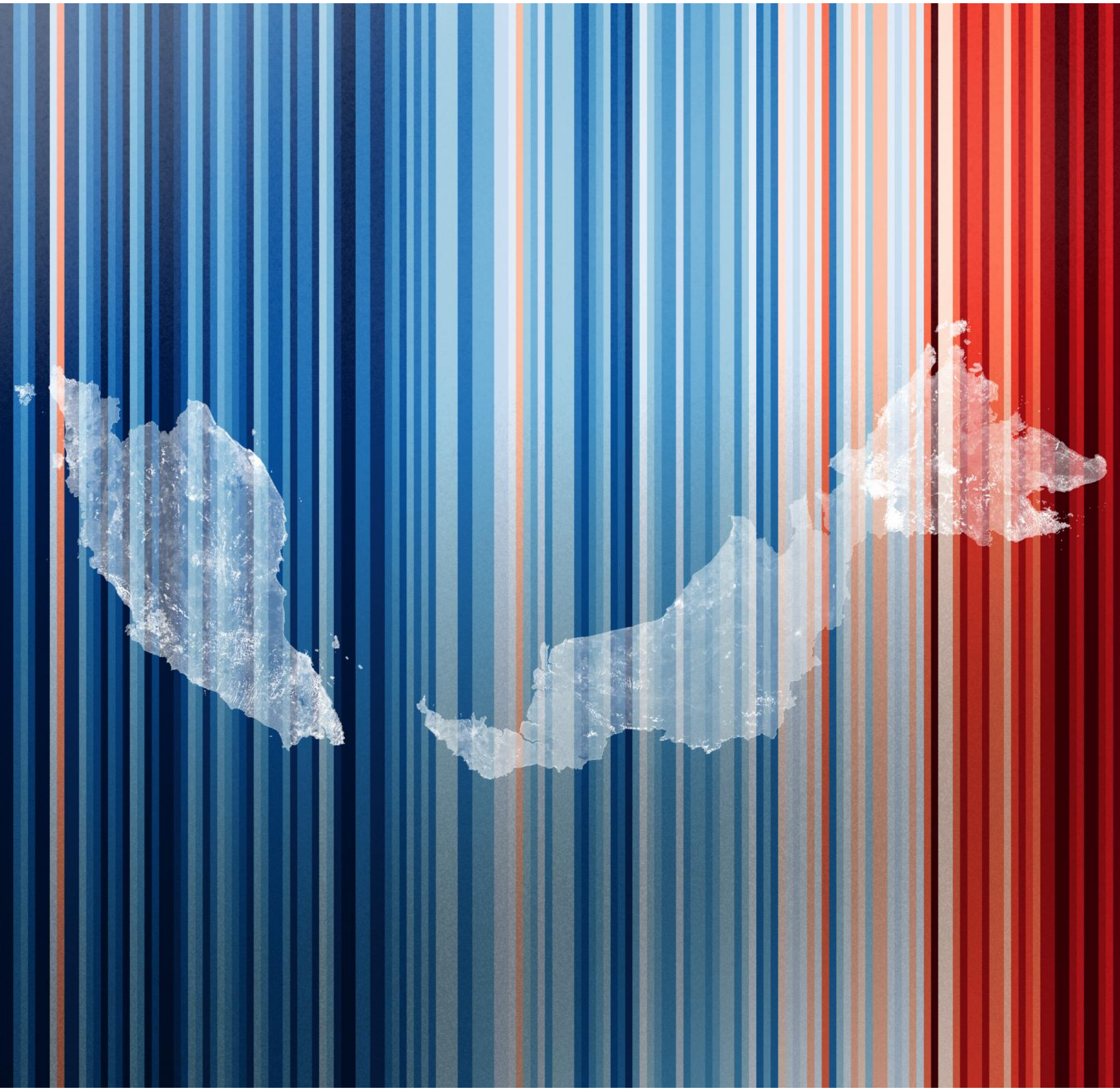
KHAZANAH
RESEARCH
INSTITUTE

WHAT IS TO BE DONE?

CONFRONTING CLIMATE CRISIS IN MALAYSIA



WHAT IS TO BE DONE?

CONFRONTING CLIMATE CRISIS IN MALAYSIA

KHAZANAH
RESEARCH
INSTITUTE

What Is To Be Done? Confronting Climate Crisis in Malaysia – Kuala Lumpur, Malaysia: Khazanah Research Institute

Published November 2024. Published by Khazanah Research Institute at Level 17, Mercu UEM, Jalan Stesen Sentral 5, Kuala Lumpur Sentral 50470 Kuala Lumpur, Malaysia.
Fax: +603 2034 0000; email: enquiries@KRInstitute.org

Information on Khazanah Research Institute publications and digital products can be found at www.KRInstitute.org

Cover photo by KRI, designed with stripes showing historical surface temperature change of Malaysia, courtesy of Prof. Ed Hawkins (University of Reading) available at showyourstripes.info and satellite maps from gisgeography.com.

This report was prepared by the researchers of Khazanah Research Institute (KRI): Yin Shao Loong, Khoo Wei Yang, Siti Nooraznie Abdul Rahim (Contract Research Associate) and Wan Amirah Wan Usamah*.

It was authorised for publication by the Board of Trustees of KRI.

ACKNOWLEDGEMENTS

We would like to extend our gratitude to the following, without whom this report would not have been possible. We have benefited greatly from meetings, discussions and the exchange of ideas over the years in which this project was produced. They include: Khazanah Nasional Berhad and the Dana Impak, Energy and Sustainability teams, the Ministry of Natural Resources and Environmental Sustainability (NRES), the Ministry of Energy Transition and Water Transformation (PETRA), the Ministry of Finance (MOF), the Ministry of Economy, the Ministry of Investment, Trade and Industry (MITI), the Malaysian, Saudi Arabian and Brazilian Missions to the World Trade Organisation (WTO), PETRONAS, Bank Negara Malaysia, Bursa Malaysia, Securities Commission, MyPower Corporation, Prof. Joy Pereira, Akademi Sains Malaysia, Perdana Fellows Alumni Association, Institute of Strategic and International Studies Malaysia (ISIS), Sahabat Alam Malaysia, Third World Network, Adriana Abdenur, Asia Investor Group on Climate Change, World Economic Forum, United Nations Trade and Development (UNCTAD) and Yayasan Hasanah.

We would like to thank our external reviewers, Chee Yoke Ling, Dr Muhammad Hafiz Wan Rosli, Dato' Ir. Nor Hisham Bin Mohd Ghazali and Dato' Dr Yap Kok Seng.

We would also like to express our appreciation to our colleagues and interns past and present at Khazanah Research Institute (KRI); Azfar Hanif Azizi, Nur Sofea Hasmira Azahar, Sarena Che Omar, Aidil Iman Aidid, Chanel Ng Siau Ling, Lee Ee Jen, Gunnhildur Hallgrímsdóttir, Matthew Andrews and Rachel Tan. Our thanks go out the Chairman's Office at KRI for their support, our Chairman Dr Nungsari Ahmad Radhi, the Board of Trustees and past Chairman Tan Sri Nor Mohamed Yakcop.

In completing this report, we have benefited tremendously from the contributions of the people mentioned above and others whom we have not mentioned but provided valuable inputs. However, any remaining errors lie with the authors.

*Except the lead author, remaining authors are listed alphabetically

CONTENTS

ABBREVIATIONS

AFOLU	:	Agriculture, Forestry and Other Land Use
ASEAN	:	Association of Southeast Asian Nations
ARE	:	United Arab Emirates
BECCS	:	Bioenergy with carbon capture and storage
BNM	:	Bank Negara Malaysia
BP	:	British Petroleum
BRICS	:	Grouping founded by Brazil, Russia, India, and China
CAGR	:	Compound annual growth rate
CBAM	:	Carbon Border Adjustment Mechanism
CBDR-RC	:	Common but differentiated responsibilities and respective capabilities
CCS/CCUS	:	Carbon capture and storage / Carbon capture, utilisation and storage
CDR	:	Carbon dioxide removal
CERP	:	Climate Equity Reference Project
CHN	:	China
CO_2	:	Carbon dioxide
DRR	:	Disaster risk reduction
ECS	:	Equilibrium climate sensitivity
EFT	:	Ecological Fiscal Transfer
ESG	:	Environmental, social, and governance
ETS	:	Emissions Trading System
EU/EU27	:	European Union
EUDR	:	EU Deforestation-free Regulation
EWS	:	Early warning system
FDI	:	Foreign Direct Investment
G7/G20	:	The Group of Seven and the Group of Twenty
G77/China	:	The Group of 77 and China
GATT	:	General Agreement on Trade and Tariffs
GCF	:	Green Climate Fund
GDP	:	Gross Domestic Product
GHG	:	Greenhouse gas
$GtCO_2e$	:	Gigatonnes of carbon dioxide equivalent
IADA	:	Integrated Agriculture Development Area
IAM	:	Integrated assessment model
ICZM	:	Integrated Coastal Zone Management
IDN	:	Indonesia
IND	:	India
IPCC	:	Intergovernmental Panel on Climate Change
ha	:	hectare
JPN	:	Japan
km	:	kilometres
LMDC	:	Like-Minded Developing Countries
LULUCF	:	Land Use, Land-Use Change and Forestry
$MtCO_2e$	:	Megatonnes of carbon dioxide equivalent
Mtoe	:	Million tonnes of oil equivalent
MyCAC	:	Malaysia Climate Change Action Council
MYS	:	Malaysia
NAP	:	National Adaptation Plan
NATO	:	North Atlantic Treaty Organization
NCVI	:	National Coastal Vulnerability Index
NDC	:	Nationally Determined Contribution

ABBREVIATIONS

NETR	:	National Energy Transition Roadmap
NGHGI	:	National greenhouse gas inventory
OECD	:	Organisation for Economic Co-operation and Development
QAT	:	Qatar
RCB	:	Remaining carbon budget
RE	:	Renewable energy
RM	:	Ringgit Malaysia
RUS	:	Russia
SGP	:	Singapore
SLR	:	Sea level rise
SWF	:	Sovereign wealth fund
TCRE	:	Transient climate response to cumulative carbon emissions
tCO_2	:	Tonnes of carbon dioxide
tCO_2e	:	Tonnes of carbon dioxide equivalent
TNB	:	Tenaga Nasional Berhad
UK	:	United Kingdom
UN	:	United Nations
UNEP	:	United Nations Environment Programme
UNFCCC	:	United Nations Framework Convention on Climate Change
US	:	United States
USD	:	American Dollar
VRE	:	Variable renewable energy
WTO	:	World Trade Organization

GLOSSARY

Adaptation	:	The process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects.
Adaptation limit	:	The point at which an actor's objectives (or system needs) cannot be secured from intolerable risks through adaptive actions. Hard adaptation limit refers to no adaptive actions are possible to avoid intolerable risks. Soft adaptation limit refers to options may exist but are currently not available to avoid intolerable risks through adaptive action.
Adaptive capacity	:	The ability to adapt to potential damage or respond accordingly to climate events.
Airborne fraction	:	The fraction of total carbon dioxide (CO_2) emissions (from fossil fuels and land-use change) remaining in the atmosphere.
Bioenergy with carbon dioxide capture and storage (BECCS)	:	Carbon dioxide capture and storage (CCS) technology applied to a bioenergy facility. Note that depending on the total emissions of the BECCS supply chain, carbon dioxide (CO_2) can be removed from the atmosphere.
Biomass	:	Organic material excluding the material that is fossilised or embedded in geological formations. Biomass may refer to the mass of organic matter in a specific area.
Carbon Capture and storage (CCS)	:	A process in which a relatively pure stream of carbon dioxide (CO_2) from industrial and energy-related sources is separated (captured), conditioned, compressed and transported to a storage location for long-term isolation from the atmosphere.
Carbon cycle	:	The flow of carbon (in various forms, e.g., as carbon dioxide (CO_2), carbon in biomass, and carbon dissolved in the ocean as carbonate and bicarbonate) through the atmosphere, hydrosphere, terrestrial and marine biosphere and lithosphere.
Carbon dioxide removal	:	Anthropogenic activities removing carbon dioxide (CO_2) from the atmosphere and durably storing it in geological, terrestrial, or ocean reservoirs, or in products. It includes existing and potential anthropogenic enhancement of biological or geochemical CO_2 sinks and direct air carbon dioxide capture and storage, but excludes natural CO_2 uptake not directly caused by human activities.
Carbon sink	:	Any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere
Climate response	:	A general term for how the climate system responds to a radiative forcing.

GLOSSARY

Climate risk	:	The potential for adverse consequences for human or ecological systems due to climate change. Climate risk arises from the dynamic relationship between climate-related hazards, the exposure of human and natural systems to those hazards, and the vulnerability of those systems.
Climate sensitivity	:	The change in the surface temperature in response to a change in the atmospheric carbon dioxide (CO_2) concentration or other radiative forcing.
Constant composition commitment	:	The constant composition commitment is the remaining climate change that would result if atmospheric composition, and hence radiative forcing, were held fixed at a given value. It results from the thermal inertia of the ocean and slow processes in the cryosphere and land surface.
El Niño-Southern Oscillation (ENSO)	:	The term El Niño was initially used to describe a warm-water current that periodically flows along the coast of Ecuador and Peru, disrupting the local fishery. It has since become identified with warming of the tropical Pacific Ocean east of the dateline. This oceanic event is associated with a fluctuation of a global-scale tropical and subtropical surface pressure pattern called the Southern Oscillation. This coupled atmosphere-ocean phenomenon, with preferred time scales of two to about seven years, is known as the El Niño-Southern Oscillation (ENSO).
Equilibrium climate sensitivity	:	The equilibrium (steady state) change in the surface temperature following a doubling of the atmospheric carbon dioxide (CO_2) concentration from pre-industrial conditions.
Exposure	:	The presence of people; livelihoods; species or ecosystems; environmental functions, services and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected.
Flood	:	The overflowing of the normal confines of a stream or other water body, or the accumulation of water over areas that are not normally submerged. Floods can be caused by unusually heavy rain, for example during storms and cyclones. Floods include river (fluvial) floods, flash floods, urban floods, rain (pluvial) floods, sewer floods, coastal floods and glacial lake outburst floods (GLOFs).
Flood Management	:	The strategies and actions taken to prevent, reduce, or manage flood risks. It is a comprehensive approach that combines mitigation, preparedness and adaptation.
Flood Mitigation	:	Widely used to describe technical solutions involving technical, physical engineering projects that primarily focused in reducing direct risks and managing impact of floods.

GLOSSARY		
Global warming potential (GWP)	:	An index measuring the radiative forcing following an emission of a unit mass of a given substance, accumulated over a chosen time horizon, relative to that of the reference substance, carbon dioxide (CO_2).
Hazards	:	Current and future climate conditions. These conditions will determine the likelihood of an area being affected by extreme events or slow-onset events.
Integrated Flood Management (IFM)	:	An integrated approach for an effective and efficient flood mitigation management that maximises the efficient use of flood plain and minimises damage to properties and loss of life. The IFM framework that is currently used by the Department of Irrigation and Drainage specify two distinct methods: structural and non-structural.
Lifetime	:	General term used for various time scales characterizing the rate of processes affecting the concentration of trace gases.
Land use, land-use change and forestry (LULUCF)	:	In the context of national greenhouse gas (GHG) inventories under the United Nations Framework Convention on Climate Change (UNFCCC, 2019), LULUCF is a GHG inventory sector that covers anthropogenic emissions and removals of GHG in managed lands, excluding non-CO2 agricultural emissions.
Radiative forcing	:	The change in the net, downward minus upward, radiative flux due to a change in an external driver of climate change, such as a change in the concentration of carbon dioxide (CO_2).
Remaining carbon budget	:	The maximum amount of cumulative net global anthropogenic CO_2 emissions that would result in limiting global warming to a given level with a given probability, taking into account the effect of other anthropogenic climate forcers.
Resilience	:	The capacity of interconnected social, economic and ecological systems to cope with a hazardous event, trend or disturbance, responding or reorganising in ways that maintain their essential function, identity or structure.
Risk	:	The potential for adverse consequences for human or ecological systems, recognising the diversity of values and objectives associated with such systems.
Sea Level Rise	:	Change to the height of sea level, both globally and locally (relative sea level change) at seasonal, annual, or longer time scales due to (1) a change in ocean volume as a result of a change in the mass of water in the ocean (e.g., due to melt of glaciers and ice sheets), (2) changes in ocean volume as a result of changes in ocean water density (e.g., expansion under warmer conditions), (3) changes in the shape of the ocean basins and changes in the Earths gravitational and

		rotational fields and (4) local subsidence or uplift of the land.
Transient climate response to cumulative carbon emissions (TCRE)	:	The transient surface temperature change per unit cumulative carbon dioxide (CO_2) emissions.
Vulnerability	:	The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.
Zero emissions commitment	:	The zero emissions commitment is an estimate of the subsequent global warming that would result after anthropogenic emissions are set to zero. It is determined by both inertia in physical climate system components (ocean, cryosphere, land surface) and carbon cycle inertia.

