric vehicles)	19,500	6,370
Air conditioning	45,000	23,856
Category 2: Immediate priorities for public or international financing		
Flood-mitigation plans/projects	44,140	15,940
Water storage and irrigation	77,885	33,469
Urban greening and heatwave early warnings and responses	488.15	258.78
LULUCF (forestry protection and restoration)	9,172	4,862
Power sector	265,687	140,848
Public infrastructure (pluvial floods prevention)	66,456	35,230
Category 3: Longer-term actions for public or international financing		
Water supply infrastructure	168,976	69,848
Sub-total	*795,304*	*377,581*

[38] US$578.93 billion to US$700.14 billion in discounted NPV, assuming a 6 percent discount rate.

Retrofitting Investment	Undiscounted totals, 2025–50	NPV of totals, 2025–50
Category 1: Investments expected to be made by private firms and individuals		
Private asset upgrades	85,551	38,335
Category 2: Immediate priorities for public or international financing		
Disaster risk reduction and resilience solutions	32,563	15,212
Category 3: Longer-term actions for public or international financing		
Public infrastructure (upgrading and retrofitting)	612,524	269,016
Sub-total	*730,638*	*322,563*
Total	***1,525,942***	***700,144***

Source: World Bank staff calculations

Figure 6.1. Financing needs call for significant scaling-up of climate finance



Source: World Bank staff calculations

Malaysia's climate financing needs can be addressed through three primary avenues. Given the scale of investments required for both climate mitigation and adaptation, Malaysia will need to tap multiple sources of funding. While public financing remains the most immediately viable option, reflecting the government's fiscal capacity and policy frameworks, it must be complemented by greater domestic private sector participation and external finance, including international climate funds such as Green Climate Fund (GCF) and FDI. A critical challenge is ensuring that projects are bankable to attract private capital, so limited public funds remain allocated to critical other development priorities. The following sections examine mechanisms to mobilize these resources to support Malaysia's climate commitments and economic ambitions.

6.2. Mobilizing public sector finances

Significant public financing hurdles must be overcome by Malaysia to support its long-term development and climate goals. Chronically low tax capacity, reflected in persistently modest revenue collection despite incremental reforms, limits fiscal flexibility and constrains efforts to finance inclusive growth, climate

adaptation, and mitigation, as well as essential public services. Malaysia has struggled to broaden its narrow tax base, particularly in personal income and capital gains taxation, while its reliance on regressive consumption taxes risks deepening inequality. Additional challenges include the need to rationalize fragmented corporate tax incentives, modernize outdated tax administration systems, and build political consensus for reforms, such as broadening the GST/VAT framework (World Bank, 2022). Without a robust Medium-Term Revenue Strategy to address these structural weaknesses, Malaysia risks continued fiscal shortfalls, delayed climate investments, and a potentially unsustainable debt trajectory.

Malaysia's pathway to decarbonization hinges on the strategic and timely implementation of carbon pricing as a catalyst for systemic change. With the government planning to implement a carbon tax on the iron, steel, and energy sectors in 2026, collaboration with the World Bank through the Malaysia Partnership for Market Implementation (PMI) is helping establish a strong framework to guide this transition. Using HA scenario carbon prices from the PMI, analysis suggests significant potential for structural shifts across key sectors. In steel, for instance, carbon pricing would make traditional blast furnace operations less competitive than electric arc furnace production, potentially reducing sectoral emissions by around 2.5 $MtCO_2e$ annually (25 percent), aligning with global decarbonization trends. Achieving these outcomes, however, will depend on targeted policy measures, transitional financing, and capacity-building programs to support industries, maintain competitiveness, and ensure a just and equitable transition for workers and communities.

Potential revenue from carbon pricing is significant. The revenue potential of a carbon tax in Malaysia will largely depend on its design—specifically, which sectors are included, the tax rate applied, and the treatment of exemptions or offsets. The allocation of carbon tax revenues will also play a key role in ensuring that the tax not only drives emissions reductions, but also supports social equity, for example by funding low-carbon investments, compensating vulnerable households, or promoting just transition measures. The 2025 Budget announcement earmarked carbon tax proceeds for green technology research and deployment. However, channeling a portion of revenue into targeted cash transfers or a Just Transition Fund could help cushion energy price shocks for vulnerable households, ensuring the policy does not exacerbate inequality (Section 3.8). Some revenues may also need to be used to offset competitiveness impacts (Section 3.9). However, a careful balancing act is required: overly generous exemptions or subsidies could dilute emissions reduction targets and expose Malaysian exports to trade penalties (e.g. from CBAM). Conversely, overly stringent pricing could strain domestic industries unprepared to manage abrupt transitions.

To navigate these challenges, Malaysia should adopt a phased and transparent approach to carbon pricing. Revenues should be recycled not only into green innovation, but also into social safety nets such as subsidies for energy-efficient housing retrofits and retraining programs for workers in high-emission sectors. Carbon pricing trajectories should be aligned with national sector-specific roadmaps to ensure that viable low-carbon technologies are effectively incentivized. In parallel, aligning tax design with international benchmarks like CBAM and advocating for equitable global carbon pricing frameworks will enable Malaysia to strengthen its climate leadership, while reducing GVC exclusion risks.

Raising adequate financing for climate adaptation poses significant fiscal challenges. Unlike mitigation investments, which can generate measurable and short-term returns (e.g. energy savings), adaptation projects often yield benefits that are harder to monetize and may only materialize over longer timeframes. Moreover, these benefits can be especially difficult to quantify, further weakening the business case for investments in climate adaptation and resilience. Externalities embedded in adaptation investments frequently lead to the mispricing of benefits, costs, and risks. In other words, uncertainty about the timing and magnitude of returns hampers the bankability of these projects. Investments in flood defenses, resilient infrastructure, and early warning systems are thus less attractive to private investors, and cost recovery mechanisms are limited (Section 6.3). With 70 percent of GDP generated in climate-exposed geographic zones, Malaysia's adaptation finance remains inadequate (BNM and World Bank, 2024). The country also

faces limited access to international concessional finance, further constraining funding options. At the same time, public resources are stretched thin by competing demands, including post-disaster recovery, which frequently crowds-out proactive spending on ex-ante adaptation efforts. Agrobank and other agrofood financing schemes could be expanded to support smallholders, promote climate-smart practices, integrate digital advisory services, and incentivize innovation in agro-processing and renewable energy, while tracking outcomes to align with Malaysia's sustainability and industrial decarbonization objectives.

While climate adaptation is inherently local with needs and priorities varying substantially across states and districts, local authorities face major financing challenges. Despite being on the frontlines of climate risk management, local authorities operate with fragmented mandates, limited technical capacity, and scant access to long-term finance. More than 90 percent of revenues come from local sources, with a similar share spent on routine operations, leaving limited funds for climate investments. Borrowing options are still underdeveloped, and accessing federal or state funding involves navigating complex intergovernmental procedures. Local authorities often lack both the financial tools and technical capacity needed to design and implement robust, bankable climate projects.

Expanding the use of EFTs could incentivize investments in ecosystem services and nature-based solutions at state level to boost climate resilience. EFTs, which distribute public funds based on ecological or climate-related criteria, can be combined with other tools such as blended finance for adaptation. Additionally, targeted de-risking measures such as insurance, risk-pooling, and credit guarantees, alongside public incentives like the Green Investment Tax Allowance or disaster relief funding could help attract private capital and direct support to vulnerable communities.

This report recommends:

- **Fiscal and tax reforms for climate resilience.** Malaysia's low tax-to-GDP ratio (11.8 percent versus ASEAN's 14.4 percent) and rising climate risks strain funding for critical adaptation infrastructure (e.g., flood barriers) and a low-carbon transition. To bridge this gap, the government should broaden the tax base by targeting underutilized streams like personal income, capital gains, and digital economy activities, while modernizing tax administration and phasing out inefficient corporate incentives. Reintroducing a progressive GST with low-income safeguards could boost revenue equitably. A Medium-Term Revenue Strategy would align fiscal planning with climate priorities, ensuring stable funding for resilience without austerity.
- **Equitable carbon pricing.** A phased carbon tax (US$30–50/t$CO_2$e by 2026) targeting energy and industrial sectors could spur clean tech adoption. Households in Kelantan and Sabah spend up to 15 percent of their income on energy (DOSM, 2022), highlighting energy poverty risks. Redirecting revenues toward green innovation and social safety nets can alleviate this burden. Aligning tax exemptions with EU CBAM standards protects export competitiveness while limiting carve-outs for palm oil and cement. Malaysia should also advocate for fair global carbon pricing in trade agreements to prevent economic disadvantages.
- **Unlock public finance for adaptation.** Scaling-up public climate adaptation projects—such as flood-proof infrastructure as well as those leveraging nature-based solutions like mangrove restoration—requires mechanisms like EFTs to reward states conserving peatlands and watersheds. Empowering local governments, including through grants and capacity-building efforts, enables local solutions, such as Kuala Lumpur's drainage upgrades and Sabah's drought-resistant crop subsidies. Moreover, such efforts can have demonstration effects regarding the effectiveness of adaptation investments, thereby promoting scalable private investments. Policymakers could consider developing a National Climate Finance Strategy that includes adaptation financing to help catalyze and coordinate investments.