Note: All definitions follow IPCC Sixth Assessment Report Working Group I (Annex VII) and II (Annex II) unless stated otherwise.

EXECUTIVE SUMMARY

Climate change has become a central focus of Malaysian policy driven by international commitments, growing direct experiences of extreme climate impacts and growing environmental concerns. Malaysia's unique position as a developing country facing climate challenges differs significantly from Western countries, as it seeks to chart its own course while balancing development needs with climate action.

The risks that Malaysia faces in tackling climate change extend beyond physical impacts, they also include socioeconomic and geopolitical dynamics. Both impacts and solutions of climate change have complex implications for Malaysia's sustainable development. As a developing nation, Malaysia has limited responsibility for global climate change and more limited capabilities than developed countries. This report takes a holistic and strategic examination of pressing issues in national climate policy,

The key findings of the report are:

The potential for climate change to negatively affect three existential areas—prosperity, energy and physical security—over a long period of time makes it an appropriate subject for strategic action by middle-power states and their firms to manage long-term risks amidst uncertainty over the behaviour of key actors. Key actors in the form of great powers or hegemons with the largest greenhouse gas emissions can act to either mitigate or exacerbate climate risks for the entire world, far beyond the scale of action possible for middle powers. Malaysian climate strategy needs to recognise this and move beyond national reporting and *de minimis* fulfilment of Paris Agreement obligations. The likely non-participation of the US in the Paris Agreement for five years, if not more, is significant and needs to be factored into national policy.

A climate strategic approach involves hedging strategies to account for worst case scenarios where multilateralism fails to achieve the 1.5°C target of the Paris Agreement. Higher levels of warming would involve correspondingly higher adaptation responses and greater losses and damages.

The ultimate objective of national climate strategy should not be investment. That is the purview of industrial policy. National climate strategy must set its sights on long-term climate resilience and security for Malaysia. It must protect the enabling conditions for our future sustainable development. Industrial policies offer a far more diverse and effective toolbox with which to support climate transition compared to conventional climate policy tools such as carbon pricing. Carbon pricing only addresses demand incrementally whereas subsidies, financing, performance requirements and other industrial policy measures can tackle supply-side issues and profitability that are far more consequential for successful investment and business activity.

Externally imposed ESG double standards can form a constraint on national sustainable development particularly for developing countries. Defunding coal co-exists with exuberant funding of oil and gas. Developed countries support exports of plastic waste and waste carbon dioxide to Malaysia. Climate measures are strongly emphasised in ESG while other environmental concerns are deprioritised. These double standards should be critically evaluated from the standpoint of climate justice, well-informed regulatory assessment and national priorities for ESG. Regulatory imperialism, including unfair unilateral impositions on trade, can be and should be challenged.

Malaysia's responsibility in causing global warming is small, but the country is not free from physical risks. Malaysia's contribution to global cumulative carbon emissions is around 0.37% and per capita emissions of 8.2tCO_2 in 2019. The carbon sinks remove nearly half of the country's absolute emissions. Historically, the country has also experienced gain in annual surface temperature change from 1990 to 2021. In terms of climate projections, under the SSP2-4.5 scenario, the country is expected to experience a maximum temperature of 34.7°C in 2100 compared to its current 32.7°C, accompanied by increased number of hot days. The country is also bound to receive higher amounts of precipitation and increased likelihood of extreme weather conditions with drier dry seasons and wetter wet seasons.

Malaysia's vulnerability to climate change highlights critical gaps in its policy framework, particularly in addressing floods, sea-level rise and rising temperatures. Fragmented governance and a top-down approach limit effective adaptation efforts, with insufficient coordination and local engagement. The focus of implementation has been on short-term high-cost disasters, long-term climate risks and socio-economic vulnerabilities, especially in coastal areas, remain inadequately addressed. Flood mitigation has been a feature of adaptation in Malaysia with an estimated 0.8% of GDP committed for spending until 2030. While the risks of floods are well documented and implementation is prioritised, impacts from slow onset sea level rise are not well reflected in policy.

Malaysia faces significant challenges in managing climate risks and current strategies must evolve to address future demands. The report calls for a shift from reactive to proactive and integrated adaptation that addresses localized vulnerabilities and promotes equitable climate resilience. Strengthening policy integration, empowering state and local authorities, and adopting nature-based solutions are key steps. A participatory risk-based approach can enhance local capacity, safeguard infrastructure and ensure sustainable climate-resilient development.

An equity-informed approach to climate policy is needed to mitigate the distributional impacts of climate change. The unique status of Malaysia as a developing state exposes the country to equity risk from a low-carbon transition. Chapter 5 found that Malaysia is committing 165% higher than its fair share of mitigation requirements, considering net emissions. In pursuing low-carbon transition, Malaysia along with other developing countries faces macroeconomic, fiscal and distributional risks that may affect poorer groups more than the rich.

A review of climate laws in six countries shows that climate laws are designed according to national circumstances, which diverge along the line of developed and developing nations. Developed countries' law tend to establish market-based instruments, while developing countries' law focus on funding mechanisms.

The policy recommendations of the report are as follows:

1. **Build a national climate strategy that pursues core national interests via industrial policies and international climate diplomacy.**
    a. Malaysia should explore establishing a national climate envoy to build multilateral consensus in our favour.

    b. Establish a forest stewardship scheme to match funds from strategic national firms such as PETRONAS and sovereign wealth funds with domestic conservation and forest enrichment needs.
    c. Proactively spell out domestic ESG concerns to balance against volatility in the hype cycle of western ESG priorities.
    d. Hedge risk. Great power conflict is increasing at a time when climate goals require great power cooperation. National strategy needs to account for scenarios where the world fails to achieve the Paris goal of 1.5°C. This implies a greater role for adaptation than already exists in national policy.
    e. Discriminatory unilateral trade measures disguised as climate action should be challenged. Direct and indirect subsidies provided to European firms by the EU's Carbon Border Adjustment Mechanism (CBAM) can be challenged at the World Trade Organisation (WTO) as well as the United Nations climate treaties.
2. **Strengthen the current policy framework for climate adaptation.**
    a. Improve inter-agency coordination across all levels of government.
    b. Empower states and local governments to develop adaptation plans backed by locally driven strategies.
    c. Foster private sector and community participation to build adaptive capacity.
3. **Address long-term impacts of climate change today.**
    a. Develop comprehensive coastal management plans.
    b. Shift to risk-based adaptation planning.
    c. Leverage cost-effective solutions.
4. **Pursue an equity-informed climate policy.**
    a. Climate institutions and policies should consider the risks of inequitable outcomes for the country. Malaysia should recognise its role within the global climate effort and pursue a fair share of burden. We suggest that the distributional risks of low-carbon transition and climate-related initiatives should be balanced, and climate institutions should avoid entrenching the same distributional risks.

CHAPTER

01

CHAPTER 1
INTRODUCTION

1.1 Background

Since 2021, climate change has moved into the mainstream of Malaysian policy. While previously a specialist topic, international factors and growing direct experience of planetary warming have made climate change part of the spirit of our times, our *zeitgeist*, mentioned alongside our experiences of financial crisis, war, and anxieties and hopes for the future.

On the international front, we can identify factors such as Malaysia's active participation in United Nations negotiations on climate change since the early 1990s, culminating in the 2015 Paris Agreement, which required all countries to undertake actions to prevent dangerous man-made interference with the climate system. Other international factors include the launch of the UN's Sustainable Development Goals in 2016 and the maturing of environmental, social and governance (ESG) concerns in Western markets in the late 2010s. That same decade saw terrible floods strike the East Coast of Peninsular Malaysia and Sabah, as well as multi-year droughts. Meanwhile, quietly, silently, sea levels continued to rise.

Considerable scholarship by Malaysian academics and research institutions has contributed to our store of local climate change knowledge, though much of it is contained in scholarly journals and specialist publications. It is easy enough to find climate change narratives, books and research from developed countries, but there is precious little in comparison from the Global South, let alone from Malaysia. It is, therefore, of vital importance that more is written by Malaysians about Malaysian and international dimensions of climate change.

It is important because Malaysia's climate change challenge is fundamentally different from that in the United States or Europe. Climate change is not part of our culture wars. There is bipartisan support for Malaysia to remain in the Paris Agreement. Malaysia does not condescend to preach to other countries how they should manage climate change. However, Malaysia faces challenges in determining an authentically Malaysian path that is relevant to our ambitions and needs rather than those of others. Fundamentally, Malaysia is not a major contributor to climate change. Our challenge is to find a way to both survive and prosper in the face of climate and other challenges. Knowledge, particularly locally-produced knowledge, is critical to help Malaysians find their way. This report is one small contribution.

1.2 Objective and Scope of the Report

This report aims to take a holistic and strategic examination of pressing issues in national climate policy. While by no means exhaustive, it aims to deepen insight, provoke thoughtful reflection and outline productive ways forward for the nation.

The report is structured into six chapters. Following this introduction are four core chapters examining national climate strategy, climate data, climate adaptation, and climate equity, culminating in a final chapter that synthesises key findings and presents policy recommendations. The selection of topics reflects neglected issues and gaps in policy since 2021.

Chapter 2 National Climate Strategy sets out a realist approach for Malaysia to manage climate threats to prosperity, energy and physical security. It argues for a strategic approach given that great powers are also great emitters of greenhouse gases. Their ability to cooperate in the global interest is critical to the success of global climate goals. At a time of intensified great power conflict climate politics is subject to greater than usual uncertainty and information deficits. This complicates Malaysia's ambition for climate security and greater industry. This chapter outlines strategic challenges for Malaysia that include oil and gas dependency, debt sustainability, climate vulnerability, managing great powers, foreign regulatory constraints and the need to make Malaysia's climate policy tools compatible with the serious challenges confronting any country seeking to break into the rarefied ranks of developed countries.

Chapter 3 Making Sense of Climate Data provides an accessible introduction to climate science for policymakers and the general public. Knowledge about the sources and effects of climate change is important for evidence-based policymaking. A foundational knowledge of the Earth system processes and its observed impacts from human interference is necessary for informed discussion of the issues, avoiding false solutions and developing effective strategies to both mitigate greenhouse gas emissions and adapt to inevitable climate impacts across different sectors of society. The chapter covers key concepts of climate science, and explore some of the approaches to interpretation of emissions and risk data.

Chapter 4 Advancing Climate Adaptation in Malaysia delves into the necessity of adaptation within Malaysia's climate policy. The chapter analyses current adaptation responses to manage flood and sea level rise in Malaysia. It also discusses the gaps in the adaptation measures and recommends ways forward to ensure that Malaysia not only reduces its emissions but also prioritises adaptation.

Chapter 5 Climate Equity presents a case for implementing climate equity in developing countries. The challenge of climate change lies not only in driving climate action but also in determining a fair share of benefits and burdens. The chapter examines (1) the equity implications of climate burden sharing, (2) the equity risks imposed by climate mitigation as implied in low carbon transition and (3) enabling conditions as implied in formal climate legislation. This chapter is an abridged synthesis of the KRI working paper published in 2023: "Climate Policy: An Equitable Approach".

Chapter 6 concludes with a summary of policy recommendations from the preceding chapters.

CHAPTER

02

CHAPTER 2

NATIONAL CLIMATE STRATEGY

Always and everywhere it is the paradoxical logic of strategy that determines outcomes, whether the protagonists know of its existence or not.

Edward Luttwak

Strategy without tactics is the slowest route to victory. Tactics without strategy is the noise before defeat.

Sun Tzu

2.1 Introduction

This chapter explores the importance of taking a strategic approach to climate action by middle power nation-states or their firms. The potential for climate change to negatively affect three existential areas—prosperity, energy and physical security—over a long period of time makes it an appropriate subject for strategic action by states and firms to manage long-term risks amidst uncertainty over the behaviour of key actors. Key actors in the form of great powers or hegemons with the largest greenhouse gas emissions can act to either mitigate or exacerbate climate risks for the entire world, far beyond the scale of action possible for middle powers. This strategic approach is distinguished from more narrow efforts to manage environmental, social and governance (ESG) risks imposed by investors for the private sector or a national climate policy that stops at the borders. Climate change is a transboundary, multi-generational issue. Informed by international law, climate action is a function of a country's historical responsibilities, development policy, future trajectory, relative capabilities and commitment to fairness. It is also a function of a country's ability to shape global outcomes, whether alone or in coalition.

This essay assumes that like great powers, middle power states seek to maximise their power. Power is used to gain and sustain wealth and security. The high costs of climate transition as well as the costs of failed transition risk diminishing state power. Getting it right matters. Like international politics, climate politics operates amidst uncertainty and information deficits[1].

Will sufficient actors engage in collective action to prevent the worst outcomes? What are the risks of non-compliance by key actors? Is enough understood about the physical risks faced by regions of the world with fewer scientific studies?

Climate treaties can be seen as institutional interventions to reduce both uncertainty and information deficits, but they cannot fully eliminate them, nor can they prevent *realpolitik* from scuppering progress. Witness the repeated exits of the United States from the climate process. First its abandonment of the Kyoto Protocol, then President Trump's withdrawal from the Paris Agreement. Strategic action is particularly important for upper middle-income countries like Malaysia who seek to break into the ranks of high-income developed countries. Even without the challenge of climate change it is very difficult to climb the development ladder due to: i) constraints imposed by the international system and greater powers[2], ii) the challenges in getting the right institutional, strategy and policy mix for rapid and sustained development[3]; and, path-dependent dominance established

[1] Mearsheimer and Rosato (2023); Kuik (2021)
[2] Chang (2002)
[3] Lee (2024)

by today's rich countries since the 18th century[4]. Only a minority of developing countries have managed to make it[5]. If Malaysia wants to be a more prosperous, inclusive, less unequal society then these developmental objectives need to be harmoniously reconciled with climate policies.

2.1.1. Why does Malaysia need a climate strategy?

Why, it might be asked, write about the need for a climate strategy when Malaysia has seen a flurry of climate-related policies since 2021? Surely the more bold pronouncements it has the better?

In the lead up to the Glasgow climate summit in 2021, Malaysia revised its climate policy three times, although only a single updating of national ambition was required that year under the terms of the Paris Agreement.

First in July, the government abandoned a long-held condition in its climate target stating that Malaysia would achieve the highest levels of greenhouse gas (GHG) intensity reduction of its gross domestic product (GDP) *without* assistance from developed countries in the form of climate finance, technology transfer or capacity building[6]. It also expanded its scope to cover seven GHGs from an original three[7].

Second in September, the Prime Minister announced a goal for Malaysia to become a carbon-neutral country as early as 2050[8].

By November at the Glasgow climate summit, the Minister of Environment and Water announced that Malaysia was committed to a net zero target as early as 2050 for seven GHGs, a broader target than the Prime Minister's carbon-only announcement and a longer-term goal than the July climate target (which only applied until 2030)[9].

These rapid revisions to national policy on the international front are not the primary concern. Rather, it is the government's policy sequencing. By dropping conditionality for finance, technology and capacity building (a common position held by developing countries), Malaysia was signalling that it could pay its own way with climate mitigation; a status normally held by developed countries[10].

Notably, the Malaysian government was only to arrive at a figure for its net zero energy transition two years later with the National Energy Transition Roadmap (NETR). In that document the investment required for transforming the nation's energy infrastructure was estimated to range from RM1.2 - 1.3 trillion[11]. This is an amount broadly equal to Malaysia's current sovereign debt excluding contingent liabilities[12]. It is a huge amount. The debt owed on 1Malaysia Development Berhad is a

---

[4] Allen (2011)
[5] These are primarily concentrated in northeast Asia: Japan, South Korea, Taiwan, and now most likely, China.
[6] These conditions referred to obligations and commitments of developed countries under the UNFCCC and Paris Agreement. It is unclear if any Malaysian attempt to signal ambition in 2021 also implied that it had scaled back its commitment to uphold developed country obligations in the climate treaties, or if such implication was considered.
[7] Ministry of Environment and Water (2021a)
[8] Ismail Sabri (2021)
[9] Ministry of Environment and Water (2021b)
[10] It remains arguable that Malaysia was *not* conceding conditionality on adaptation since its climate target referred only to GHG intensity of GDP with no reference to adaptation.
[11] Ministry of Economy (2023); Note: the estimate does not include the cost of conserving Malaysia's stocks of carbon sinks over the next 26 years. This would amount to many billions of ringgit.
[12] Choy (2024)

mere RM53.5 billion, nearly 24 times smaller[13]. While fiscal hawks often underestimate government borrowing capabilities, doubling sovereign debt has implications for fiscal sustainability and the government's ability to credibly raise future debt through the issuance of bonds. The development expenditure portion of the annual federal budget is primarily financed by borrowing. Without development expenditure the government would not be able to make fresh investments, as it would just be covering operating expenses. This would limit the capacity of the state to invest in education, health, welfare, environmental protection, industrial policy and other desirable public goods.

By dropping external conditionality in its Nationally Determined Contribution (NDC) to the Paris Agreement, Malaysia signalled that it was a developing country not in need of financial assistance, unlike it peers. This sits awkwardly with the baseline negotiating position that the Malaysian government holds today for the United Nations Framework Convention on Climate Change (UNFCCC): that Malaysia defends the principle of common but differentiated responsibilities and respective capabilities in the apportionment of burdens and responsibility for implementation of the climate convention[14]. This principle under Article 3.1 of the UNFCCC and Article 4.3 of the Paris Agreement, often abbreviated as CBDR-RC, is a redline for developing countries including Malaysia to ensure that the developed countries who are the principal culprits responsible for anthropogenic climate change do their fair share. This includes providing financial assistance to developing countries who have contributed very little to climate change but are disproportionately vulnerable to it. Malaysia is very much in the latter category and Southeast Asia is one of the most climate vulnerable regions of the world[15].

As countries gather to negotiate a new quantum of climate finance in the November 2024 meeting of the UNFCCC called COP29, Malaysia may find its past policy positions come back to haunt it. Developed country negotiators may well ask: Why should Malaysia be entitled to access external funding for climate transition when it has committed to doing without it since 2021?

Even after the revised 2021 Glasgow NDC, Malaysia has continued to apply to international climate finance bodies such as the Green Climate Fund (GCF) for financial assistance to prepare its National Adaptation Plan (NAP)[16]. GCF support for NAPs is an entitlement for all developing countries, this is not directly related to decoupling GHG intensity from GDP, so Malaysia is not practising double standards. However, turning to the GCF for USD3 million in grant financing suggests that Malaysia or its climate ministry are not able to mobilise sufficient financing from domestic sources for capacity building. If Malaysia faces financing constraints for climate measures then it should re-introduce conditionality into its next NDC due by February 2025.

Malaysia's current climate policies are considered bold and ambitious. However, the government still has not spelled out how over a trillion ringgit of financing is to be mobilised, let alone how the cost of capital is to be managed. A plan without finance faces a serious implementation challenge. Malaysia's climate policies are also incomplete—energy transition is spelled out, but climate adaptation plans are lagging. Even the national mitigation plan outlined by the NETR is incomplete: the 'net' in net zero implies subtracting positive emissions from emission removals by carbon sinks. NETR projects

[13] 1Malaysia Development Berhad (1MDB) is an insolvent strategic development fund wholly owned by the Malaysian Government that has been the subject of considerable scandal. It is frequently cited as a significant debt burden and the reason why government borrowing needs to be rolled back.
[14] Personal communication with Ministry of Natural Resources and Environmental Sustainability at the 'COP29 Masterclass' organised by ISIS Malaysia/TWN, 9 October 2024.
[15] ASEAN (2021)
[16] Malay Mail (2023)

Malaysia's removals by sinks to remain unchanged from 2019 to 2050[17]. This heroic conservation assumption is completely uncosted and lacks a plan[18].

This chapter is written in an effort to make sure that Malaysia does not fail in achieving its climate goals. That its climate goals are not overly narrow that they neglect adaptation for mitigation. That they do not make financial commitments that cannot be sustained. That they do not compromise Malaysia's overall development and national security ambitions. That domestic effort isn't mistaken as sufficient to protect Malaysia from climate change. To do so means going beyond mere national policies towards a strategic approach that integrates foreign policy and economic policy. Uncertainty over the behaviour of major GHG emitters needs to be accounted for because Malaysia is a very small emitter of carbon dioxide, being historically responsible for less than 0.4% of global emissions[19]. In contrast, the US accounts for over 25% of historical emissions, the EU nearly 17%, Russia around 7%, and the UK and Japan nearly 5% and 4% respectively, totalling 56% of global emissions for these five parties to the UNFCCC[20].

Domestic mitigation action alone—at an estimated minimum cost of RM1.2 – 1.3 trillion—cannot perceptibly reduce Malaysia's risk to climate impacts unless big emitters engage in big cuts. The tragedy of climate change is that the world is dependent on some of its most selfish, irresponsible yet powerful states in order to save itself from climate catastrophe.

Malaysian climate strategy needs to recognise this and move beyond national reporting and *de minimis* fulfilment of Paris Agreement obligations. Safeguarding Malaysia's future climate security requires assessment of international relations and strategic interventions to build favourable outcomes for the long-term survival and prosperity of our small nation-state.

2.1.2. Energy, Climate and Great Power Conflict

The need to manage climate risks strategically is all the more pressing due to climate and energy-related industries having become a fault line of geo-economic[21] conflict between the United States and China. These two countries are among the largest emitters of greenhouse gases, both are also among Malaysia's largest trading and investment partners. Heightened conflict or war between them brings some risk of constraints on clean energy technology or semiconductor supply chains, both of which are important for Malaysia's climate transition and economic development. However, geo-economic rivalry between the US and China could potentially be economically beneficial for neutral Malaysia, and consequently help alleviate the burden of high climate transition costs with improved income opportunities.

There are time pressures for Malaysia's climate strategy. In addition to supporting efforts to meet key global climate milestones in 2030 and 2050 to forestall the worst physical climate risks, leaders must strengthen Malaysia's climate resilience and industrial capabilities as much as possible ahead of any intensification of great power rivalry or potential war in the Asia-Pacific. It is worse to be poor and climate vulnerable than it is to be rich and climate vulnerable. Wealth offers a way to buy resilience or offset loss.

[17] Ministry of Economy (2023)
[18] Malaysia has a number of plans related to combating forest loss, but they are not harmonised from the standpoint of maintaining GHG removals at 2019 levels. A plan could emerge from the long-awaited Long-Term Low-Emission Development Strategy (LT-LEDS).
[19] Yin (2022)
[20] Ibid.
[21] Luttwak (1990)

Supply-chain disruptions due to war affecting access to clean technologies and semiconductors could be mitigated with greater vertical integration of production domestically or diversification to neutral trading partners. Industry climate adaptation measures will improve the long-term resilience of production, particularly if conflict or domestic politics in key global actors delays achievement of Paris climate goals. Emission reduction efforts will require coordinated and altruistic action by great powers to be truly effective.

Realist international relations theory might argue that this would be a fool's hope[22]. Liberal internationalists would hope for sustainable cooperation between states typically mediated by the United Nations. The early 1990s, in the wake of the Cold War when major environmental and climate agreements were birthed, may have given cause for optimism regarding the liberal view.

Today, Malaysian climate strategy faces a more conflictual and uncertain world better explained by realism, where great powers are involved directly or indirectly in wars in Europe, the Middle East, with escalating tensions in Asia evidenced by geopolitically-motivated trade restrictions on China. The main multilateral rules-making institution for trade, the World Trade Organisation, is unable to resolve trade dispute appeals because the US has refused to appoint judges for the Appellate Body. Lofty expectations for Paris Agreement meetings need to be reconciled with evidence of an anarchic international system[23].

Peace and climate resilience share similar tensions. *Si vis pacem, para bellum*. If you want peace, prepare for war, goes the Roman proverb[24]. We work on mitigation, but we prepare for adaptation. If one prepares only for peace, one will be unprepared for war. If one prepares only for mitigation, one will be unprepared for collective action failures that will require greater adaptation efforts. Adaption is inevitable, while war is not.

This chapter combines insights from climate studies, industrial policy and international relations to offer an approach for developing countries, particularly Malaysia. Mainstream climate discussion normally comes in three flavours: doomsaying, denial or studied optimism. The first two are unproductive or self-serving, the latter informs most intentional international action. To draw on a realist approach avoids all of these. Climate change is real, it is actionable, however altruistic coordinated collective action involving power sacrifices by great powers may be improbable, particularly at a time of heightened great power rivalry. The latest United Nations Environmental Programme (UNEP) Emissions Gap Report warns that the window to 1.5°C "will be gone within a few years" and we are on track for "catastrophic" warming of 2.6-3.1°C[25].

If it is probable that the Paris Agreement's 1.5°C warming target may be missed, then greater climate adaptation efforts may be required at national level. If this is the way the world is then Malaysia's climate strategy needs to be carefully calibrated to signal both constructive international action and hedge against risk of system failure. Malaysian policy is currently focused on signalling high mitigation ambition; it has no hedging strategy. Care must be taken when committing to substantial

[22] In recent years, we have seen an apparent "climate leader" such as the EU greenwash natural gas and nuclear power as "sustainable". European Parliament (2022)
[23] In realist international relations theory "anarchy" refers to the claim that the world has no supreme authority. States are the main actors in world politics. Rather than meaning chaos, anarchy directly derives from the original Greek αναρχία for "without a ruler", just as monarchy refers to a system led by a single ruler. Source: Mearsheimer (2001)
[24] Vegetius, *Epitoma Rei Militaris*.
[25] UNEP (2024)

financial expenditure or a major shift in energy security policy that they do not result in unacceptable curtailment of Malaysia's limited state power and development potential.

Climate strategy therefore is a long-term power maximisation approach from the perspective of state security and the developmental agenda. It is fully consistent with the roles and responsibilities set out for developing countries in the UNFCCC and Malaysia's core negotiating position based on CBDR-RC.

2.2 Nine Challenges for Malaysian Climate Strategy

Here are challenges Malaysian climate strategy needs to tackle.

1. **Oil and gas dependency** - Malaysia is an oil and gas exporter. The oil and gas sector contributes high-income jobs and directly supports Malaysia's budget to the tune of 15-40% per annum[26]. It is anchored by PETRONAS, Malaysia's first multinational enterprise. Does climate transition mean fossil fuel phase-out for Malaysia or a phase-down?
2. **Malaysia is operating near its debt ceiling** - Due to the pandemic Malaysia revised its statutory debt limit upwards to 65% of GDP. Federal government debt stood at 63.1% of GDP as of end-June 2024[27]. Malaysia's government debt and liability exposure stood at RM1.5 trillion by December 2023. The National Energy Transition Roadmap (2023) ballparked energy transition investment needs at RM1.2 - 1.3 trillion, an estimation which did not include the cost of capital. If total climate transition costs were to breach RM2 trillion it would eclipse present day debt if the public sector were to be the principal source of finance. What new sources of revenue and wealth would allow us to sustainably service such debt?
3. **Regional climate vulnerability** - Southeast Asia is one of the most vulnerable regions to climate change[28]. Malaysia is a highly coastal country with 70% of its population in coastal zones. Critical economic infrastructure such as Port Klang, Malaysia's international trading gateway, lie in areas at risk of sea-level rise. However, research is lacking on the quantification of adaptation interventions needed as opposed to modelling of impacts.
4. **Malaysia needs to upgrade its industrial standing** - Malaysia's export-oriented economy significantly depends on manufacturing as a contributor of higher income jobs, foreign exchange and supply-chain linkages for SMEs. Malaysia's top two trade and investment partners—the US and China—are in economic conflict with each other over semiconductors, solar panels and critical minerals. Malaysia is involved in global value chains (GVCs) tied to both and in some sectors such as solar is used by Chinese companies to circumvent US trade restrictions. However, Malaysia's involvement in these GVCs is not at a sophisticated or high value-added level. The mere presence of foreign direct investment (FDI) in these sectors has not been sufficient to catalyse dynamic home-grown firms. Something is missing in the policy mix.
5. **Malaysia is catering to ESG, but is ESG catering to Malaysia?** - Malaysian financial institutions and corporations have responded to the threat of being cut off from financial capital utilising environmental, social and governance (ESG) investment screening. However, there is a tendency for ESG to be reduced to just environment, for the environmental dimension to be reduced to climate, and climate to be reduced to greenhouse gas mitigation

[26] Lafaye de Micheaux (2017); Ministry of Finance (2024)
[27] FitchRatings (2024)
[28] ASEAN (2021)

at the expense of a more balanced approach to risk management. This reflects a bias in policy and financing from developed countries that favours mitigation and de-emphasises adaptation and loss and damage, which are more important to developing countries since the majority are small GHG emitters as well as being poor and climate vulnerable[29]. This bias in ESG not only undermines the complexity of climate change as an environmental phenomenon, but also undermines its complex socioeconomic nature.

6. **Malaysia needs to manage Great Powers in order to stabilise the global climate** - Domestic action by Malaysia has a relatively small role to play in global climate stabilisation due to Malaysia's relatively small share of global emissions. Malaysia has been a net positive emitter only since 2004 due to significant carbon sinks mostly in the form of forests. While Malaysia should pursue low-emissions development for long-run sustainability, the great bulk of greenhouse gas mitigation will have to come from the largest historical polluters. Namely, countries like the US, EU, Russia, Japan and Britain. However, these countries are in conflict over territories and technologies. The US, the largest polluter, is capable of wild swings in climate policy but has intensified its anti-China stance over the last few presidencies. The EU, which likes to style itself as a climate leader, has recently dropped climate policy in favour of defence as it once again sees Russia as a threat and now seeks to source its fossil gas from elsewhere. Japan and Britain are supporting actors to the US. Japan has plans to use Malaysia to store its waste carbon dioxide, presenting Malaysia's climate and oil and gas policy with a dilemma[30].
7. **Few countries reach developed status, climate change makes it more difficult** - Malaysia seeks to graduate beyond its structural economic limitations, out of middle-income status, into a full-fledged developed economy in a manner similar to late industrialisers such as Japan, South Korea, Taiwan, and increasingly China. As the development economist Keun Lee cautions us, the pathway out of middle-income status is narrow and the goalposts are ever-shifting[31]. Malaysia needs to settle on some formula of innovation, renegotiating its relationship with GVCs and FDI, mobilise finance, resolve federal revenue constraints, and build a skilled workforce and domestic firms able to undertake technological leapfrogging that supports export competitiveness. Malaysia has struggled to do better in all these areas. Consciousness is growing that climate change is a cross-cutting stressor.
8. **Developed country climate standards may be less optimal for Malaysia's pathway** - There is a risk that climate standards and priorities imported from G7/G20 countries, such as ESG, investment and disclosure frameworks, or unilateral impositions such as the European Union's Carbon Border Adjustment Mechanism (CBAM), will steer Malaysia into a sub-optimal development pathway that may be at odds with principles of fairness and justice, known in climate change processes as 'common but differentiated responsibilities and respective capabilities'. The transition pathway for developed countries is not necessarily replicable or suitable for developing countries. Countries such as Malaysia are heavily endowed with forests, whilst most developing countries are heavily deforested. As another example, we may follow the EU investment taxonomies in classifying natural gas as 'amber' and coal as 'red', therefore steering investment away from affordable imported coal, but we will note that the EU is continuing to build coal-fired power plants, and its member state

[29] For example, the 2021 NDC submitted by the Philippines incorporates adaptation commitments alongside its mitigation goals. Furthermore, the country committed to a projected GHG emissions reduction and avoidance of 75%, of which 2.71% is unconditional and 72.29% is conditional signalling high expectations for external cooperation and finance. See: UNFCCC (2021)
[30] Obayashi and Golubkova (2023)
[31] K. Lee (2024)

Poland, a developed country, intends to phase out coal by 2049. Malaysia plans to be down to 1% coal by 2044.