6.3. Mobilizing private sector finances

While sustainable finance has grown in Malaysia, it remains small relative to the overall size of financial markets and has limited reach. Between 2017 and 2024, approximately US$21 billion was raised via tracked sustainable debt instruments, with US$15 billion generated in just 2022–24 (Figure 6.2).[39] However, this accounted for only 4.7 percent of total market financing, underscoring significant potential for growth.[40] In addition, the reach of capital markets remains limited, with fewer than 15 non-financial companies raising funding directly either through sustainable bonds or sukuk, or syndicated loans annually. Similar patterns appear within the domestic banking system, although data is more limited. Information from the annual reports of Malaysia's largest banks indicates that US$37 billion was allocated for sustainability purposes between 2022 and 2024, representing around 4 percent of outstanding loans over this period.[41] Equity financing also is limited, with only 2 percent of private equity and venture capital investments directed toward sustainable activities.

Sustainable finance in Malaysia has funded both green and social goals. Since 2017, about 43 percent of tracked sustainable financing from capital markets has been directed toward social goals, such as affordable housing and SME financing, while the remainder targeted green initiatives (Figure 6.2). Allocation varies by issuer. Non-financial corporations allocated almost all proceeds to green projects like renewable energy investments, whereas financial institutions, development financial institutions (DFIs), and the government predominantly use these instruments to fund social projects. For example, DFIs allocate only 18 percent of sustainable bonds and sukuk proceeds to green investments. Similarly, commercial banks channeled about 35 percent of sustainability-related loans allocated to green purposes, including for renewable energy, energy efficiency, clean transport, and green buildings in 2024.[42]

Notably, there is a lack of funding toward climate adaptation and resilience. No tracked financial flows, including from capital markets and bank loans, specifically target resilience. There is also no tracked financing realizing nature-based climate adaptation solutions. Ex-ante financing for climate risk mitigation (such as flood-resistant infrastructure, drought-resistant agriculture) and ex-post resilience mechanisms (such as climate insurance, disaster recovery funds) remain critically underdeveloped (BNM and World Bank, 2024). Households and SMEs that are most vulnerable to floods and other climate shocks lack access to financial buffers that leave them particularly vulnerable to escalating climate risks. Blended finance is an important tool to help close the financing gap for sustainable and climate-friendly investments.

Insurance penetration remains particularly limited with significant protection gaps among vulnerable populations. Accurate risk assessments are hindered by limited data and modeling capabilities – particularly around bridging data granularity gaps, translating complex climate risk drivers into financial impacts, and managing long-term modeling uncertainties – which affect the development of effective insurance solutions. Additionally, there is a pressing need to design insurance products that are affordable and accessible to low-income and informal sector participants. Further, it remains crucial to align regulatory frameworks,

[39] Sustainable debt instruments include sustainable bonds and sukuk, along with sustainable syndicated loans. Data taken from Climate Bonds Initiative's Green Bond Database, Social and Sustainability Bond Database, and Sustainability-Linked Bond Database, and Refinitiv/LSEG's SDC Platinum Financial Securities Database.

[40] Total market financing refers to the combined value of financial resources raised through bonds and sukuk (Islamic bonds), syndicated loans (loans provided by a group of lenders), and private equity (PE) or venture capital (VC) investments. Data for total market financing are sourced from Refinitiv/London Stock Exchange Group (LSEG) and PitchBook, which track capital market activity and private investment transactions.

[41] World Bank staff calculations based on 2022–24 published sustainability reports from Malaysia's top-six banks.

[42] Sustainability reports of the top-six commercial banks in Malaysia.

industry practices, and public policy to ensure that the insurance sector can better navigate the complexities of a changing climate while ensuring resilience and equitable protection for vulnerable communities. Yet, mobilizing capital for climate adaptation and mitigation via insurance-led solutions will be important. Innovative instruments such as jurisdiction-specific climate-resilient bonds, insurance-linked financing, and results-based adaptation financing can help ensure adaptation finance moves beyond concessional funding toward sustainable private investment.

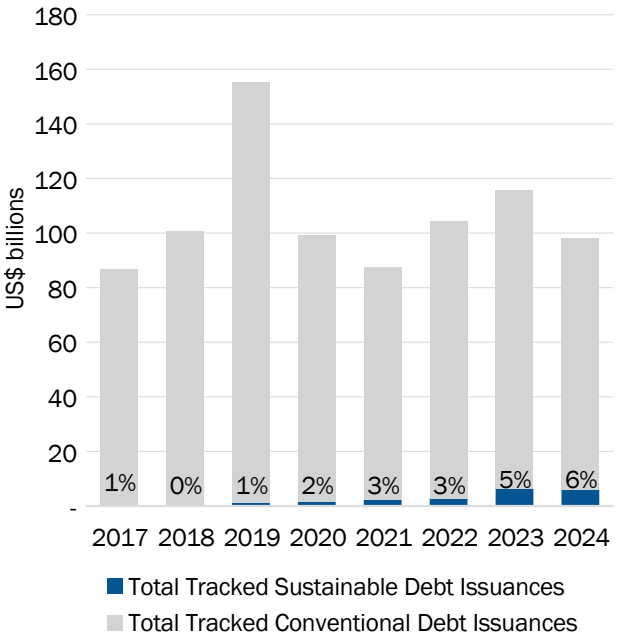
Sustainable debt financing dominates Malaysia's climate finance ecosystem, but private equity is quietly supporting innovation. Venture capital has funded a diverse array of cutting-edge solutions using clean and climate technologies, including biofuels, green materials, circular economy technologies, and advanced waste and water management systems (Figure 6.3). In contrast, sustainable debt instruments remain narrowly focused on established sectors like hydropower, solar power, and green transport infrastructure, alongside energy efficiency efforts. Green buildings, water and waste management, and land use receive significantly less funding through tracked capital market issuances, reflecting a risk-averse approach among market participants. This dichotomy underscores critical dynamics in financial markets: debt markets can be effective in funding scalable, relatively low-risk projects, while equity markets can fund innovations with transformative potential.[43]

Overall, Malaysia's climate financing landscape has notably evolved, but investment flows remain insufficient to meet the country's 2050 climate targets. Since 2022, annual inflows toward green activities have averaged US$2.5 billion from syndicated loans, bonds, and sukuk, alongside an estimated US$3.7 billion from the domestic banking sector. However, these amounts fall short of total investment needs (Figure 6.1). Critical areas like climate adaptation, circular economy innovations, and biodiversity conservation remain significantly underfunded. The complementary role of debt and equity financing, as well as insurance, underscores the importance of developing financial markets more holistically to accelerate Malaysia's transition to a sustainable and resilient economy. MITI's Green Investment Strategy complements ongoing efforts to strengthen the sustainable finance ecosystem by enhancing investor confidence, improving transparency, and aligning industrial investment promotion with climate objectives. The strategy seeks to expand access to green capital through clear investment taxonomies, ESG-linked facilitation services, and stronger collaboration with the Ministry of Finance (MoF), Malaysian Green Technology and Climate Change Corporation, and financial sector.

[43] This dichotomy is generalized to a broader context in Didier and Cusolito (2024), Unleashing Productivity through Firm Financing.

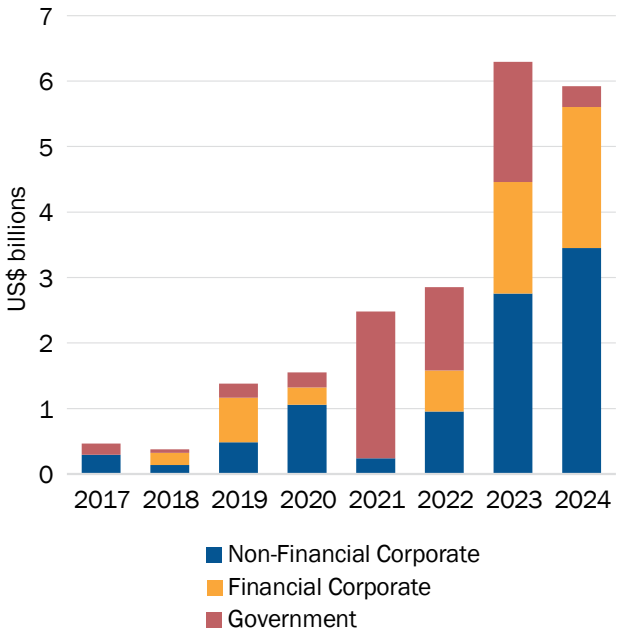
Figure 6.2. Sustainable financing in Malaysia

6.2a. *Total tracked sustainable debt issuances*



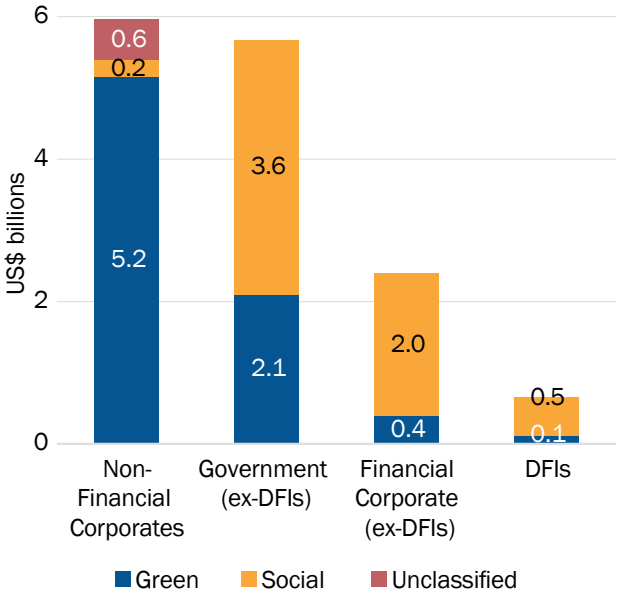
Source: CBI and LSEG/Refinitiv

6.2b. *Profile of sustainable bonds, sukuk and loans*



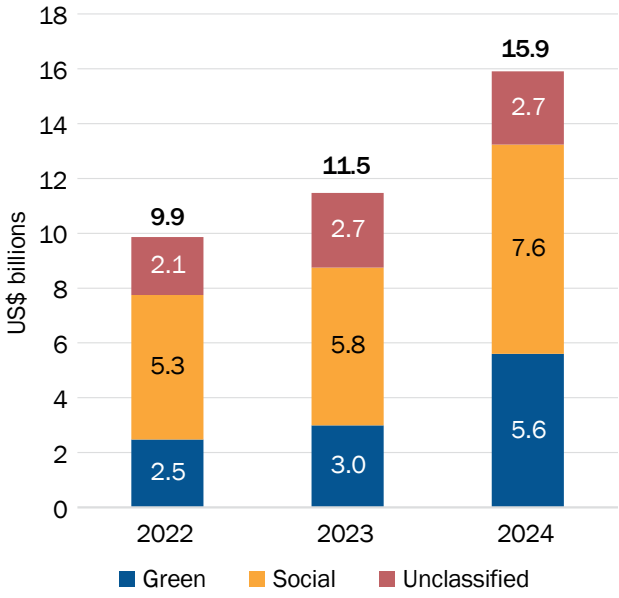
Source: CBI and LSEG/Refinitiv

6.2c. *Composition of sustainable debt finance: sustainable bonds and sukuk (2017–24)*



Source: CBI and World Bank analysis of issuers' disclosure documents

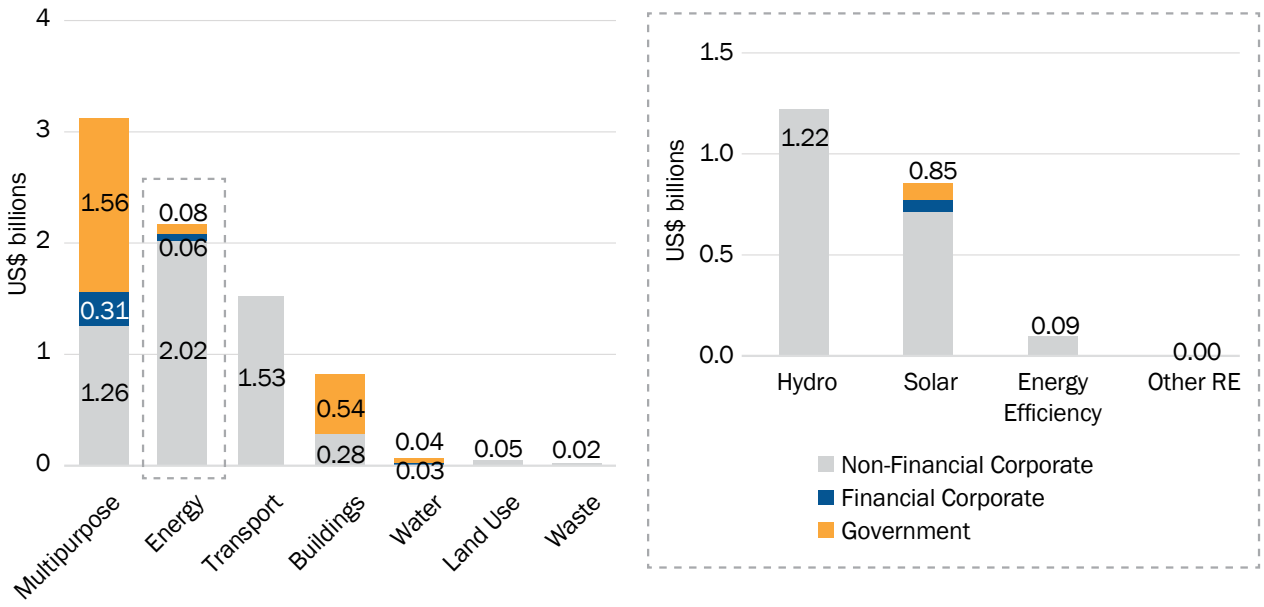
6.2d. *Composition of sustainable loans from top-six domestic commercial banks*



Source: Annual and sustainability reports from domestic commercial banks

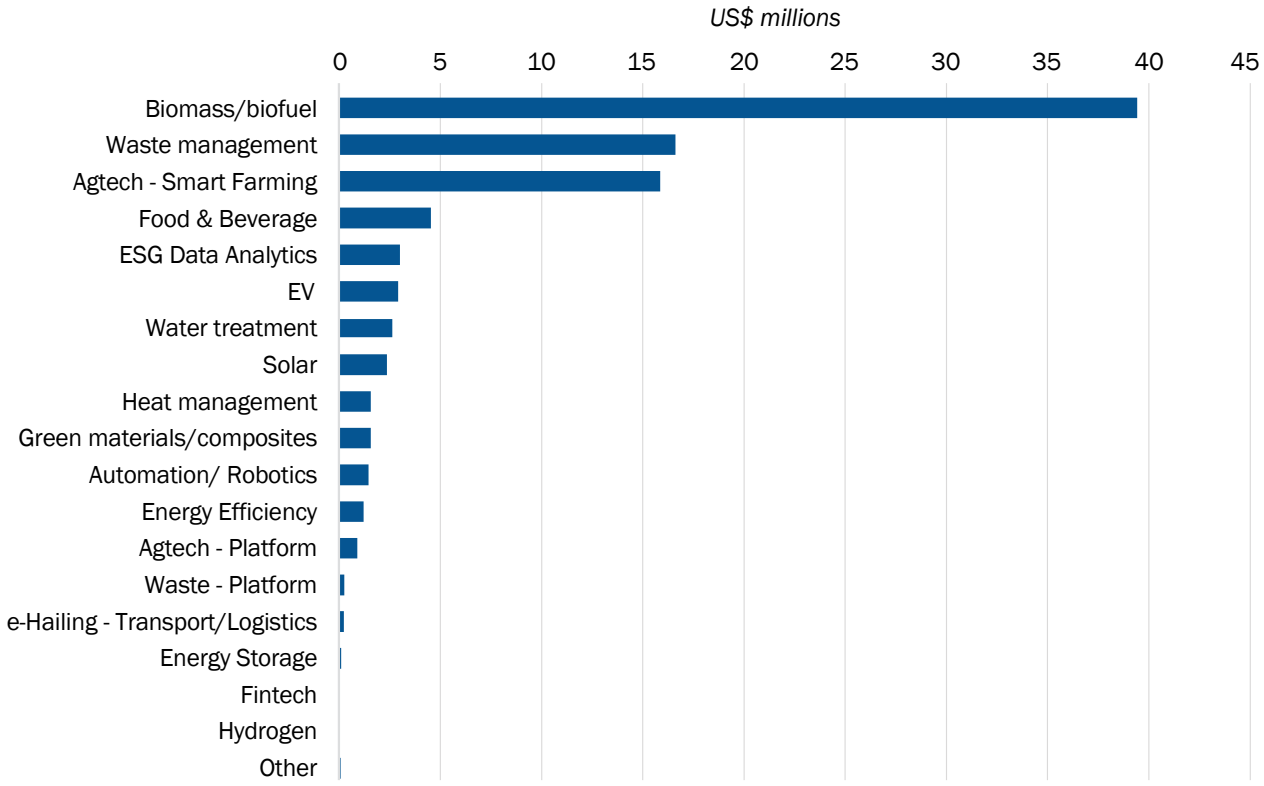
Figure 6.3. Range of green activities funded through sustainable finance