9. **The climate policy toolbox needs to expand beyond carbon pricing** - There is also a challenge posed by conventional climate policy tools developed in the 1990s. Unimaginative calls for orthodox climate tools such as carbon markets or carbon taxes will not address transition challenges of the complexity outlined above. They are only focused on demand-side management, lack scale, distributional fairness and impact compared to traditional industrial policy tools which tackle both supply and demand, such as subsidies, grants, financial instruments, labour and technology support, and public procurement. Witness the scale of manufacturing investment mobilised by the US Inflation Reduction Act (done without domestic carbon pricing) or China's green technology industries' export competitiveness. Both have policies to make desirable technologies cheaper and—crucially—more profitable rather than just making fossil fuels more expensive. However, if a country desires a gradualist mechanism for optics to cater to developed country biases then carbon markets offer an excellent performative policy. They just are not effective in practice (see the case of the EU below).

One of the fashionable answers posed to such challenges is that climate change is not just a threat, but also an opportunity that can be best seized by a sort of 'Green New Deal' or green industrial plan akin to those undertaken by developed economies such as the US and EU. Structural transformation and saving the climate can be synthesised in a grand policy package that creates well-paying green jobs in dynamic green industries. However, currently the only developing country with comparable fiscal strength and policy determination to the US and EU is China. Success in this regard has led the US and EU to put a target on China's back. The US and EU want China to decarbonise, which it is gradually doing via a determined industrial policy, but they also want it to accept a subordinate position in the global economy. Hegemons and one-time hegemons loathe competition even if it pushes them to overcome their weaknesses.

Still, the problems of success that China faces remain a long way away for Malaysia[32].

Simply put, the nine present challenges Malaysia faces can be boiled down to two long-term challenges that require higher order strategic planning. First, it needs to definitively graduate from middle-income status to develop the wealth needed to achieve higher levels of development. Second, Malaysia's response to the climate emergency needs to both reduce its physical risks and vulnerability whilst being financially and socioeconomically sustainable. Industrial success with accompanying economic reforms can tackle the first challenge and financially support a sustainable response to the climate emergency. An unbalanced climate strategy, one that primarily pursues energy transition could find itself underfunded or highly indebted if finance is not addressed. A mitigation-centric strategy could leave Malaysia underprepared to face physical climate impacts that are either 'locked in' or dependent on collective global mitigation driven by altruistic great powers[33]. The current course of policy risks being too mitigation-centric and domestically-focused. As the recently released National Climate Change Policy 2.0 notes:

[32] Malaysia's problems of success are that it successfully diversified away from commodities, but it has struggled to thrive via manufacturing and services.
[33] Boston Consulting Group and WWF-Malaysia (2021)

> *Despite the increasing acknowledgment of the importance of climate adaptation within the framework of sustainable development, Malaysia's climate policies and actions are unbalanced between mitigation and adaptation; and have predominantly focused on the former. The government's emphasis on low-carbon incentives and enablers has been instrumental in advancing Malaysia's mitigation efforts, particularly in renewable energy and green technology. However, without a more strategic and proactive approach in climate adaptation, Malaysia can potentially lose its development gains including its low-carbon investments. The cost of inaction could be severe, as the impacts of climate change are already being felt and are expected to intensify in the future[34].*

This chapter and report would argue furthermore that reducing Malaysia's overall climate risks involves tackling physical risks via adaptation and diplomatic action to achieve a critical mass of global mitigation.

2.3 Both Problems and Solutions Are Interlinked

The nine challenges suggested above do not operate in isolation, they intersect in multiple ways. This section considers them in clusters, offering analysis and ways forward.

2.3.1. Balancing Net zero Goals

Climate change negatively affects human life and the wealth of nations in a variety of ways. Chief among them are direct physical impacts. These can take the form of more extreme weather events—floods, typhoons, drought, wildfires, and so forth. Such events can disrupt households and industries, costing lives and livelihoods. Physical impacts also take the form of rising sea-levels which, together with erosion, displace and damage coastal settlements. Sea-level rise can even reduce the sovereign territory of coastal countries such as Malaysia. The oceans absorb excess carbon dioxide (CO_2) and heat from the warming atmosphere which negatively impacts marine life. It is likely that the majority of the world's coral reefs will perish at only 1.5°C warming over pre-industrial levels[35]. This would have a cascading impact on fisheries and the availability of marine protein, particularly to the poor. Achieving 1.5°C warming is currently considered to be a success under global and national policy. Missing this target and ending up with 2°C warming or higher would invite greater and unacceptable ecological and human catastrophes.

Preventing the most dangerous levels of climate change will necessitate constraints upon the kinds of energy humanity can collectively use as well as changes in how we use (or abuse) the land and forests. This is because "global surface temperature increase is close to linearly proportional to the total amount of cumulative CO_2 emissions"[36], and currently, CO_2 emissions are almost directly proportional to the amounts of fossil fuels consumed, moderated by removals by carbon sinks. Due to imbalances in the production of greenhouse gases and their removals from the atmosphere, the climate is currently warming at an unprecedented rate.[37] To stabilise the climate, humanity must balance its emissions of planet warming greenhouse gases such as CO_2 and the limited capacity of the

[34] NRES (2024b)
[35] IPCC (2018)
[36] Forster et al. (2024)
[37] Ibid

world to remove those emissions through natural cycles, expanding carbon sinks and, more controversially, engineered removals.

This balancing goal is enshrined in the United Nation's 2015 Paris Agreement to which almost all the world's states are party to. In more recent times, this balancing of emissions and removals at a global level has been popularised as "net zero". Although this popularisation has its deficiencies, particularly when downscaled from the global to the national and firm levels, it has helped summarise a fairly technical aspect of physical climate science for a broader audience.

Notably, a net zero goal only covers action on emissions. It does not tackle adaptation to physical risks, nor the limits to adaptation beyond which lies loss and damage. While it is fairly robust at the global level where large natural carbon sinks can be accounted for, and many nations own tracts of land and forests which absorb carbon dioxide, most firms are not in the same position. Faced with the lack of ownership of carbon sinks, firms declaring net zero emissions goals have found themselves either postulating very ambitious decarbonisation strategies, buying large amounts of worthless carbon offsets[38], or overpromising the potential of carbon capture technologies[39]. The growing number of such incidents, including the mass verification scandals at offset certifier Verra[40], have not resulted in increased caution about pursuing market-based climate actions under Article 6 of the Paris Agreement.

Malaysia has several climate goals, but its headline goal has become achieving net zero greenhouse gas emissions by 2050. In 2024, the target was revised upwards from 2021's "as early as 2050", trading off flexibility for a clear target date. A flexible landing date, such as used by Indonesia's "net zero emissions by 2060 or sooner", allows for uncertainties in financing and economic conditions (since financial crises tend to happen roughly once a decade).

Within the Paris Agreement, NDCs are updated every five years and are supposed to communicate progression over time. Malaysia's 2024 revision was also in advance of submitting an updated NDC climate target to the Paris Agreement in 2025 (for the period 2031 to 2035). It may have made more sense to reserve the increase in ambition to fit the UN submission cycle in order to maximise messaging increased ambition lest Malaysia be accused of recycling goals.

Likewise, given the large cost of energy transition at RM1.2 – 1.3 trillion, which does not include carbon sink conservation or the cost of capital, and the lack of a detailed climate finance plan, Malaysia should also revisit financial conditionality in its 2025 revised NDC. This would signal that while Malaysia is willing to increase its Paris ambition to a judicious level, now it has an estimate of its long-term transition costs it would require external financial assistance to reach greater heights. This is also in line with the commitments of developed countries under the UNFCCC and Paris Agreement which Malaysia currently seems keen to support.

Malaysian solutions to global problems

Malaysia also has to exercise caution about being swept up in climate fads from developed countries. Net zero pledges were all the rage in 2020 with many large Western corporations adopting them and the UN Secretary-General campaigning for all levels of institutions to adopt net zero goals. By 2024, oil companies such as BP and Shell have dropped their net zero goals as profits continue to beckon

[38] Lakhani (2023)
[39] Westervelt (2024)
[40] Greenfield (2023)

from their traditional business. Meanwhile, TNB and PETRONAS maintain their commitment to net-zero emissions by 2050. Do Malaysian companies such as these gain an ESG investment advantage compared to BP and Shell? This is an area requiring further careful study.

Unorthodox approaches to protecting the strategic value of PETRONAS and Malaysia's sovereign wealth funds (SWFs) could be explored. Companies with net zero 2050 pledges tend to feel pressure to achieve net zero in the near term rather than long-term horizon. This can mean resorting to carbon offsets and carbon credits to net off their emissions rather than engaging in deep decarbonisation of their core business. However, the credibility of the carbon offset market has plummeted in recent years due to the Verra scandal where most of their certified credits were revealed to be bogus[41].

Malaysia has a generous endowment of domestic carbon sinks that most developed countries do not, since the latter tend to have heavily deforested their lands. While Malaysia has established a promising Ecological Fiscal Transfer (EFT) mechanism in recent budgets, the conditional quantum provided to state governments for conservation is only RM250 million.

Another way to safeguard Malaysia's forests could be to establish stewardship arrangements between forests and strategic state-owned firms such as PETRONAS and SWFs. This would allow Malaysian—and only Malaysian—firms, strategic ones at that, to balance their remaining emissions *after mitigation measures* against removals by forests and other ecosystems[42]. This is distinct from the outright privatisation of nature that occurs in other parts of the world since the aforementioned state-owned firms contribute dividends and other benefits to national wealth. Therefore, they may merit strategic coverage under national climate transition strategies rather than being targeted with carbon taxes or similar punitive instruments favoured by Pigouvian neoclassical economics while still being expected to deliver hydrocarbon products. National strategic stewardship would also safeguard against tendencies for Malaysia's carbon sink capacity to be traded overseas for developed countries to count against their net zero targets[43]. Due to the terms of the Federal Constitution, state governments have limited revenue raising powers and generally cannot tax. They thus have an incentive to deplete their forests through logging or land conversion. RM250 million of EFT divided amongst 13 states of the federation averages out to just over RM19 million per state. This is highly likely to be insufficient for long-term conservation even if only a handful of states absorb the funds. However, PETRONAS and SWFs have the deep pockets and sense of national mission to work out long-term conservation arrangements that could protect Malaysia's remaining forests. The loss of more carbon sinks would place more burden on the public and private sector to undertake countervailing efforts to meet national emission goals: either regrowing forests (typically monocultures rather than restoring lost biodiversity) or investing in more energy transition, both of which are inefficient alternatives to conservation.

Is this greenwashing? If a developed country private oil company did this with forests in a highly-indebted poor country, this would rightly be accused of 'carbon colonialism'. The policy suggested above is for financial stewardship for Malaysian forests by Malaysian state firms. National strategic stewardship would allocate a proportion of Malaysia's stock of carbon sinks to domestic firms that conform to Malaysia's industrial policy and developmental agenda. These activities are implicitly covered under the government's net zero transition plans in the NETR. However, because the NETR

[41] Greenfield (2023)

[42] Access to this mechanism should not be extended to foreign firms, especially those resource-intensive ones. Secondly, the mechanism should not be used to cover business as usual emissions. Rather it should act to counterbalance a firm-level decarbonisation pathway.

[43] Given that carbon credits are by design cheaper than mitigation via energy transition, it seems bad economics for Malaysia to invest trillions in decarbonisation while selling off forest credits for mere millions.

does not outline how carbon sinks are to remain undiminished from 2019 and 2050 there is a need for a solution to safeguard these sinks as they constitute a strategic development reserve for Malaysia's long-term socioeconomic ambitions.

2.3.2. Energy Security, GDP and Just Transitions

One of the principal ways to reduce emissions while meeting the Paris climate goals involves changing the kinds of energy we use, effectively decarbonising the energy supply, such as by moving to renewables. This process has also been described as moving from combustion of fossils to generating electricity from metals. Poorer developing countries will find this transition hard to achieve primarily because limited financial capacity makes them struggle to supply sufficient levels of any form of energy.

Energy security is a fundamental strategic challenge for countries given its economic role underpinning prosperity, the asymmetrical geographical distribution of energy resources, plus variable affordability and access. Some states have gone to war to improve energy security. Great powers and rising powers have been reluctant to fully embrace climate action without confidence about energy security.

If we take GDP as an indicator of national prosperity, however imperfect, it has been established that there has been a linear relationship between GDP and greenhouse gas emissions[44]. Affordable and abundant access to fossil fuels has powered industrial prosperity in the small club of industrialised countries. The poorest countries in the world are amongst the lowest consumers of energy, with much of Africa and parts of Asia standing out[45]. De-linking GDP and emissions tends to only happen at high levels of GDP. Studies point to slight to weak decoupling in China at the aggregate level, however, thanks to industrial policy, investment and technology, at the provincial level an inverted U-shape relationship has been observed "between the intensity of emissions-GDP relationship and the level of per capita GDP" suggesting that China in time will be able to de-link the two.[46] As the International Energy Agency notes:

> *Electricity use has grown at twice the pace of overall energy demand over the last decade, with two-thirds of the global increase in electricity demand over the last ten years coming from China[47].*

The average warming for the decade 2014-2023 was 1.19°C above pre-industrial levels[48]. The 12 months from June 2023 to June 2024 saw the world reach 1.63°C warming[49]. The atmosphere has limited capacity to absorb more greenhouse gases without pushing temperature increases to unacceptably dangerous levels. The burning of fossil fuels to power economies and mechanical mobility effectively uses the atmosphere as a dumping ground for the waste gases resulting from fossil fuel combustion. Much of the atmosphere's absorptive capacity has been used up by the most industrialised nations such as the United States, Europe, Russia, Britain and Japan. These five countries account for nearly 56% of cumulative emissions (2022) but only 14% of the global

[44] Yin (2022)
[45] Ritchie, Roser, and Rosado (2024)
[46] Cohen et al. (2019)
[47] International Energy Agency (IEA) (2024)
[48] Forster et al. (2024)
[49] World Meteorological Organization (WMO) (2024). Note: Warming on an annual basis is not the same as decadal average warming used in climate science.

population (2023)[50]. China, a populous late industrialiser, accounts for 14.7% of emissions and 17.5% of world population[51]. Compared to the Big Five polluters, China is a relative under-consumer, but it is almost never framed this way by the mainstream media who focus instead on current annual emissions. However, global warming is a function of cumulative emissions and overall GHG concentrations in the atmosphere; it is a problem of stocks more than flows.

The challenge for all countries is to pursue economic development without overstepping planetary limits. This problem is sometimes posed as how to avoid developing countries pursuing development without their emissions burning up the world. However, this framing neglects the privilege and overuse of global resources by developed countries. The atmosphere and oceans could in theory support the emissions of all of humanity, but currently most of that absorptive capacity has been taken up by the most industrialised nations with little left for the growth of the majority of humanity. The development bargain of the UNFCCC and Paris Agreement is that developed countries should take the lead in reducing emissions while developing countries pursue sustainable development pathways that do not replicate the destructive fossil fuel-driven pathways of today's developed countries.