6.3a. *Green activities funded through sustainable bonds and sukuk (2017–24)*



Source: CBI and World Bank analysis of issuers' disclosure documents

6.3b. *Green activities funded through venture capital and private equity*



Source: Pitchbook

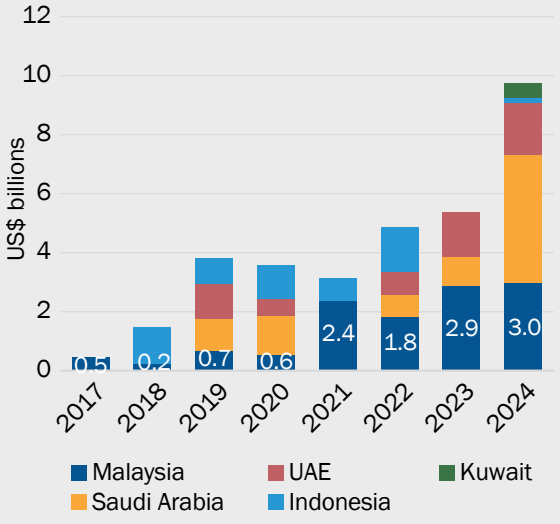
Box 6.1. Malaysia as a global leader in the sustainable Islamic finance space

Malaysia has established itself as a global leader in sustainable Islamic finance, particularly issuances of sustainable sukuk (Figure B1). Sustainable sukuk have accounted for 80 percent of sustainable issuances in capital markets in Malaysia since 2022. The country has played a pioneering role in this growth, starting with the launch of the world's first green sukuk in 2017. By December 2024, its cumulative sustainable sukuk issuances reached US$12 billion, reflecting a commitment to align Islamic finance with climate and sustainability goals. Malaysian corporate issuers accounted for about 60 percent of global sustainable sukuk corporate issuers between 2022 and 2024, underscoring the country's continued leadership and innovation in this niche, but growing market segment. The Securities Commission Malaysia and Bursa Malaysia established a sustainable sukuk framework that enables issuers to raise capital via SRI-linked sukuk, tying financial terms to sustainability Key Performance Indicators.

Effective leadership in Islamic finance offers a strategic opportunity — but realizing this potential will require overcoming regulatory and market challenges. Malaysia has pioneered sustainable Islamic financial products, such as green sukuk and waqf-linked funds, that have seen substantial growth. Yet, challenges persist, including a lack of standardization, limited ESG integration in investment decisions, and low global investor awareness. Scaling Islamic sustainable finance will require continued innovation, clearer ESG criteria, and targeted capacity building to broaden participation across the financial system. To unlock the full potential of sustainable finance, Malaysia must prioritize a coherent and inclusive ecosystem: dynamic standards, improved data systems, and targeted support for vulnerable market segments like SMEs and non-banks. Strengthening climate risk management and leveraging Islamic finance will be central to positioning Malaysia as a global leader in responsible and resilient financial markets.

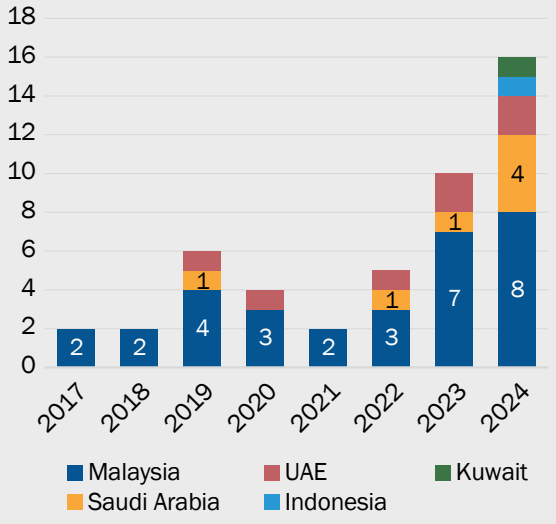
The ongoing Eco-Industrial Park initiative, coordinated by the MITI in collaboration with the World Bank, provides a promising platform for advancing measurable sustainability outcomes within industrial clusters. It also offers a policy and operational roadmap for integrating environmental sustainability and inclusive economic growth into Malaysia's broader industrialization strategy.

Figure B1. Volume of global sustainable sukuk issuances



Source: CBI

Figure B2. Number of corporate issuers of sustainable sukuk



Source: CBI

Malaysian authorities have introduced a wide array of policies and initiatives to promote sustainable finance, yet significant gaps remain relative to international standards. A World Bank assessment found that these measures have increased the uptake of climate finance—particularly among larger financial institutions—but implementation across the broader financial sector remains uneven. Malaysia does have strong foundational frameworks, including the Financial Sector Blueprint 2022–26, Capital Markets Masterplan 3, and the SRI Roadmap, which provide a basis for the CCDR's analysis of climate-finance readiness and potential pathways for scaling green investment. However, the country lacks an integrated climate finance strategy that systematically assesses national and sectoral funding needs and outlines a clear plan to close financing gaps. Existing governance structures, such as the Joint Committee on Climate Change (JC3), foster stakeholder collaboration, but their limited authority and focus primarily on financial-sector participants constrain effectiveness. Strengthening coordination, monitoring, and capacity across the financial sector remains a critical opportunity to accelerate the scale of sustainable finance in Malaysia.

Key initial steps to strengthen Malaysia's information architecture for sustainable finance have been taken. This has resulted in establishment of two principles-based taxonomies—the Climate Change and Principle-based Taxonomy for banks and the Sustainable and Responsible Investment Taxonomy for capital markets. However, the absence of clear technical thresholds and harmonized frameworks creates ambiguity, raises compliance costs, and complicates implementation. Climate-related disclosures remain limited and inconsistent across the financial sector and broader economy, hampering transparency, accountability, and effective capital allocation. Recent policy advances are promising, such as BNM's mandated climate disclosures and the phased introduction of the National Sustainability Reporting Framework aligned with global standards. However, robust execution will be key. At the same time, Malaysia's climate data infrastructure remains fragmented, constraining access to reliable information and undermining efforts to assess risks or align financial flows with climate goals. While initiatives like JC3 Climate Data Catalogue offer a foundation, further investment is needed to build a comprehensive, integrated climate data ecosystem that can truly mobilize sustainable finance.

On prudential regulation, Malaysia has introduced climate risk management and climate stress testing guidelines broadly aligned with international best practices. Yet, significant gaps persist: there is limited locally tailored guidance for scenario development—especially for acute physical risks like flooding—and not all financial sector actors are covered. Transition planning guidance for financial institutions and integration of climate risk scores into supervisory assessments have yet to materialize. Continued progress in these areas will be vital for embedding climate considerations across the sector and ensuring resilience in the face of escalating climate risks.

At the same time, new sustainability regulations could have unintended consequences. As financial institutions tighten climate-risk management, they may shift capital away from smaller or higher-risk clients—leaving many SMEs, especially those unable to meet climate reporting requirements, facing reduced access to finance. Non-bank lenders, which often support these smaller businesses, could also be squeezed by increased regulatory and funding pressures. Without safeguards, climate-focused reforms risk unintentionally undermining financial inclusion and resilience. Currently, there are no systematic monitoring mechanisms to assess these side effects. Financial authorities should address this by closely tracking potential impacts and, where necessary, introducing proportionate transition-credit facilities or guarantee schemes to ensure SMEs remain supported during the low-carbon transition (Carvajal and Didier, World Bank, 2024).[44]

Malaysia has made notable strides in developing instruments and incentives to support sustainable finance, however, significant gaps remain. Notably, the country is aligning its sustainable finance framework with the ASEAN Taxonomy to promote harmonized green and transition investments across the region, while

[44] Didier, Tatiana, and Ana Paula Cusolito. 2024. Unleashing Productivity through Firm Financing. Washington, DC: World Bank. doi:10.1596/978-1-4648-1939-1.

regulators have introduced frameworks such as SRI sukuk and bond standards aligned with ASEAN and Green Loan Principles. These initiatives are in step with targeted incentives like BNM's GTFS and Disaster Risk Management Scheme to promote green lending and SME resilience. Securities Commission Malaysia supports market development through tax deductions and grants that subsidize the costs of external reviews for SRI sukuk and bonds. However, the range of financial instruments is not fully aligned with Malaysia's climate ambitions, particularly climate adaptation, just transition, and nature-related investments—all of which remain underdeveloped. Growth in sustainability-linked instruments such as bonds, sukuk, loans, and blended finance is limited. The absence of strong linkages between incentive schemes and a national taxonomy, as well as limited insurance and voluntary carbon market activity, also constrain progress. Ultimately, to mobilize more capital for transformative, climate-resilient investments, Malaysia will need stronger alignment with national priorities, innovative de-risking solutions, and greater collaboration across the financial system.[45]

The launch of the Climate Finance Innovation Lab (CFIL) represents a promising step forward. Supported by JC3 and administered by Bank Pembangunan Malaysia Berhad, a development bank in Malaysia, CFIL aims to serve as a national platform to incubate concrete, scalable projects for climate mitigation and adaptation by bridging public and private capital. Securing dedicated resources or mechanisms for pre-investment work—such as project screening, pre-feasibility studies, and preparation—will be critical to building a robust pipeline of bankable projects.

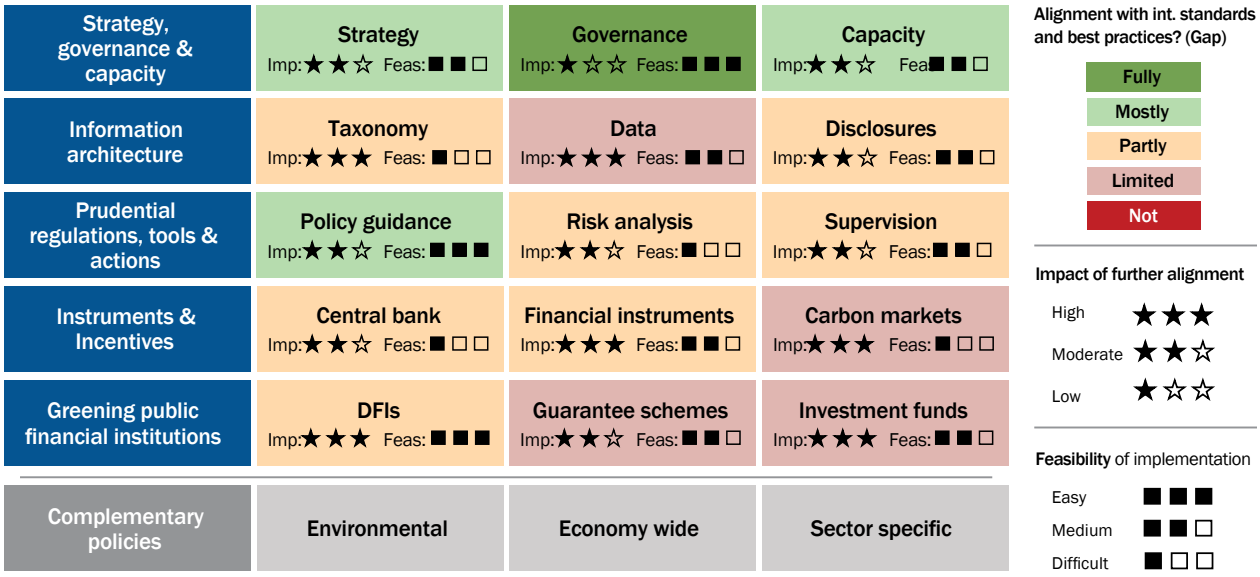
Malaysia's public financial institutions—including six government-linked investment funds managing more than US$400 billion and four DFIs with assets of around US$60 billion—hold considerable potential to catalyze private climate investment, yet this capacity remains underutilized. Although most government-linked investment funds have opened the door to climate risk management, with four institutions joining the United Nations Principles for Responsible Investment (UN PRI) - a global network that encourages investors to integrate environmental, social, and governance (ESG) factors into their investment decisions, DFIs have yet to align portfolios and targets with Malaysia's climate ambitions. Moreover, innovative climate finance instruments to attract private sector participation are rarely deployed. Support for vulnerable groups such as micro, small, and medium enterprises is also fragmented, with credit guarantees often limited to short-term government initiatives rather than embedded in long-term strategies. Unlocking the full catalytic role of these institutions will require clear mandates, ambitious climate targets, and expanded use of blended finance tools to drive public and private investment toward Malaysia's net-zero goals.[46]

Several challenges to tap international climate finance at scale are apparent, especially blended financial structures. International climate finance offers opportunities to support Malaysia's climate agenda. Global mechanisms such as the GCF, Climate Investment Funds, Just Energy Transition Partnerships (JETPs), Climate Investment Fund Accelerating Coal Transition window, and bilateral partnerships can help mobilize concessional funding and technical assistance, particularly in sectors where commercial financing remains limited. However, as an upper middle-income country, Malaysia competes with lower-income nations for limited concessional resources and must clearly demonstrate additionality, impact, and co-benefits to justify funding. Weak project pipelines, fragmented institutional coordination, limited accountability and transparency, and the absence of standardized monitoring methodologies further hamper access and investor confidence. Moreover, Malaysia lacks an accredited institution to directly access resources from GCF, the world's largest dedicated climate fund. Addressing these issues through a clear national financing strategy, stronger governance, enhanced project preparation and accredited entities is crucial to fully leverage international support and mobilize private capital.

[45] At the ASEAN level and under the chairpersonship of Malaysian authorities, work has been initiated on ASEAN Mitigation, Adaptation, Resilience and Sustainable Finance (MARS).

[46] Total assets under management of six government-linked investment funds as at end-2024 was estimated at US$422 billion (RM1.88 trillion), based on the funds' latest annual reports and press releases. Total assets of DFIs in Malaysia are around US$60 billion (RM267 billion), based on latest publicly available reports.

Figure 6.4. World Bank assessment framework for Malaysia on policies, regulations and initiatives to support sustainable finance

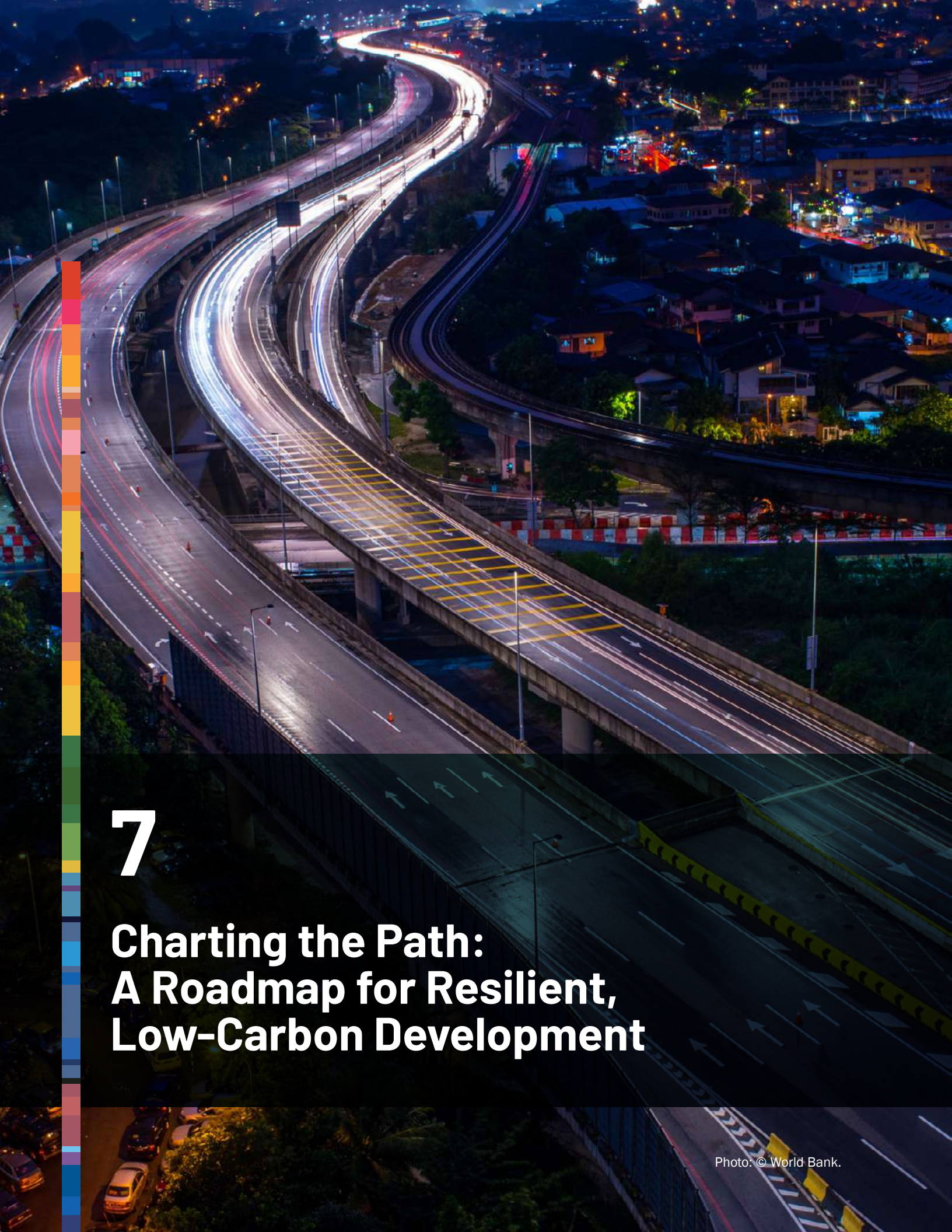


Source: World Bank analysis
Note: The policy scoring reflects an expert assessment that compares Malaysia's practices against relevant standards, guidance, and sound practices in peer countries. The benchmark draws on an updated version of the World Bank's 2021 Toolkit for Greening the Financial System.