This has given rise to demands for a fair and equitable means to promote development for all and to share global public goods such as the atmosphere and oceans. Failing to achieve this just transition could mean continued energy prosperity for rich countries and relative energy poverty for poor nations in the name of global climate stability. Slim as achieving 1.5°C is, it could still be achieved by balancing GHG emissions and removals amidst persistent global inequality, i.e. an unjust global transition. Developing countries raising their energy consumption with more emissions after global net zero is achieved could be accused of being the "bad guys" by countries such as the US and EU who sit on the lion's share of cumulative emissions. By 2050, countries in the Global North could continue to be both wealthy and climate champions, while the majority of countries in the Global South would have to remain poor in order to be climate compliant. The deficiencies of climate models in the IPCC in this regard have begun to be called out by developing country scholars[52]. They point out that equitable scenarios also need to be developed for a juster transition. In some scenarios, North America and Europe only reduce emissions by 50-55% by 2030, while Africa has to reduce its emissions by 80%[53].

Avoiding such an unjust transition should be a central pillar of Malaysian climate strategy. We need to maintain our ability to pursue sustainable development to higher and more inclusive levels. Malaysia will do this best with combined vigilance and pressure from other developing countries. This is an appropriate agenda for an expanded climate diplomacy covered below.

2.3.3. Whose ESG?

There is an asymmetry in the imposition of developed country environmental, social and governance (ESG) standards on developing countries. The environment, society and good governance are valued across all countries, but priorities may differ by geography and culture.

People in a developing country may value environmental quality in terms of reducing air pollution or toxic discharge into the water system, whereas investor stakeholders from developed countries may

[50] Our World In Data (2021); Ritchie, Rosado, and Roser (2023)
[51] Ibid.
[52] Pardikar (2024)
[53] Kanitkar, Mythri, and Jayaraman (2024)

be most concerned about greenhouse gas emissions and deforestation. The EU for example, claims to be concerned about greenhouse gas emissions and deforestation in other countries such as Malaysia. However, this has not stopped it from making Malaysia its second largest export destination for plastic waste after China stopped accepting plastic waste in 2018[54]. Almost 11% of life-cycle emissions for plastic come from the waste management stage[55], meaning that the EU is exporting GHGs from its waste to Malaysia. While the EU claims that it wants to stop exporting plastic waste to non-OECD countries by mid-2026, this does not rule out other OECD countries acting as a trans-shipment point for continued waste exports to Malaysia[56]. A stronger principle-based policy would be to simply stop exporting plastic waste.

Pragmatists in developing country businesses may see ESG as an opportunity to seize competitive advantage from rivals by adopting climate policies. In Malaysia, we see initiatives such as Climate Governance Malaysia and the Capital Markets Malaysia Simplified ESG Disclosure Guide for SMEs. An influential WWF/Boston Consulting Group (WWF/BCG) Report on Net zero Pathways for Malaysia pitched itself towards ESG and climate-based competitive advantage concerns[57]. However, recalling the case of plastic waste, "competitive advantage" for Malaysia rose after China decided to block imports, leading the EU to seek other countries to dispose of its rubbish. Therefore, ESG does not hold a monopoly on new sources of competitive advantage, although ESG-related industries arguably should be cleaner than plastic waste. Ironically the Carbon, Capture, Utilisation and Storage (CCUS) industry which is associated with ESG and climate is also effectively a waste processing industry that is being offered by Malaysia to developed countries such as Japan and South Korea[58]. Is it consistent with Malaysia's sustainability ambitions that it carves out a niche as an international processing and storage hub for hydrocarbon waste? Long-term indefinite stewardship of other countries' waste carbon dioxide raises issues of Malaysia's liability for any leakage and the carbon accounting thereof.

Given the costs of adoption, auditing and compliance, ESG gambit initiatives need to be wise to the tendency for Western investors and companies to engage in performative declarations about ESG or net zero only to quietly drop them later once the difficulty of implementation and muted profitability makes itself clear. Big banks as well as big oil have been "quiet quitting" their climate promises after the exuberance of the US 2020 elections and 2021 Glasgow climate summit wore off[59]. The challenges of implementing fundamental changes to their business model, turning away clients, and foregoing profitability have proved too inconvenient for some. Basing national policy on business fads could be unwise as non-binding corporate platitudes carry next to no legal weight compared to treaty commitments filed by nations. With Donald Trump's second presidency, his potential withdrawal from the Paris Agreement, and a Republican sweep of the US House of Representatives and Senate, the Republican hostility to 'woke capitalism' could further regress big business commitments to climate and other Western ESG issues.

2.3.4. The Investment Climate

The WWF/BCG 2021 report pitched its call for a Malaysian net zero target based on fears of missing out:

---

[54] Azmi (2024)
[55] Ritchie (2023)
[56] Hutt (2024)
[57] Boston Consulting Group and WWF-Malaysia (2021)
[58] Ho (2024)
[59] Yang and Holder (2024); Aronoff (2024)

> *Increasing numbers of countries have committed to a Net-Zero ambition. If we are slow to act, our country runs the risk of falling behind, ultimately losing its attractiveness as a destination for international investment and multinational organisations[60].*

There is no straightforward relationship between a net zero climate policy and attracting investment. In the years following its net zero policy announcement, Malaysia has experienced a significant uptick in investment by data centres, arguably the opposite of climate-friendly investment since they are land-, energy- and water-intensive. Multinationals such as Google, NVIDIA, Amazon Web Services and Microsoft have announced over RM69 billion in data centre investment in Malaysia[61]. Likewise, energy- and water-intensive semiconductor investment interest has been increasing, driven by geopolitical factors. Malaysia's net zero plans are silent about managing demand from such activities.

Countries eager to court foreign direct investment (FDI) may have latched onto climate signalling as the latest branding effort to attract increasingly scarce flows of FDI[62]. However, non-portfolio FDI tends to flow based on business fundamentals of the rule of law, lower cost production, proximity to markets, or derisking supply chains. Climate policy has never been a determining factor. A 2019 survey by the World Bank Global Investment Competitiveness Report of 2,400 multinational enterprises (MNEs) in 10 middle-income developing countries including Malaysia found that the only environment that mattered to MNEs was the "legal and regulatory environment"[63]. Note, that this reflects the views of the real sector, not the financial sector.

While the financial sector has been the main proponent of ESG, aside from defunding coal it has continued to invest in gas and oil. Expectations of investment reward for a strong climate positioning may need to recognise the differences between investment priorities of the real versus financial sector. Developing countries largely reliant upon domestic investment may have the policy space to develop ESG criteria suited to domestic priorities rather than those popular in developed countries. BNM has exercised leadership in preparing the financial sector with tools to assess the climate impact of investments with its Climate Change and Principle-Based Taxonomy in 2021 following two years of local consultation. Malaysia has also looked to developed countries for policy leadership in areas such as the G20-initiated Taskforce on Climate-Related Financial Disclosures (TCFD) made mandatory from 2024 by Bank Negara Malaysia (BNM) for local financial institutions.

2.3.5. Climate and Trade: An inter-disciplinary challenge

Developing countries have to be discerning in order to distinguish ESG concerns from opportunistic trade protectionism.

Climate policies are fundamentally economic policies when they determine the relative cost of energy and who gets protected, or not, from extreme weather events. Climate ministries typically lack expertise in economic matters. Economic ministries typically lack expertise in climate nuances. These domains are increasingly overlapping with contemporary climate policy. Formulating climate strategy from any one narrow sectoral viewpoint—even environment—risks introducing information asymmetries and underserving overarching national development objectives which are

[60] Boston Consulting Group and WWF-Malaysia (2021)
[61] Zalani (2024)
[62] UNCTAD (2024)
[63] World Bank (2020)

cross-cutting. Fostering inter-disciplinary expertise informed by deep pools of specialist knowledge will be essential for upper-middle income states which typically have more complex economies.

Getting climate policies wrong can lead to gross inefficiencies or worsening relations with trade partners as we see in the case of the European Union (EU), its Emissions Trading System and its related Carbon Border Adjustment Mechanism (CBAM). The latter converts subsidies for polluting industries into import barriers that punish trade partners[64].

The EU's Emission Trading System (ETS) is its flagship climate policy that it is attempting to promote to the world. Free pollution permits were introduced into the carbon market to counter industry threats that they would relocate to countries with less onerous policies. The existence of free pollution permits has meant that the EU's energy-intensive industries have been effectively exempted from paying a carbon price within the ETS. This has effectively reduced the scope of coverage of the ETS. According to a competitiveness report commissioned by the President of the European Commission:

> *The EU is also the only major region worldwide to have introduced a significant CO2 price. This cost factor is of* ***limited importance*** *so far as heavy industrial production has been largely covered by free allowances under the Emissions Trading Scheme (ETS). However, these allowances will be progressively phased out with the introduction of the Carbon Border Adjustment Mechanism (CBAM) [Emphasis added]*[65]*.*

Heavy industries have become so used to subsidies that the CBAM was developed to compensate the phase-out of free pollution permits with import protection.

CBAM purports to levy a corresponding carbon price on imports in six sectors (cement, electricity, iron and steel, aluminium, hydrogen, and fertiliser). These energy-intensive industries are among the many European industries struggling with competitiveness[66]. The claim of the industries and the European Commission (EC) is that absent a subsidy in the form of free pollution permits or a carbon price on imports, these industries will be at risk of purported "carbon leakage". The definition of carbon leakage is broad and well-suited to justify subsidies for: i) more carbon-intensive imports displacing EU-produced goods, or ii) firms relocating to non-EU countries to seek a lower-cost regulatory environment. How the EU's investment promotion bodies are able to distinguish the latter from European FDI they assist in moving overseas for the purpose of low-cost production is unclear. Furthermore, studies have shown that the ability of European ETS participants to pass through ETS costs onto customers demolishes any basis for carbon leakage claims[67].

Subsidies help shore up the competitiveness of these industries who claim they might otherwise be negatively impacted by the EU's carbon pricing. With CBAM, the EU is hoping to force its trade partners to adopt carbon pricing in order to reduce their CBAM payments to the EU[68]. By raising their costs of production this could also reduce their export competitiveness. The EU is thus forcing trade partners to subsidise its policy choice to pursue carbon markets rather than opt for a more effective

[64] European Union (2023); Also, see Yin and Aidil Iman Aidid (2024, forthcoming)
[65] Draghi (2024)
[66] Ibid.
[67] Carbon Market Watch (2019)
[68] CBAM payments would be reduced to the degree that a product pays a carbon price in its origin country. CBAM is silent on what happens should a non-EU carbon price exceed those of the CBAM.

policy. CBAM's focus is industry protection not climate protection. In fact, it violates Article 3.5 of the UNFCCC which states that:

> *Measures taken to combat climate change, including unilateral ones, should not constitute… a disguised restriction on international trade[69].*

This is not well understood due to information deficits about CBAM's origins in ETS sweetheart subsidies for heavy industry[70], and the lack of cross-domain expertise in climate and trade ministries. Failure to understand the true nature of CBAM could lead Malaysia to adopt an inefficient policy response.

There have been calls within the Malaysian government to adopt carbon pricing in response to CBAM, primarily for the iron and steel industry which is most affected (See Table 1). Budget 2025 announced a carbon tax by 2026 (coincidentally the year CBAM fully enters effect). However, the announced scope covered iron, aluminium and, crucially, the energy sector. While those metals are not significant in terms of Malaysia's exports or domestic consumption, a carbon tax on the energy sector would function like a broad-based regressive consumption tax as well as having competitiveness and investment implications[71]. The government appears to be avoiding regressive taxes presumably because they would increase income inequality which has been a longtime target of Malaysian development policy. Electricity and transport form a greater proportion of rural household expenditure than it does for urban households suggesting that lower income households spend a greater proportion of their income on energy[72]. Malaysia's response to CBAM may be more consequential than the baseline impacts of CBAM on Malaysia. This shows how complex international policy shocks can be and how they can extend down to the level of Malaysian households.

For those optimistic about transposing carbon pricing policies from the EU to Malaysia it should be noted that beyond free pollution allocations the EU employs an extensive system of subsidies to cushion the impact of carbon pricing or decarbonisation on its industries. When the EU speaks of "level playing fields" it should be assumed that the level tilts towards European competitive advantage.

Germany is one of the leaders of subsidy initiatives despite its ideological commitment to a market economy. In August 2023, the European Commission (EC) approved a Euro 6.5 billion German subsidy to offset purported carbon leakage risk for industries that include coal mining, iron, steel, aluminium, nuclear fuel processing, and even tomato puree, milk powder and bakers' yeast[73]. In February 2024, the EC approved a Euro 4 billion decarbonisation scheme that subsidises ETS costs for companies[74]. Thus, while the EU pledges to phase out free pollution permits under CBAM we see Germany introducing other kinds of ETS subsidies. Of course, despite the EU's talk of CBAM forming a level playing field, Europe's trade partners will not enjoy access to such subsidies, but they will be levied the ETS carbon price.

---

[69] United Nations (1992)
[70] European Parliamentary Research Service (2023)
[71] Andersson and Atkinson (2020)
[72] DOSM (2022)
[73] European Commission (2023)
[74] European Commission (2024b)

Table 2.1: Potential CBAM exposure of Malaysia's exports to the EU (USD bn)

	Total exports to EU	Aluminium	% share of total exports to EU	Iron & steel	% share of total exports to EU	Fertilisers	% share of total exports to EU	Chemicals	% share of total exports to EU	Exports impacted by CBAM	% share of total exports to EU	Exports to EU impacted by CBAM (% of total exports to the world)
	USD bn	*USD bn*	*% of total*	*USD bn*	*% of total*	*USD bn*	*% of total*	*USD bn*	*% of total*	*USD bn*	*% of total*	*USD bn*
2014	19.9	0.1	0.5%	0.2	1.0%	0.0	0.0%	0.0	0.0%	0.3	1.5%	0.1%
2015	17.9	0.1	0.5%	0.2	1.1%	0.0	0.0%	0.0	0.0%	0.3	1.6%	0.1%
2016	17.2	0.1	0.4%	0.2	1.1%	0.0	0.0%	0.0	0.0%	0.3	1.5%	0.1%
2017	19.5	0.1	0.6%	0.4	1.9%	0.0	0.0%	0.0	0.0%	0.5	2.5%	0.2%
2018	22.3	0.3	1.3%	0.4	2.0%	0.0	0.0%	0.0	0.0%	0.7	3.3%	0.3%
2019	21.2	0.2	1.1%	0.4	1.8%	0.0	0.0%	0.0	0.0%	0.6	2.9%	0.3%
2020	19.8	0.1	0.7%	0.2	1.3%	0.0	0.0%	0.0	0.0%	0.4	2.0%	0.2%
2021	25.2	0.3	1.1%	0.5	1.9%	0.0	0.0%	0.0	0.0%	0.7	3.0%	0.2%
2022	29.2	1.0	3.5%	1.0	3.5%	0.0	0.1%	0.0	0.0%	2.1	7.2%	0.6%
2023	18.6	0.8	4.4%	0.7	3.7%	0.01	0.0%	0.0	0.0%	1.5	8.2%	1.0%
5-year average	**22.8**	**0.5**	**2.2%**	**0.6**	**2.4%**	**0.0**	**0.0%**	**0.0**	**0.0%**	**1.1**	**4.6%**	**0.4%**
10-year average	**21.1**	**0.3**	**1.4%**	**0.4**	**1.9%**	**0.0**	**0.0%**	**0.0**	**0.0%**	**0.7**	**3.4%**	**0.3%**

Source: UN COMTRADE/compiled by Nur Sofea Hasmira, KRI

Notes:

Data is the sum of all kinds of exports to the EU27 countries

For exports to the world in 2013, there are no exports for aluminium, iron & steel and fertilisers

For exports to the EU, there are none for chemicals

Fertiliser exports exist but amount to only millions of USD

CBAM is trade protectionism, not ESG

In Malaysia, CBAM has been misperceived as an ESG measure that Malaysia should aim to comply with[75]. While claiming to be a level playing field climate measure for Europe's high emission industries it effectively reallocates a controversial sweetheart subsidy scheme for heavy industry into import barriers—over a very long phase-in period of 10 years. CBAM punishes developing country exporters for not enjoying the same fossil fuel, economic and technological privileges enjoyed by the EU for the past one and half centuries. This goes against the UNFCCC and Paris Agreement principle of common but differentiated responsibilities as well as UNFCCC Article 3.5 on disguised trade restrictions, as noted above. It is also in violation of several articles of the World Trade Organisation's (WTO) General Agreement on Trade and Tariffs (GATT)[76]. A study by the United Nations Trade and Development (UNCTAD) found that CBAM would produce negligible reductions in GHGs (-0.1% globally), but its main effect would be to transfer wealth from poor developing countries to the EU[77].