This report recommends:

- **Malaysia should develop a unified climate finance strategy encompassing mitigation and adaptation,** aligned with national and sectoral plans. This strategy must clearly define investment needs, priority sectors, choice of financial instruments, and engagement pathways for investors and partners. The JC3, co-chaired by BNM and Securities Commission Malaysia, should be strengthened to serve as Malaysia's central climate finance coordinator, responsible for guiding market standards, overseeing progress, and supporting development of a robust pipeline of bankable climate projects. A more empowered JC3 would enhance market transparency, provide unified direction to financial institutions, and improve the flow of capital toward priority sectors aligned with national strategies such as the NETR and NIMP 2030—ultimately helping Malaysia attract greater concessional and blended finance from global sources.
- **A just transition financing framework is necessary to ensure equitable climate action.** This includes mapping sectoral and regional impacts on labor, calculating just transition funding needs, and embedding fair finance mechanisms—rooted in the polluter-pays principle and open social dialogue—within national taxonomies and public budget processes. Integration of clear metrics will help track progress, ensure regional equity, and promote inclusive outcomes.
- **Consolidating Malaysia's sustainable finance taxonomies into one science-based framework with detailed sector guidance covering mitigation, adaptation, and nature-based solutions is essential.** Implementation of the National Integrated Climate Data Repository and the National Sustainability Reporting Framework with high-quality, globally aligned disclosures will improve capital allocation and investor confidence. Expanding climate supervision, especially for Malaysia-specific risks like flooding and establishing monitoring mechanisms for unintended regulatory consequences, will help embed climate resilience and safeguard financial inclusion.

- **Scaling-up targeted financial support along with policies and pipeline development are critical to mobilize private investment in green and resilient sectors, such as nature-based solutions.** This includes expanding the use of risk-sharing tools, blended finance, credit guarantees, and insurance, as well as operationalizing the CFIL to foster transformative projects, supported by blended finance and early-stage project preparation solutions. All support should be rigorously monitored and tailored to reach vulnerable segments.
- **Malaysia's public financial institutions—DFIs and government-linked investment funds—must align their portfolios with national climate targets** and expand guarantee schemes and innovative products for priority sectors. These institutions should track, disclose, and set annual targets for just transition outcomes, including job creation, regional resilience, and support for SMEs, thereby setting market standards and maximizing their catalytic effect. To address these challenges, federal and state Economic Planning Units could establish joint coordination committees, implement integrated development frameworks, and adopt clear fiscal and administrative protocols to streamline decision-making, align priorities, and accelerate climate and infrastructure initiatives.
- **Malaysia should strengthen cross-border collaboration through ASEAN to widen access to international climate funding** and develop regional project pipelines. Designating accredited institutions to tap global funds—such as the Green Climate Fund—paired with a strong commitment to transparency and innovation, will position Malaysia as a leading regional climate finance hub and accelerate progress on mitigation, adaptation, and inclusive transition goals.
- **Explore innovative financing models,** such as the Climate Insurance-Linked Resilient Infrastructure Fund and Restoration Insurance Service Company, that link insurance premiums or payouts to climate adaptation and ecosystem restoration, creating incentives for resilient infrastructure and sustainable coastal protection.



7

Charting the Path: A Roadmap for Resilient, Low-Carbon Development

Photo: © World Bank.

7. Charting the Path: A Roadmap for Resilient, Low-Carbon Development

This chapter presents a structured prioritization of the report's recommendations to ensure clarity and actionable outcomes for policymakers. The recommendations are organized using a multidimensional framework based on three key criteria: urgency, feasibility, and cross-sectoral impacts. This approach helps align interventions with strategic goals, resource constraints, and implementation timelines, ensuring that actions are both practical and high impact.

To guide implementation, the recommendations are categorized by urgency across two time horizons:

- **Short-term (0–2 years):** Actions in this category address immediate risks and are critical to prevent irreversible outcomes. They include regulatory reforms and urgent climate adaptation measures, with a focus on integrating nature-based solutions into urban infrastructure, particularly those that influence long-lived infrastructure or policy trajectories.
- **Medium-term (3–5 years):** These recommendations allow time for planning and capacity-building. They involve transitioning energy systems, scaling resilience initiatives, or rolling out institutional reforms.

Each recommendation is further assessed for its cross-sectoral relevance to three overarching objectives: development, climate adaptation, and climate mitigation:

- Development-oriented actions aim to reduce poverty, generate employment, and ensure equitable access to services.
- Climate adaptation measures strengthen resilience to extreme weather events, water scarcity, and other climate-related shocks, including through nature-based solutions such as wetland restoration and urban greening.
- Climate mitigation strategies seek to reduce GHG emissions through decarbonization, renewable energy deployment, and ecosystem restoration.

Recommendations with synergies across these dimensions—such as Embed Climate Targets in Agrofood Policy that promote equity, enhance climate resilience, and reduce emissions—are prioritized for their compounded benefits. To support decision-making, the key recommendations have been identified as those most likely to be feasible, implementable in the short- to medium-term, and impactful across multiple dimensions. They represent a practical starting point for immediate and coordinated action.

While the government rightly leads the way in setting Malaysia's green agenda, addressing climate risks and advancing decarbonization is ultimately a shared responsibility across government, the private sector, and civil society. To translate ambition into tangible outcomes, strategies could focus on stepping up awareness and capacity-building through tailored technical outreach for businesses, ongoing training for climate risk management encompassing SMEs, and strengthening the role of civil society organizations with resources to deliver locally driven solutions. Multi-stakeholder dialogue platforms can enhance transparency, alignment, and participatory governance, while incentives and recognition schemes can spur leadership and innovation in low-carbon development. By fostering these partnerships and capacities, Malaysia can ensure that every segment of society is empowered and accountable in delivering a resilient, climate-ready future.

A complete list of all recommendations is provided in Annex A.

Table 7.1. Key recommendations from the CCDR

No	Action Area	Type	Granular Recommendations	Fiscal Needs	Development Impact	Agency
1	Climate-smart agriculture and irrigation	Adaptation + Mitigation	Climate-smart agriculture and irrigation: Promote drought-resistant crops, expand precision and water-efficient irrigation, and provide climate advisory and early warning services to farmers, especially in water-stressed regions.	Budget consuming	High	Ministry-MOA; Agency-MARDI, DOA
2	Fossil fuel subsidy reform and carbon pricing	Mitigation + Fiscal Reform	Gradually phase-out fuel subsidies. Introduce targeted cash transfers and pilot carbon pricing in high-emission sectors.	Budget generating	High	Ministry-MoF
3	Green urban infrastructure	Adaptation + Mitigation	Integrate nature-based solutions, such as urban green corridors, rooftop greening and cooling zones into city planning.	Budget consuming	High	Ministry-KPKT, Agency-Plan Malaysia and State Governments
4	Modernize grids for renewables	Mitigation	Prioritize grid expansion in East Malaysia. Implement smart grid tech and enable decentralized solar and storage.	Budget consuming	High	Ministry-PETRA, Agency-Energy Commission, MGTC and TNB
5	Flood-risk management including restoring mangroves & peatlands	Adaptation	Strengthen flood risk mitigation through integrated nature-based solutions, with a focus on watershed management to enhance upstream water retention, reduce sedimentation, and buffer downstream communities against extreme rainfall events.	Budget consuming	High	Ministry-PETRA, NRES; Agency-DID, JPSM
6	Public building retrofits	Mitigation	Mandate energy audits, install solar panels on schools/ hospitals and adopt green building standards.	Budget consuming	Medium	Ministry-KKR; Agency-JKR
7	Expand climate finance	Cross-cutting	Scale-up targeted financial support, including through platforms such CFIL, blended finance and financial products fit for SMEs. Strengthen the role of public financial institutions in private capital mobilization, and enhance state and PBT-level green budgeting.	Budget generating	High	Ministry-MoF and State Governments; Agency-BNM, SC, LA
8	Streamline low-carbon construction	Cross-cutting	Simplify permitting for green buildings, fast-track sustainable materials and provide tax breaks for retrofits.	Budget neutral	Medium	Ministry-KKR; Agency-CIDB

No	Action Area	Type	Granular Recommendations	Fiscal Needs	Develop-ment Impact	Agency
9	EV Infrastructure	Mitigation	Fast-track EV charger deployment to close 3,300-station gap. Prioritize DC fast chargers on highways, leverage RM81.3 million in recent investments and tax incentives	Budget Consuming	Medium	Ministry-MITI; Agency-MIDA, TNB, EC, State Governments
10	Climate transparency portal	Governance + Finance	Publish GHG inventory and tracking tools, enable subnational data reporting and link to budget and policy outcomes.	Budget consuming	Medium	Ministry-NRES

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Annexes

Annex A. Recommendations of the CCDR

Short-Term Actions (0–2 Years)

Action Area	Granular Recommendation	Mitigation / Adaptation / Cross-Cutting	Fiscal Needs	Development Impact
Food Security & Agriculture	Develop climate-resilient rice and palm oil varieties, expand water-efficient irrigation in Kedah/Perlis and other key highland areas in Peninsular Malaysia, promote soil conservation in Cameron Highlands, promote agroforestry in Sabah/Sarawak and integrate CSA tools (weather data, precision farming, pest monitoring).	Adaptation	Budget Consuming	High
Digital Resilience & Early Warning	Deploy hyperlocal weather forecasts, early warning systems for floods/ droughts, index-based crop insurance for smallholders, expand rural broadband and digital infrastructure, especially in East Malaysia.	Adaptation	Budget Consuming	High
Farmer Support & Training	Subsidize CSA tools, expand affordable internet in rural areas, deliver Bahasa Malaysia-based training for farmers, launch community-led demonstration projects in Johor/Kelantan.	Adaptation	Budget Consuming	High
Agricultural Innovation	Increase public R&D for climate-resilient crops, foster partnerships with agritech startups and plantation companies, streamline regulatory processes for adaptation finance.	Cross-Cutting	Budget Consuming	Medium
Water Infrastructure	Upgrade dams and reservoirs with climate-resilient designs, AI-driven predictive maintenance, and community-based monitoring for adaptive management.	Adaptation	Budget Consuming	High
Urban Flood Resilience	Enhance urban/road flood resilience with innovative infrastructure (such as permeable pavements), and nature-based solutions (water retention areas, rain gardens), real-time flood monitoring (SMART Tunnel), stricter flood zoning in high-risk cities.	Adaptation	Budget Consuming	High
Adaptation Finance	Pilot blended finance (PPP, green bonds) for water/flood projects, align with national climate funds (GTFS) to attract investment.	Cross-Cutting	Budget Generating	Medium
Coastal & Mangrove Resilience	Mandate mangrove conservation in state plans, expand community-led restoration (e.g., Sarawak's Rajang Mangrove NP) and integrate nature-based solutions into disaster risk frameworks.	Adaptation	Budget Consuming	Medium

Action Area	Granular Recommendation	Mitigation / Adaptation / Cross-Cutting	Fiscal Needs	Development Impact
Public Building Retrofits	Mandate energy audits, install solar panels on schools/hospitals and adopt green building standards.	Mitigation	Budget Neutral	Medium
Capacity Building	Establish regional hydroclimate data hubs, train local experts in modeling tools, embed Indigenous/local knowledge in early warning systems and run community flood risk education campaigns.	Adaptation	Budget Consuming	Medium
Water Resources Management	Implement IWRM nationwide, prioritizing demand management (leakage reduction, tiered tariffs), digital monitoring, and rural equity.	Adaptation	Budget Consuming	High
EV Infrastructure	Fast-track EV charger deployment to close 3,300-station gap. Prioritize DC fast chargers on highways, leverage RM81.3 million in recent investments and tax incentives.	Mitigation	Budget Consuming	Medium
Social Protection	Merge social protection databases with disaster risk maps, pilot shock-responsive financing for climate-contingent payouts,	Adaptation	Budget Neutral	High
Resilient Construction	Streamline permits resilient/green buildings in vulnerable municipalities. Adopt risk-based health/safety inspections tailored to climate vulnerabilities.	Adaptation	Budget Neutral	Medium
Forest Governance	Strengthen anti-logging laws, real-time satellite monitoring, and legal protection for primary forests. Support Indigenous co-management schemes.	Mitigation	Budget Consuming	High
Plantation Emissions	Require GHG accounting for MSPO-certified plantations by 2027. Premium pricing for methane capture, peatland conservation, agroforestry.	Mitigation	Budget Neutral	Medium
Indigenous Land & Community Forestry	Fully register Indigenous forest land tenures. Fund community-led agroforestry, eco-tourism, and AI-driven deforestation monitoring.	Cross-Cutting	Budget Consuming	Medium
Green Financing	Scale-up targeted financial support, including through CFIL and blended finance, extend GTFS 4.0 for energy-efficient retrofits. Offer RM25 million in loans for upgrades, launch green REITs and sustainability-linked bonds.	Cross-Cutting	Budget Generating	Medium
Affordable Housing	Offer zero-interest retrofit loans for B40 communities. Align affordable housing PPPs with ZEB targets and offer tax breaks for sustainable materials/energy-efficient designs.	Adaptation/ Mitigation	Budget Consuming	Medium

Medium-Term Actions (3–5 Years)

Action Area	Granular Recommendation	Mitigation / Adaptation / Cross-Cutting	Fiscal Needs	Development Impact
Integrated Land Use & Forests	Institutionalize integrated land-use policy, eliminate deforestation, expand forest plantations (100,000 hectares), block plantations from high-carbon zones, scale restoration (200,000-hectare degraded forests, 500,000-hectare peatlands).	Mitigation	Budget Consuming	High
National Climate Risk Assessment	Conduct five-year national climate risk assessments, link to adaptation budgets, infrastructure priorities, and state resilience plans. Build in-house modeling capacity.	Cross-Cutting	Budget Consuming	High
SDG & Climate Budget Tagging	Expand SDG budget tagging to require climate-specific tracking across all ministries. Enable systematic tracking and redirection of green expenditures.	Cross-Cutting	Budget Neutral	Medium
Urban Climate Project Preparation	Appoint climate specialists in PBTs. Establish Malaysia Urban Green Project Preparation Facility for technical assistance and concessional financing. Create a green funding window.	Cross-Cutting	Budget Consuming	Medium
Fiscal & Tax Reform	Broaden tax base (personal income, capital gains, digital economy). Reintroduce progressive GST with low-income safeguards and align fiscal planning with climate priorities (Medium-Term Revenue Strategy).	Cross-Cutting	Budget Generating	High
Carbon Pricing	Implement phased carbon tax (US$30–50/t$CO_2$e by 2026) targeting energy/industry, use revenues for green innovation and social safeguards. Align tax exemptions with EU CBAM standards.	Mitigation	Budget Generating	High
Ecosystem Service Payments & REDD+	Pilot EFTs for states conserving peatlands/watersheds, develop carbon projects (e.g., Sarawak), finalize REDD+ strategies and build Tier 3 emissions tracking and National LULUCF Registry.	Cross-Cutting	Budget Generating	High
Power Market Liberalization	Liberalize power markets, phase out fossil fuel subsidies, implement cost-reflective tariffs, set coal exit roadmap and introduce carbon pricing.	Mitigation	Budget Generating	High
Financial Supervision	Integrate climate stress-testing and risk management into financial supervision.	Cross-Cutting	Budget Neutral	Medium
Bioenergy & Waste	Launch national roadmap to convert crop residues/livestock waste into bioenergy/compost by 2030. Generate rural incomes,	Mitigation	Budget Generating	Medium

Action Area	Granular Recommendation	Mitigation / Adaptation / Cross-Cutting	Fiscal Needs	Development Impact
Align Agriculture & Trade with Climate Goals	Introduce GHG standards in agricultural exports, support low-carbon certification and align subsidies with climate targets.	Cross-cutting	Budget Neutral	Medium
Agrofood Policy Benchmarks	Mandate sector-specific climate benchmarks for rice, oil palm, livestock in National Agrofood Policy 2021–30.	Mitigation	Budget Neutral	Medium
Farmer Training & Extension	Deploy targeted training and extension for 500,000 farmers in IoT, drones, AI-driven irrigation. Subsidize slow-release/ neem-coated urea and expand farmer education and demo plots.	Adaptation/ Mitigation	Budget Consuming	Medium
Capacity Building	Scale-up capacity building, regional knowledge hubs, continuous training for officials, embed Indigenous knowledge, community education on climate and water risks.	Adaptation	Budget Consuming	Medium
High-Value Manufacturing	Accelerate high-value manufacturing upgrades. Launch the National Eco-Industrial Parks Program, incentivize FDI and green investment and build local capabilities in solar and semiconductors.	Mitigation	Budget Consuming	High
Trade & Tech Transfer	Strengthen trade resilience and tech transfer mandates. Boost R&D to 2.5 percent of GDP and align vocational training with green sector needs.	Cross-Cutting	Budget Consuming	Medium
Net-Zero Governance	Embed net-zero 2050 target into law. Require five-year national climate risk reviews, empower regulatory bodies for emissions reporting and cross-agency coordination.	Cross-Cutting	Budget Consuming	High
Climate Data & Disclosure	Merge SRI and CCPT taxonomies. Implement National Integrated Climate Data Repository for robust risk assessment and disclosure.	Cross-Cutting	Budget Neutral	Medium
Business Support for Resilience	Focus public programs and finance on firms most exposed to climate risks. Embed advisory services in support programs and expand concessional loans for clean technology and resilience practices.	Adaptation/ Mitigation	Budget Consuming	Medium

Annex B. Position Malaysia as a Regional Green Hydrogen Hub Through Strategic Investments[47]

Malaysia is leveraging its abundant solar, hydro, and offshore wind resources to position itself as a key green hydrogen exporter in Asia-Pacific. With global hydrogen demand projected to reach US$201 billion by 2025, Malaysia's NETR and Hydrogen Economy and Technology Roadmap (HETR) aim to produce 2.5 million tons of green hydrogen annually by 2050, targeting markets like Japan, Republic of Korea, and the EU. However, green hydrogen remains two- to five-fold costlier than fossil-based alternatives, requiring urgent policy alignment and infrastructure investment to compete globally.