Responding appropriately to such structural injustices is one very important reason why developing countries need to embrace climate strategy. Not only could developmental avenues be closed off, but developing countries could be framed as the main climate culprits despite having contributed far less to the climate crisis than developed countries.

A variety of Malaysian institutions—including BNM[78] and the Ministry of Investment Trade and Industry (MITI)[79]—have accepted the EU's flawed and unsubstantiated premise for CBAM based on a cursory two-page analysis by WWF/BCG in their *Net Zero Pathways for Malaysia* report. In an effort to scare readers into adopting a carbon price in Malaysia, WWF/BCG uncritically advanced the EU's logic for CBAM but failed to note:

1. The lack of evidence for carbon leakage, the core phenomenon free pollution subsidies and now CBAM were supposed to deter[80].
2. Reports filed for years by civil society groups, including WWF, on how the EU ETS enriched high emission industries via free pollution permits. From 2013-2021, industries received Euro 98.5 billion in free pollution allowances while governments received only Euro 88.5 billion in revenue[81]. From 2008-2019, the total value of free pollution allowances handed out amounted to Euro 200 billion, resulting in windfall profits of Euro 50 billion to Europe's most polluting industries[82].
3. The weakness of the EU ETS to lobbying. A study found that for Euro spent on lobbying EU governments, companies earned from Euro 1 to Euro 4.60 in free pollution permits[83].
4. Mediocre annual emission reductions delivered by the EU ETS in the order of 0% to 1.5% per year[84].
5. CBAM's violations of the UNFCCC, the Paris Agreement and the WTO's GATT[85].

---

[75] MITI (2024)
[76] Bacchus (2021); Beaumont-Smith (2024)
[77] UNCTAD (2021)
[78] Bank Negara Malaysia (BNM) (2023)
[79] MIDA (2024)
[80] Carbon Market Watch (2019)
[81] Carbon Market Watch (2019); WWF (2022)
[82] Carbon Market Watch (2019)
[83] Winkler (2022)
[84] Green (2021)
[85] CBAM contravenes UNFCCC Article 3.5 as a "disguised restriction on international trade". It goes against the Paris Agreement's Article 2 and 4, while cynically undermining Article 9 on climate finance by proposing to recycle CBAM levies taken from LDCs back to them as climate finance (EU 2023). CBAM also runs up against the GATT Articles 1 and 2.

6. The opposition mounted by dozens of countries at the UN and WTO against CBAM[86].
7. The huge geopolitical and bureaucratic challenges for the EU to implement CBAM beyond a handful of uncompetitive sectors[87]. The CBAM FAQ produced by the EC runs to 128 questions[88].

The Malaysian institutions above have adopted the WWF/BCG projection that around 75% of Malaysia's exports to the EU will eventually be covered by CBAM, up from only 3.4% today (see Table 1). This does not account for the reflexive nature of unilateral trade discrimination by the EU. Backlash from trade partners and internal opposition can affect policy development. The EU does not enjoy unfettered agency in imposing its will on the world. If it did, it would not be a declining power.

The EU Deforestation Regulation: Failed unilateralism

For example, the EU's Deforestation Regulation (EUDR) was slated to take effect from 30 December 2024 but has now been postponed a year due to internal and external opposition. The controversial law which bans the import of commodities related to deforestation was opposed by 20 out of the EU's own 27 member states over fears the EU's own farmers—ever the Achilles' heel of elite plans—would be banned from exporting products grown on deforested land[89]. It also faced opposition and concern from the EU's trade partners including Brazil, Thailand, Indonesia and Malaysia[90]. Malaysia has accused the EUDR of being "unjust" and a cover for protecting the EU's domestic oilseeds market[91].

The EU is purportedly the second largest contributor to global deforestation via its imports so there is merit to tackling its destructive consumption. However, methods such as CBAM and EUDR tend to be punitive on developing country trade partners, pushing the costs of transition onto them. These policies have no just transition framework, violating a commitment to a "just and equitable transition" that the EU accepted at COP28 in 2023. They impose costs and penalties, with no consideration for different economic circumstances or capabilities, ala CBDR-RC. The EUDR and CBAM are fresh reminders that the EU's zeal to impose its policy view on other nations can result in flawed and unjust legislation that can be challenged. It is also helpful to recognise that domestic opponents within the EU can help further the interests of developing countries. Likewise, a growing group of countries is opposing the CBAM within the WTO and forcing the EU to answer for its impacts.

In light of the EU's U-turn on the EUDR, Malaysia should reassess the merits and legality of its compliance with CBAM. One of the simplest ways to register concern is to join the meetings of the WTO Committee on Market Access or the Council for Trade in Goods where around 20 countries including Indonesia, Thailand, China, Russia, India, Türkiye, Japan and South Korea have been among those voicing concerns about CBAM. Such dialogue could give rise to CBAM reforms or become the basis for WTO challenges filed by one or more parties that could result in a reform or repeal of CBAM.

2.3.6. Industrial policy and carbon pricing

One of the most powerful instruments to grow the economy is industrial policy, where a state imparts support and direction to specific industries, firms or economic activities. Industrial policy has been used successfully by Northeast Asian states such as Japan, South Korea, Taiwan and China to catch up

[86] World Trade Organization (WTO) (n.d.)
[87] Kurmayer (2023)
[88] European Commission (2024a)
[89] Meijer and Angel (2024)
[90] European Commission (2024c)
[91] Ang (2023)

with Western industrialised states. It has been less successfully practiced in Southeast Asia, which is sometimes used as a cautionary counterpoint to their northeast Asian neighbours[92]. Economic orthodoxy from Western states and their institutions such as the World Bank and International Monetary Fund has frowned on industrial policy, preferring instead a commitment to free trade and free markets. This has changed recently as the US has realised that its support for globalisation, where multinational corporations moved their manufacturing overseas to lower-cost sites of production such as Mexico and China, has led to deindustrialisation of the US and the industrialisation of China which it views as a military and strategic rival[93].

Industrial policy tools run the gamut from subsidies, trade protection, tax relief, credit (concessional or not), infrastructure development, to research and development support. Compared to industrial policy, the policy tools traditionally offered for climate change have been far more limited in scope and ideologically constrained. Besides regulation, markets for trading emission credits or Pigouvian corrective taxes dominate the policy offerings. Climate advocates have been conditioned to expect the perfect carbon price to precipitate a tipping point away from fossil fuels to sustainable production and consumption. Yet, for reasons of economics, politics and vested interests carbon taxes are never high enough to meet the social cost of carbon that theory prescribes, and carbon markets get saddled with loopholes or poor valuations that render them incremental and therefore ineffectual as emissions need to be dramatically reduced in a matter of decades[94].

In the 1990s when the climate convention and the Kyoto Protocol were born, carbon pricing—whether markets or taxes—was a sideshow where climate concerns could be relegated. Renewable energies such as solar and wind were then very expensive. They would not initially enjoy the mainstream industrial policy support—subsidies, price controls, investment incentives, R&D—given to the fossil fuel and automobile sector. It was theorised that carbon pricing would make renewables more cost competitive with fossil fuels. Meanwhile, even cheaper— efficient as economic parlance goes – emissions reductions could be delivered via the purchase of carbon offsets in credit markets. Poor developing countries would offer their forest sinks up for purchase by rich countries in lieu of actual decarbonisation efforts or economic empowerment by the latter. Finally, it was thought that carbon dioxide, a global transboundary pollutant with an atmospheric lifetime of several hundred years, could be traded just like sulphur dioxide was in the US market. Climate change was just a market failure, the greatest one in the words of Nicholas Stern, a prominent British climate economist[95]. There is no problem too big—even climate change—that a market couldn't swallow it with the right intervention.

The Kyoto Protocol and its market mechanisms eventually collapsed under pressure from developed countries. The obsession with market mechanisms was preserved and smuggled into the Paris Agreement's Article 6 in the form of so-called Internationally Transferred Mitigation Outcomes, meaning that developed countries can buy emission reductions generated elsewhere, particularly in developing countries. Since the typical developed country has been heavily deforested, they lack access to carbon sinks apart from buying them from poorer countries in the form of carbon trading. The expectation is that this will be cheaper than emission reductions pursued in developed countries.

[92] Studwell (2013)
[93] Tooze (2024)
[94] Green (2021)
[95] Stern (2007)

For the poorest countries, selling their emission reductions may appear attractive since they may have been deprived of better developmental options.

For an upper middle-income country such as Malaysia there is no compelling reason to engage in selling rights to its carbon sinks abroad. The NETR calls for no net change in carbon sinks from 2019 until 2050, meaning that any international sales would reduce the amount of carbon sinks that Malaysia could claim for its national target. Carbon sinks are Malaysia's strategic development reserve, allowing us to temporarily and cost-effectively pursue development with high emission industries before we convert that wealth into a greener transition. Depleting our sinks through poor management and international carbon trading would push us into the strategic situation most developed countries face: highly deforested and high emissions, with high costs of transition.

Malaysia's draft Climate Change Act focuses on carbon markets and emission trading as one of its main policy tools[96]. This appears to take the lead from developed countries' emphasis on carbon markets as the lead form of action, an emphasis as much ideological as it is unimaginative. A different toolbox may be needed compared to those theorised and developed for highly deforested, high emission developed countries.

The EU's ETS is the world's oldest carbon market, now around twenty years old. This has given sufficient time to evaluate its performance as a policy instrument. A review of the empirical performance found that the ETS delivered annual emission reductions of between 0% and 1.5% per annum[97]. The problems and poor performance of the ETS are well documented but they are not well known[98]. Several of them have been covered in the preceding section on CBAM and unilateral trade measures.

Where the EU has been able to deliver big emission reductions is in the slowing down of its economy. GHG emissions fell by 8.3% in 2023, the largest annual drop in decades, which the EC attributed to growth in renewable energy, which outpaced fossil fuels[99]. However, the EC conceded that in 2023 its economy was stagnant at a mere 0.4% growth year-on-year, which follows years of declining growth[100]. Industrial emissions fell 6%, but industrial output also fell by 2%. The recently released competitiveness report by EU doyen Mario Draghi paints a bleak picture of the European economy:

> *Technological change is accelerating rapidly. Europe largely missed out on the digital revolution led by the internet and the productivity gains it brought: in fact, the productivity gap between the EU and the US is largely explained by the tech sector. The EU is weak in the emerging technologies that will drive future growth. Only four of the world's top 50 tech companies are European. …*
>
> *If Europe cannot become more productive, we will be forced to choose. We will not be able to become, at once, a leader in new technologies, a beacon of climate responsibility and an independent player on the world stage. We will not be able to finance our social model. We will have to scale back some, if not all, of our ambitions.*

---

[96] NRES (2024a)
[97] Green (2021)
[98] Carbon Market Watch (2019); Winkler (2022); WWF (2022)
[99] European Commission (n.d.)
[100] Eurostat (2024)

This is an existential challenge[101]*.*

No one ever expected a country to prosper from carbon markets in the way it might from manufacturing semiconductors or electric vehicles. However, the EU is struggling in these manufacturing areas and is belatedly realising that it needs an effective industrial policy such as China's or even the US, both of whom are outcompeting it.

Developing countries should consider very carefully before adopting policy tools from Europe. Subpar tools may not meet the long-term strategic needs of developing countries, more substantial industrial policy measures will better deliver transition along with prosperity. While the EU's carbon markets are grounded in the punitive principle of 'polluter pays', the European Commission has built an elaborate system for the worst polluters to avoid paying. The stick wielded by policy is in fact a big carrot. The US Inflation Reduction Act skips carbon pricing entirely and uses only carrots in an effort to minimise conflict with the incumbent energy and manufacturing elites. Rather than raise the price of fossil fuels, it reduces the cost of renewables and crucially focuses on their profitability. Price alone is not enough to persuade businesses to invest. They must foresee profits[102].

While Europe has struggled to come forward with good answers to climate policies, the Draghi Report raises a salient question. How can we reconcile decarbonisation and competitiveness when the former implies transition costs and reduced competitiveness?

For China, establishing technological and manufacturing leadership and—crucially—profitability in renewable technologies, electric vehicles and batteries has allowed it to reap benefits from the decarbonisation trend in multiple countries. Current industrial policy in the US is determined to seize back manufacturing share in these sectors and semiconductors, as well as deliver green jobs. The EU practices ambivalence. It has taken steps to defend its automobile industry from Chinese competition, to which China has retaliated. But the EU has so far chosen to turn a deaf ear to appeals to do the same for solar panel imports.

Malaysia lacks the market scale and fiscal strength of any of these economies. It needs to carve out a middle-income country strategy. Decarbonising energy supply for FDI is part of current thinking. It is implicit in NETR and explicit in WWF/BCG (2021). Decarbonising for FDI thus becomes a form of subsidy alongside cheap land, water, electricity, labour and tax incentives FDI already enjoys in Malaysia.

The US solar industry has been accusing Chinese solar companies based in Southeast Asia of flooding the US market with under-priced subsidised solar panels. A recent US Department of Commerce preliminary ruling on solar imports from Malaysia and other Southeast Asian countries claim that at least one firm, South Korean Hanwha Qcells enjoyed government loans and below-market land provision in Malaysia, justifying countervailing tariffs of 14.72%. China's Trina Solar received a duty rate of just 0.14% for products made in Thailand. Ironically, the case in the US was filed by Hanwha Qcells, Arizona-based First Solar, who also operates in Kulim, Kedah and a number of smaller producers[103].

Subsidising multinational production is clearly not a straightforward matter and cost-competitive centres such as Malaysia are under increasing scrutiny. However, it takes two hands to clap. It is not

[101] Draghi (2024)
[102] Christophers (2024)
[103] Groom (2024)

just the Malaysian government—or any government for that matter—offering subsidies. Multinationals also solicit them and engage in subsidy arbitrage between locations. Will decarbonising efforts under the NETR someday be targeted as unfair subsidies? Assessment of the mood and disposition of producers in key retaliatory markets such as the US and EU is necessary.

In recent years, Malaysia has been trying to move towards a more discerning approach to courting FDI. Being a low-skill, low-cost export centre places constraints on the desire for upward mobility, increased wages and improved government revenue. The National Investment Aspirations took a more qualitative focus on strategic sectors, subsequently incorporated into the New Industrial Master Plan (NIMP) 2030.

More consequential for Malaysian competitiveness would be increasing the dynamism, number and participation of local firms in producing goods of greater complexity and increasing Malaysia's manufacturing capabilities. Lower carbon footprints may help smooth access to markets such as the EU which are prone to arbitrary unilateral trade restrictions based on "environmental" concerns. However, there are other markets where such discrimination is absent and other goods such as semiconductors where demand is so great that there is no desire to constrain supply unless they are from China. Data centres are energy intensive but their cross-border services are also not environmentally regulated.