Accelerate large-scale projects to build market leadership

Sarawak and Sabah are spearheading Malaysia's hydrogen ambitions with flagship initiatives like the H2ornbill and H2biscus projects, backed by Japanese and Korean partners. The Sabah Green Hydrogen Hub, set to produce 250,000 tons/year using solar and wind, and Perak's floating solar hydrogen plant exemplify Malaysia's innovative approach. PETRONAS and TNB are piloting hydrogen co-firing in power plants, while Sarawak's hydrogen buses demonstrate early domestic adoption. Scaling these projects requires US$15–20 billion in renewable infrastructure to meet 2030 targets.

Close regulatory gaps to unlock investment

Malaysia lacks a unified hydrogen law, forcing projects to navigate fragmented frameworks like the Gas Supply Act 1993. Implementing a Guarantee of Origin certification system and integrating hydrogen into the national Climate Change Bill are critical to meet export market standards. Carbon pricing mechanisms, such as a phased carbon tax, could bridge cost gaps between green and grey hydrogen, while PPPs for pipelines and storage infrastructure would reduce investor risks.

Address cost and infrastructure barriers to ensure competitiveness

High production costs (US$10–15/kg), reliance on imported electrolyzers, and underdeveloped transport/storage systems hinder Malaysia's hydrogen scalability. Prioritizing R&D in electrolyzer efficiency, localizing supply chains, and securing long-term offtake agreements with industrial users (e.g., steel, chemicals) is essential. Reallocating fossil fuel subsidies to fund green hydrogen hubs and workforce reskilling programs can drive down costs and mitigate a projected 45,000 job skills gap by 2030.

Leverage international partnerships for technology and market access

Malaysia must emulate Australia's success by negotiating hydrogen-related export deals with Japan and Germany, adopting demand mandates (a 5 percent hydrogen footprint in industry by 2030), and aligning certifications with ISO/TC 197 standards. Australia's US$4 billion Hydrogen Headstart Program and regional hub strategy offer a blueprint for Malaysia to attract investors like Iberdrola and BP, while joint ventures with electrolyzer manufacturers (such as Thyssenkrupp) could cut equipment costs by 30 percent.

Drive demand via domestic decarbonization mandates

Introducing hydrogen quotas for power generation, such as 10 percent co-firing by 2030, and subsidies for hydrogen-fueled transport can stimulate local demand. Expanding TNB's pilot projects and adopting Singapore's carbon tax model to fund hydrogen infrastructure will ensure policy coherence. With ASEAN's hydrogen demand projected to hit 7.5 million tons by 2050, Malaysia's strategic focus on integrated hubs and cross-border collaboration will determine its role in the global hydrogen economy.

[47] Based on the background paper prepared for the Malaysia Country Climate and Development Report.

Annex C. Malaysia's E-Waste: Challenges and Opportunities[48]

As Malaysia transitions toward a high-income economy, rapid technological adoption and renewable energy initiatives are driving a surge in electronic waste (e-waste). Key challenges include illegal e-waste imports, a 79 percent spike in domestic e-waste generation — notably from solar panels and EVs, improper disposal practices, low public awareness of health and environmental risks, and unregulated recycling operations. Solar PV capacity, projected to grow from 3.8GW to 59GW by 2050, and EV adoption (targeting 80 percent of total industry volume by 2050) will exacerbate waste volumes. Solar panel waste is expected to spike post-2040 due to end-of-life cycles, while EV battery waste—lacking recycling infrastructure—poses a looming crisis. Data centers further contribute through discarded servers, networking gear and storage systems, compounding disposal challenges.

Environmental and climate impacts

Improper e-waste management accelerates GHG emissions. Landfilling and burning e-waste release refrigerants (HCFCs/HFCs) and toxic metals, while energy-intensive metal extraction for electronics production fuels carbon emissions. Projections indicate a 905 percent surge in GHG emissions from solar panel waste between 2040–45, with EV battery waste becoming the dominant emitter by 2050. These trends underscore the urgency of sustainable disposal methods to mitigate climate impacts.

Policy and regulatory gaps

Malaysia's e-waste framework remains underdeveloped. While the 12th Malaysia Plan proposes EPR regulations, implementation is delayed until 2026. Current policies lack household e-waste mandates, relying on voluntary industry participation. Weak enforcement enables illegal recycling, with more than 200 unregulated facilities operating. SMEs resist EPR due to cost concerns, and jurisdiction overlaps among agencies hinder coordination. The absence of mandatory reporting and technical knowledge gaps further impedes progress.

Financial mechanisms and barriers

Government incentives like the Green Technology Financing Scheme (GTFS 4.0) and tax allowances (GITA) aim to boost recycling infrastructure. However, financing challenges persist as startups face collateral requirements, banks perceive green projects as high-risk, and regulatory delays (e.g., environmental approvals) deter investment. Informal recyclers dominate due to low operational costs, undercutting licensed facilities struggling with insufficient e-waste supply.

Opportunities for sustainable transition

Addressing Malaysia's e-waste crisis demands integrated strategies: enforcing EPR laws, scaling recycling infrastructure, and fostering PPPs. Leveraging solar and EV growth could spur circular economy innovations, such as battery refurbishment and panel recycling. Public awareness campaigns and incentivizing formal recycling through green bonds or carbon credits offer pathways to reduce illegal dumping. Strengthening enforcement and aligning policies with global standards will be critical to balancing economic growth with environmental sustainability.

By prioritizing regulatory coherence, technological investment, and stakeholder collaboration, Malaysia can transform e-waste challenges into opportunities for leadership in sustainable resource management.

[48] Based on the background paper prepared for the Malaysia Country Climate and Development Report.

Annex D. Valuing Ecosystem Services: Changing Mindset – Investment in the Environment is a Smart Investment

Integrating ecosystem services into the core of economic development and decision-making is not only the right thing to do—for both people and nature—but also represents smart, sustainable economics.

Nature-based approaches also contribute significantly to climate adaptation and mitigation, water purification, flood regulation, soil fertility, improved crop yields, public health, and overall human well-being.

Despite these benefits, governments and businesses often face challenges integrating ecosystem services into mainstream planning and investment. A prevailing emphasis on short-term economic returns frequently overshadows the long-term value that healthy ecosystems offer. Furthermore, limited awareness of the intricate linkages between natural systems and economic prosperity makes it difficult to reflect these services in financial models or incentive structures. Regulatory frameworks may be outdated or fragmented, and political or fiscal pressures can prioritize immediate infrastructure investments over nature-based solutions.

The Ulu Muda ecosystem in Kedah, Malaysia, exemplifies the critical link between biodiversity conservation and essential ecosystem services. As a primary watershed forest, Ulu Muda supplies water to over 80 percent of the region, enabling double cropping in Malaysia's largest granary managed by the Muda Agriculture Development Authority. The steady water supply from Ulu Muda's dams supports nearly half of the country's rice production and sustains tens of thousands of farmers. The forest also harbors rich biodiversity, including threatened species such as the Sunda pangolin, Asian elephant, and agile gibbon, while providing key services like carbon sequestration and flood mitigation.

Yet Ulu Muda faces significant threats from logging and deforestation, which degrade wildlife habitats and compromise water security for Kedah and surrounding regions. These pressures risk the consistent water supply that underpins Malaysia's largest granary and the livelihoods of thousands of farmers. Conservation strategies aim to fully protect water catchments, enforce a permanent logging ban, and develop alternative, sustainable revenue streams such as ecotourism, payments for ecosystem services, and community-based conservation programs. Strengthening collaboration among government agencies, NGOs, and local communities is crucial to balancing biodiversity protection, water security, and economic livelihoods, ensuring the long-term sustainability of this invaluable ecosystem.

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