Subsidy reviews such as those conducted by the US Department of Commerce are complementary to other industrial policy measures—including subsidies!—employed by the US to onshore more solar manufacturing. Unlike carbon markets which impede competitiveness unless defanged, industrial policies, well designed, are aimed at increasing competitiveness. Implementing carbon markets is not mandatory under the Paris Agreement. Discretion is left to individual countries to chart the most effective way forward given their national circumstances. When designing climate change laws and policies Malaysia should ask how decarbonisation and competitiveness can be fruitfully merged. Carbon markets and carbon pricing seek to answer the question of how undesirable fossil fuel industries can be made more expensive. Yet fossil fuels remain profitable, more so than renewables. Accordingly, they attract more capital. Recent research from Bloomberg reveals how the $5 trillion hedge fund industry has been shorting clean technology stocks since 2021 while going long on fossil fuels[104]. Despite longstanding hype that ESG investments would generate solid returns "clean energy and green technology stocks have lagged behind the broader market"[105]. Analysis of 500 hedge funds showed that:

> *Despite vast green stimulus packages in the US, Europe and China, more hedge funds are on average net short batteries, solar, electric vehicles and hydrogen than are long those sectors; and more funds are net long fossil fuels than are shorting oil, gas and coal[106].*

A good question for climate policymakers to begin with is rather how to make clean alternatives profitable. In capitalist systems, profitability ultimately governs supply and demand[107]. Making interventions on only the supply or demand may fall flat if they fail to account for profitability. Carbon markets and carbon taxes are demand-side interventions in the tradition of Pigouvian corrective taxes. Climate economics has done the broader movement a disservice by largely limiting itself to this one tool. Industrial policy interventions from outside climate economics have had greater impact

[104] S. Lee, Mookerje, and Udemans (n.d.)
[105] Ibid.
[106] Ibid.
[107] Shaikh (2016)

because they directly address the profitable production of climate goods. This merits further study by Malaysia and other countries so that ineffective policy institutions are not established. The EU case shows that their ineffective carbon pricing approach has generated inefficient subsidy systems to cushion the impact on industry. This has led to a drain on fiscal resources, trade relations and climate transition.

2.3.7. Institutions Alone Are Not Enough, They Need Agendas

Climate is not an environmental problem. It is an environmental, economic and diplomatic poly-problem. This makes it inherently challenging for governments to handle purely through line ministries. They will lack sufficient portfolio authority to resolve domain interlinkages. Higher level fora such as the Malaysian Climate Action Council (MyCAC) chaired by the Prime Minister offer some institutional basis from which to launch a more coordinated response. However, the scope for MyCAC deliberations appears to be entirely national or covering national submissions to the UN. Likewise, the National Climate Change Policy 2.0 (NCCP2) is primarily domestically focused, as it:

> *aims to facilitate the country's transition towards a low-carbon economy and climate-resilient development, as well as operationalising the Paris Agreement at the domestic level.*[108]

There is also scope to develop a complementary climate foreign policy to advance domestic interests including long-term national climate security in line with the ultimate objective of the UNFCCC: stabilisation of the global climate at acceptable levels. This would be consistent with Strategic Thrust 5 of NCCP2 which has scope for international cooperation.

Malaysia's diplomatic efforts in climate change have normally been confined within the halls of the UNFCCC meetings. There Malaysia has shown initiative to establish more agile diplomatic groupings than the G77/China which includes 134 developing countries. The G77/China has strength of numbers but these numbers, diversity and sometimes divergent interests, make achieving consensus on issues of concern challenging. One initiative undertaken by Malaysia was to co-found the Like-Minded Developing Countries (LMDC), a grouping of more than 20 countries from Asia, the Middle East, Africa and Latin America that focuses on defending CBDR-RC issues. In the years since leaving the LMDC Malaysia has found the need to house itself in another grouping, the latest of which is ASEAN.

ASEAN is only a grouping of ten and disparate one at that since it contains Least-Developed Countries, oil and gas states, as well as countries with some of the highest GDP per capita in Asia. With no background in cooperation at the UNFCCC or other multilateral environmental fora it will require years of work to shape the grouping into an effective vehicle for Malaysian ambition. It should be noted that members of ASEAN also maintain membership in groupings such as LMDC On the positive side, ASEAN has been making joint statements on climate change for at least a decade at the group's annual summit. These efforts may have been undertaken by the respective foreign ministries of each country as opposed to the climate ministries.

Beyond the UNFCCC meetings there is scope to consider establishing a more activist mode of diplomatic engagement. Malaysia could establish a Global South climate envoy to build consensus among developing countries on areas of common interest such as climate finance, adaptation and a just transition for mitigation pathways consistent with common but differentiated responsibilities.

[108] NRES (2024b)

The agenda would require establishing thought leadership on critical areas of widespread interest among Parties to the UNFCCC. This would have benefits for further developing Malaysia's domestic position on international issues as well as keeping a finger on the pulse of sentiment amongst peer developing countries. The envoy could be the climate minister or someone with suitable credentials and mandate to pursue the national interest. This would not be a sinecure but a strategic position. Developing countries should field more envoys to compete with developed countries who do not necessarily share common values. The US, for example, has a climate envoy to advance its interests and improve its optics. Even a declining power such as the UK has a climate envoy. Conceivably strategic dialogue fora such as BRICS would allow for conversations of this sort to take place.

2.3.8. Localising Policy Demands from the Global North: ESG and energy security

Malaysia is currently in a phase of rapid adoption of climate-related policies mostly derived from or responding to developed countries or informed by its international climate treaty obligations. The quality of such policies, and their developmental implications, merit review and consideration in light of Malaysia's overarching national strategic objectives.

International climate agreements and ESG expectations from foreign investors may appear to impose constraints on the use of fossil fuel energy[109]. Constraints on the use of abundant and affordable fossil fuels could require a developing state to either undertake the risk of substantial investment in domestic alternative power sources or spend more on importing suitable technologies. In Malaysia's case, a stop to oil and gas use could diminish the annual federal budget by 15-40%, which is the direct contribution the national oil company PETRONAS makes (it also has other wealth-generating activities which add to gross domestic product). Developing domestic manufacturing capacity in clean technologies such as solar panels and electric vehicles would face challenges as other countries are highly competitive in these products. Buying them from overseas would increase Malaysia's import bill, narrow its balance of trade, and increase the need to amass foreign exchange to make purchases. If Malaysia was unable to trade oil and gas then its ability to finance imports would also diminish. This is all a simplified scenario, but it helps illustrate the strategic challenges posed by international climate action for a petroleum-dependent country such as Malaysia. Malaysia's energy transition strategy is offered as a "net zero" approach that tapers greenhouse gas emissions (GHGs) by switching from coal to gas, phasing up renewables and energy efficiency measures, and balancing the resulting mix with GHG removals by domestic carbon sinks.

Coal, of course, is the fuel that the financial industry has come around to as a sacrificial pawn in ESG signalling while other investments in gas and oil can be sustained. Developing countries such as India and China have been less enthusiastic about phasing out coal so soon. Gas has emerged as the 'transition' fuel for richer countries, increasing competition for supply, which Japan has now cornered.

Since oil and gas investments enjoy internal rates of return of 15% to 20% in developed countries, while renewables struggle at 5% to 6%, developed country capitalism will continue to support oil and gas investments unless the profitability of renewables can be improved via policy interventions[110].

---

[109] "Appear" because it is not well recognised in Malaysia that the same foreign financial institutions that raise questions about ESG policies also continue to finance the fossil fuel industry.
[110] Christophers (2021)

In contrast to Malaysia, the United States, the world's most powerful and polluting country, is currently the world's largest oil and gas producer that is also trying to claw back lost manufacturing capacity in clean technology. It is simultaneously staking out energy security based on fossil fuels whilst developing its ability to offer manufacturing jobs in sunrise industries. Heightened tariffs on Chinese-manufactured solar photovoltaic panels, including panels from Southeast Asia, is a policy commitment that runs through the Obama, Trump and Biden Administrations[111]. It is likely to continue under the second Trump Presidency.

What may passively establish policy space for Malaysia to justify its transition to gas are the environmental compromises struck by the EU. In 2022, the European Parliament supported gas and nuclear to be labelled as sustainable, which is a fairly low level of ambition for a developed nation. While exported policy standards from developed countries like the EU or US can form a constraint on Malaysian policy, double standards by such countries can also buffer policy options adopted by a small GHG emitter with limited options for affordable renewables like Malaysia.

Ideally, Malaysia should be tracking regulatory and policy developments in jurisdictions with high financial or trade significance that practice regulatory imperialism. However, foresight is of little use if Malaysia does not also nurture the appetite to challenge or pre-empt arbitrary double standards that hurt its industries.

2.3.9. Time Is Running Out…What If It Does?

The stakes are even higher as time passes in this critical decade. In order to meet the 1.5°C goal, global emissions are supposed to peak by 2025 and decline 42% by 2030 and 57% by 2035 relative to 2019. However, in the COP28 Global Stocktake (GST) of current progress it was noted that we are far off track. An analysis of current total NDCs suggested that on average they would reduce global emissions by a mere 2% by 2030, and at most 5.3% by 2030 if enhanced financial resources, technology transfer and technical cooperation, and capacity-building support were provided[112]. Subsequently, the UNEP Emissions Gap report was to note:

> *As greenhouse gas emissions rose to a new high of 57.1 gigatons of carbon dioxide equivalent in 2023, the cuts required from today are larger; 7.5 per cent must be shaved off emissions every year until 2035 for 1.5°C. Current promises are nowhere near these levels, putting us on track for best-case global warming of 2.6°C this century[113].*

In 2021, the United Nations scientific advisory body on climate change, the Intergovernmental Panel on Climate Change (IPCC) posited that for a 50% chance—a mere coin toss—to meet the Paris climate goal of 1.5°C warming, the remaining carbon budget to be divided among the 195 nations of the world was a mere 500 Gigatonnes of CO_2. The latest independent estimate holds that as of 2024, only 200 $GtCO_2$ of the carbon budget remains[114]. This means that in the first three years of this decade, which included the global shutdown of the pandemic, some 60% of the 1.5°C carbon budget has been exhausted. If the world halved this carbon budget to 100 $GtCO_2$ we would enjoy an 83% chance of reaching 1.5°C. Unsurprisingly, those wealthier or more populous countries that already consume much of the atmospheric space have occupied much of the carbon budget leaving little space for most

[111] Tooze (2024)
[112] UNFCCC (2024)
[113] UNEP (2024)
[114] Forster et al. (2024)

developing nations. The question of who has consumed what proportion of the post-2020 carbon budget is covered in Chapter 3.

Most climate advocates are obliged to be optimists in public and would call for efforts to be doubled, trebled or more to stabilise the climate at 1.5°C. However, national strategies should not focus solely on a single best-case scenario. There is a responsibility to prepare for failure if the likelihood of keeping within the carbon budget seems improbable given the rate of reduction in recent years. If the 1.5°C carbon budget is irrevocably exhausted, then we must prepare ourselves to face far worse climate impacts than we had hoped.

All countries therefore need a climate strategy to achieve prosperity with less or no fossil fuel power and to achieve that in the face of greater physical climate risks which can destroy that prosperity. We also need to account for different degrees of altruistic global cooperation—from sufficient to insufficient.

Just as we need to balance emissions of GHGs and their removals from the atmosphere, a balanced approach to climate strategy is also needed. While reducing emissions, known as climate mitigation, will limit the ultimate level of physical risk, we also need to adapt to the climate changes that have happened and that will happen. Furthermore, we will need to begin identifying, pricing and remediating areas of loss and damage and their associated socioeconomic impacts. To do all this, we will need considerable financial resources. A strategy that is mostly focused on mitigation, typically encouraged by developed countries and ESG rules makers aligned with their values, is insufficient, especially for developing countries who are not major emitters.

2.3.10. Why Mitigation Dominates the International Agenda

Mitigation has dominated the international climate action agenda because balancing greenhouse gas emissions with removals directly addresses the driving mechanism of human-induced climate change. Developed countries have favoured mitigation for several reasons.

First, developed countries have been identified as the principal emitters by the climate convention, their domestic climate advocates, and developing countries. The first concrete operationalisation of the UNFCCC was the defunct Kyoto Protocol which mandated mitigation action by developed countries and no legal reductions from developing countries. Developed countries' dissatisfaction with this paved the way for the Paris Agreement which extends self-determined obligations to all countries, the Nationally Determined Contribution (NDC). The commitment to tackling mitigation this way challenges the differentiation principle in common but differentiated responsibilities since a handful of developed countries are responsible for more than half of historical anthropogenic emissions. The motivation of developed countries can be understood in two ways:

1. As a way to reduce relative losses in economic power due to energy transition by obliging economic competitors from developing countries to also undertake emission reduction.

2. Taking for granted their economic privilege, by under-empathising the struggle of developing countries to tackle poverty and pursue sustainable development. The struggle of developed countries is to tackle the root causes of climate change (emissions) whilst staying ahead economically. As demonstrated by their pandemic stimuli and military spending, they have considerable financial resources to address transition, adaptation and loss and damage. In 2021/2022 total global climate finance flows were estimated to be $1.3 trillion (based on a

broad definition including non-public sources), global public military expenditure was nearly double at $2.2 trillion in 2022, global fossil fuel subsidies were $7 trillion, while in 2020 the world unveiled $11.7 trillion in pandemic subsidies[115]. The struggle of developing countries is to catch up economically, mitigating a small contribution to climate change, and accessing considerable financial resources to adapt to its impacts or redress losses and damages.

Secondly, mitigation is directly associated with transition in the energy sector. While this implies losses for fossil fuel investments, it also implies investment opportunities in clean energies and technologies, and therefore profits. At least this is how it is presented by what could be called, the new green industrialism or Green New Deals as they have been known in the West[116]. The ESG movement marks the convergence of activist and investor interests. Activists were spread thin protesting the actions of polluting companies at the 'fence line'. Some realised that it was far more effective to target financial flows and investors higher up the economic food chain and thus affect many companies. This effort has been quite successful in getting financial institutions to adopt commitments or policies on ESG. However, at this critical juncture rates of return on renewable energies remain lagging behind fossil fuels. So, while investors such as BlackRock and ABN AMRO have publicised ESG policies which may cascade into demands on investees, they continue to finance fossil fuel investments[117].

If it seems contradictory that developed countries can champion both climate mitigation and fossil fuels, continued commitment to the latter is best explained by the profit imperatives of capitalist organisations dominant in the developed world and realist energy security concerns[118].

2.4 Conclusion

If Malaysia stands in the UN climate change plenary and declares a firm net zero 2050 target, or even a 2040 or 2030 net zero target, there would be no special applause other than the polite claps that greet the end of every speech. We must recognise our relative insignificance to global climate outcomes. We are not a recalcitrant great emitter whose commitments can shape the future of many nations.

Bold shows of mitigation ambition will not translate into massive inflows of investment. Following Malaysia's first net zero announcement in 2021 investors did not rush in due to the pandemic and concerns over political stability. By 2024, significant investments were being driven by China Plus One strategies to mitigate geopolitical risk. Increased investor activity from semiconductors and data centres suggest that climate policy does not dissuade energy-intensive investors and emissions are not a critical factor in investment approvals.

The ultimate objective of national climate strategy should not be investment. That is the purview of industrial policy. National climate strategy must set its sights on long-term climate resilience and security for Malaysia. It must protect the enabling conditions for our future sustainable development.

[115] Climate Policy Institute (2023)
[116] Chatzky and Anshu Siripurapu (2021)
[117] Johnson (2024); NL Times (2023)
[118] For example, the fallout between the EU and Russia over the eastward expansion of NATO led to the disruption of Germany's energy security plans that were reliant upon imports of Russian gas.

Malaysia is currently an upper middle-income country, but it could well cross the World Bank's arbitrary high-income threshold by the end of this decade. Crossing this threshold will not substantially change Malaysia's strategic challenges. It will not be comfortably high-income, but barely high-income. Greater efforts to raise Malaysia's wealth will require more power. It will also bring Malaysia into increased competition with other rich countries. The kind of policies Malaysia adopts will affect its ability to continue rising.

This is the climate policy challenge. How does Malaysia fulfil its international obligations to help stabilise the global climate whilst simultaneously pursuing its ambitions for domestic prosperity and sustainable development?

It is actually not an either/or dilemma. The failure of international efforts to stabilise the global climate at moderate levels of warming would curtail Malaysia's future prosperity. Malaysia needs a formula to reconcile both domestic and international climate action. It needs a climate strategy.

The 2015 Paris Agreement to the UNFCCC upholds these objectives. The treaty asks countries to make NDCs towards holding global temperature increase to 1.5°C above pre-industrial levels, adapt to the adverse impacts of climate change, foster climate resilience and low-emissions development, and make finance flows consistent with this. However, it does not spell out how countries should do so. This is left up to a mix of voluntary action and peer pressure.

A robust climate strategy involves understanding that climate policy is less an issue of environmental management than it is an issue of economic strategy and transformation. Responding to climate change means constraints on greenhouse gas emissions from fossil fuels or deforestation that may be incurred in the process of economic activities. Effectively, it is an issue of development, and sustainable development at that.

Malaysia needs to ensure that constraints on emissions do not become constraints on its power and economic capabilities, including its leading firms that anchor the economy. The EU and the US both offer cautionary lessons in this regard. Malaysia's future NDC commitments need to be carefully calibrated to not sacrifice excessive development policy space on the altar of increased mitigation ambition. Long-term mitigation plans offer a comparable dilemma to industrial policy deliberations: not all of today's industries can be supported indefinitely because structural transformation requires new and better industries to be supported.

Finding a successful formula for national development is actually quite difficult. Within Asia, only a handful of countries have become highly industrialised and wealthy. Japan, South Korea, Taiwan and more recently, China have managed to find a formula for late industrial catch-up. Malaysia and neighbours in southeast Asia such as Thailand and Indonesia have found it harder to become highly industrialised, such that there has been a tradition in the policy literature of comparing northeast Asian industrial success to southeast Asian failure[119].

In recent years, we have seen a great power such as the United States and a declining power like the European Union attempt to reinvent their national development strategies to simultaneously address both climate change as well as trade and security competition from China.

[119] Studwell (2013); K. Lee (2024)

Malaysia is a middle power with less resources, threats and culpability for climate change than a great power. An appropriate climate strategy for Malaysia will not take the same form as the US or EU. However, climate strategy should be consistent with Malaysia's ambition to graduate from middle-income status and to keep on rising.

In neighbouring Indonesia we can see a mix of policy responses, one being resource nationalism with restrictions on nickel exports with an attempt to vertically integrate an electric vehicle supply chain resting on its control of this critical mineral resource.

Malaysia must do more than manage the domestic costs of climate transition. Because climate change is a global transboundary issue, diplomatic efforts are needed to ensure that the world's richest and most polluting countries act in our collective self-interest. This effort rests on clarity about the impacts and costs of transition, or conversely, the costs of inaction. It also rests upon our ability to pursue the scarce resources available for transition. If we factor in potential adaptation costs and the cost of capital, Malaysia's climate transition could cost upwards of RM2 trillion[120]. This is the single largest expense item on the government's future balance sheet. This is why Malaysia should reintroduce financial conditionality into its future NDCs, starting with 2025.

Reconciling Malaysia's climate transition needs with limited domestic and international resources makes it necessary for Malaysia to have a climate strategy that allows it to master long-term change amidst uncertainty and risk. Like geopolitics, the future of climate change is information-deficient and filled with uncertainty over how actors will behave.

A Malaysian climate strategy would have to take account of the risk that cooperation amongst major powers is needed to stabilise the global climate, because major powers are also the world's biggest polluters. However, these major powers—the US, the EU, China, Japan and Russia—are economic, political and military rivals. They are currently engaged in indirect conflict over Ukraine and open contestation over control of the clean energy technology value chain and its associated minerals.

It has long been held that climate change would promote conflict over resources such as water and arable land. Ironically, what we see today is conflict between the US, EU and China over who dominates clean technology value chains. It is not enough for China to produce abundant cheap solar and electric vehicles to make decarbonisation more affordable in the US and EU. The US and EU feel that they must have ownership over these products to accrue profits. Thus, a major theme of today's climate transition is reconciling it with nationalist industrial policy ambitions. Malaysia has its own, but how can it reconcile them with the rivalry between its major trading partners?

Climate change policy is more than just competitive declaration of decarbonisation statements. Countering someone's 'net zero by 2060' target with one's 'net zero by 2050' target does not make for a well-considered climate policy. There are serious financial and structural economic implications to a decarbonisation timeline. Nor is it a straightforward matter formulating climate policy primarily as a pitch for foreign investment. Large chunks of climate expenditure, such as coastal erosion interventions to tackle rising sea levels or upgrading parts of the electricity grid, will be deeply unattractive to investors even if they are essential for saving lives and livelihoods. Investors will expect the state to de-risk climate transition which could add to fiscal burdens.

[120] Nurul Farhana Abdul Shukor and Yin (2024)

While the kinds of low emission technologies required for decarbonisation at scale are fairly well established[121], what has yet to be conclusively solved is how to simultaneously decarbonise and mitigate physical climate risks (adaptation), whilst pursuing poverty alleviation, industrial development and maintaining fiscal sustainability. Lessons can be learned across borders, but the specific package that works best for each country will have to be innovated *in situ* and involve extensive consultation with stakeholders.

Developed countries may find that they can comfortably finance such demands but will be internally divided on ideological grounds (market versus state), distributional impacts (technology and job transitions favouring the middle class), and vested interests (fossil fuel and high emission industries). Developing countries may have to deal with all these tensions, but lack the financial, technological and industrial capacity to do so. They may be dealing with multiple crises of heavy indebtedness, unfair trade rules and practices, pandemic shocks, famine, civil conflict and political instability. Given their relative poverty, they are unlikely to be major emitters of greenhouse gases but will suffer disproportionately from climate change impacts.

In these regards, Malaysia is very much a developing country. Preserving and increasing its limited stock of power is instrumental towards long-term economic and physical survival in a world characterised by great power conflict and tenuous cooperation over climate change. Avoiding policies that diminish its economic power is crucial. Adopting a climate strategy approach as suggested in this chapter would go some way towards managing these uncertainties.

2.5 References

Allen, Robert C. 2011. *Global Economic History: A Very Short Introduction*. 1. publ. Very Short Introductions 282. Oxford: Oxford Univ. Press.

Andersson, Julius, and Giles Atkinson. 2020. "The Distributional Effects of a Carbon Tax: The Role of Income Inequality." https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2020/09/working-paper-349-Andersson-Atkinson.pdf.

Ang, Ryan. 2023. "EU's Deforestation Regulation 'Unjust': Malaysia." Argus Media. April 21, 2023. https://www.argusmedia.com/en/news-and-insights/latest-market-news/2441616-eu-s-deforestation-regulation-unjust-malaysia.

Aronoff, Kate. 2024. "Whatever Happened to 'Net-Zero'?" The New Republic. 2024. https://newrepublic.com/article/186883/bp-oil-production-emissions-net-zero.

ASEAN. 2021. "ASEAN State of Climate Change Report." https://asean.org/wp-content/uploads/2021/10/ASCCR-e-publication-Correction_8-June.pdf.

Azmi, Hadi. 2024. "EU Plastic Waste Exports to Malaysia Soar despite Government's Vow to Stop Influx." South China Morning Post. 2024. https://www.scmp.com/week-asia/health-environment/article/3282583/eu-plastic-waste-exports-malaysia-soar-despite-governments-vow-stop-influx.

Bacchus, James. 2021. "Legal Issues with the European Carbon Border Adjustment Mechanism." Cato Institute. August 9, 2021. https://www.cato.org/briefing-paper/legal-issues-european-carbon-border-adjustment-mechanism.

Bank Negara Malaysia (BNM). 2023. "Navigating Malaysia's Economic Transition towards a Decarbonised Future." https://www.bnm.gov.my/documents/20124/10150285/emr2022_en_box3.pdf.

Beaumont-Smith, Gabriella. 2024. "Are Carbon Border Adjustments a Dream Climate Policy or Protectionist Nightmare?" Cato Institute. July 30, 2024. https://www.cato.org/policy-analysis/are-carbon-border-adjustments-dream-climate-policy-or-protectionist-nightmare.

[121] Even if uncertainties exist around the reliability of emerging technologies such as carbon removal or carbon capture and storage.

Boston Consulting Group and WWF-Malaysia. 2021. "SECURING OUR FUTURE: NET ZERO PATHWAYS FOR MALAYSIA." https://wwfmy.awsassets.panda.org/downloads/securing_our_future_net_zero_pathways_for_malaysia_11_january_2022.pdf.

Carbon Market Watch. 2019. "The Phantom Leakage: Industry Windfall Profits from Europe's Carbon Market 2008 - 2019." https://carbonmarketwatch.org/publications/the-phantom-leakage/.

Chang, Ha-Joon. 2002. *Kicking Away the Ladder: Development Strategy in Historical Perspective*. London: Anthem.

Choy, Nyen Yiau. 2024. "Federal Govt Debt Climbed to RM1.22 Tril at End-April 2024 — MOF." The Edge Malaysia. 2024. https://theedgemalaysia.com/node/719098.

Chatzky, Andrew and Anshu Siripurapu. 2021. "Envisioning a Green New Deal: A Global Comparison." *Council on Foreign Relations*, 2021. https://www.cfr.org/backgrounder/envisioning-green-new-deal-global-comparison.

Christophers, Brett. 2021. "Big Oil Companies Are Driven by Profit – They Won't Turn Green by Themselves." *The Guardian*, May 25, 2021, sec. Opinion. https://www.theguardian.com/commentisfree/2021/may/25/big-oil-companies-profit-green-renewables-fossil-fuels-net-zero.

———. 2024. *The Price Is Wrong: Why Capitalism Won't Save the Planet*. London New York: Verso.

Climate Policy Institute. 2023. "Global Landscape of Climate Finance 2023." Climate Policy Institute. https://www.climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2023/.

Cohen, Gail, Joao Tovar Jalles, Prakash Loungani, Ricardo Marto, and Gewei Wang. 2019. "Decoupling of Emissions and GDP: Evidence from Aggregate and Provincial Chinese Data." *Energy Economics* 77:105–18. https://doi.org/10.1016/j.eneco.2018.03.030.

DOSM. 2022. "Household Expenditure Survey Report 2022." Dosm.Gov.My. 2022. https://www.dosm.gov.my/uploads/release-content/file_20230807212736.pdf.

Draghi, Mario. 2024. "The Future of European Competitiveness." https://commission.europa.eu/document/download/97e481fd-2dc3-412d-be4c-f152a8232961_en.

European Commission. 2023. "State Aid: Commission Approves €6.5 Billion German Scheme to Address Carbon Leakage Risk for Energy-Intensive Companies Resulting from National Fuel Emission Trading System." European Commission - European Commission. 2023. https://ec.europa.eu/commission/presscorner/detail/en/IP_23_4105.

———. 2024a. "Carbon Border Adjustment Mechanism (CBAM) Questions and Answers." 2024. https://taxation-customs.ec.europa.eu/document/download/013fa763-5dce-4726-a204-69fec04d5ce2_en?filename=CBAM_Questions%20and%20Answers.pdf.

———. 2024b. "Commission Approves €4 Billion German State Aid Scheme Partially Funded under Recovery and Resilience Facility to Help Industries Decarbonise Production Processes." European Commission - European Commission. 2024. https://ec.europa.eu/commission/presscorner/detail/en/ip_24_845.

———. 2024c. "Commission Strengthens Support for EU Deforestation Regulation Implementation and Proposes Extra 12 Months of Phasing-in Time, Responding to Calls by Global Partners." 2024. https://ec.europa.eu/commission/presscorner/detail/en/ip_24_5009.

———. n.d. "Progress on Climate Action - European Commission." Accessed November 6, 2024. https://climate.ec.europa.eu/eu-action/climate-strategies-targets/progress-climate-action_en.

European Parliament. 2022. "Taxonomy: MEPs Do Not Object to Inclusion of Gas and Nuclear Activities | News | European Parliament." Www.Europarl.Europa.Eu. 2022. https://www.europarl.europa.eu/news/en/press-room/20220701IPR34365/taxonomy-meps-do-not-object-to-inclusion-of-gas-and-nuclear-activities.

European Parliamentary Research Service. 2023. "EU Carbon Border Adjustment Mechanism Implications for Climate and Competitiveness." https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/698889/EPRS_BRI(2022)698889_EN.pdf.

European Union. 2023. "Regulation (EU) 2023/956 of the European Parliament and of the Council of 10 May 2023 Establishing a Carbon Border Adjustment Mechanism (Text with EEA Relevance)." 2023. https://taxation-customs.ec.europa.eu/document/download/c4b208a6-3945-4dcd-84d3-5f9551578851_en.

Eurostat. 2024. "GDP Stable and Employment up by 0.3% in the Euro Area." March 8, 2024. https://ec.europa.eu/eurostat/web/products-euro-indicators/-/2-08032024-ap.

FitchRatings. 2024. "Malaysia Maintains Gradual Fiscal Consolidation Approach." Fitchratings.Com. 2024. https://www.fitchratings.com/research/sovereigns/malaysia-maintains-gradual-fiscal-consolidation-approach-29-10-2024.

Forster, Piers M., Chris Smith, Tristram Walsh, William F. Lamb, Robin Lamboll, Bradley Hall, Mathias Hauser, et al. 2024. "Indicators of Global Climate Change 2023: Annual Update of Key Indicators of the State of the Climate System and Human Influence." *Earth System Science Data* 16 (6):2625–58. https://doi.org/10.5194/essd-16-2625-2024.

Green, Jessica F. 2021. "Does Carbon Pricing Reduce Emissions? A Review of Ex-Post Analyses." *Environmental Research Letters* 16 (4):043004. https://doi.org/10.1088/1748-9326/abdae9.

Greenfield, Patrick. 2023. "Revealed: More than 90% of Rainforest Carbon Offsets by Biggest Certifier Are Worthless, Analysis Shows." *The Guardian*, 2023. https://www.theguardian.com/environment/2023/jan/18/revealed-forest-carbon-offsets-biggest-provider-worthless-verra-aoe.

Groom, Nichola. 2024. "US Sets Preliminary New Duties on Solar Imports from Southeast Asia." *Reuters*, October 1, 2024, sec. Energy. https://www.reuters.com/business/energy/us-sets-preliminary-new-duties-solar-imports-southeast-asia-2024-10-01/.

Ho, Samantha. 2024. "Malaysia Cannot Rule out CCUS but Must Keep 'Eyes Wide Open' to Risks, Says Environment Minister Nik Nazmi." Eco-Business. 2024. https://www.eco-business.com/news/malaysia-cannot-rule-out-ccus-but-must-keep-eyes-wide-open-to-risks-says-environment-minister-nik-nazmi/.

Hutt, David. 2024. "Malaysia Struggles to Halt European Plastic Waste Imports." Dw.Com. Deutsche Welle. 2024. https://www.dw.com/en/malaysia-struggles-to-halt-plastic-waste-imports-from-europe/a-70638812.

International Energy Agency (IEA). 2024. "Geopolitical Tensions Are Laying Bare Fragilities in the Global Energy System, Reinforcing Need for Faster Expansion of Clean Energy - News - IEA." IEA. 2024. https://www.iea.org/news/geopolitical-tensions-are-laying-bare-fragilities-in-the-global-energy-system-reinforcing-need-for-faster-expansion-of-clean-energy.

IPCC. 2018. "Impacts of 1.5°C of Global Warming on Natural and Human Systems." https://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15_Chapter3_Low_Res.pdf.

Ismail Sabri. 2021. "'Speech to Parliament: Launch of 12th Malaysia Plan.'" September 27, 2021. https://rmke12.epu.gov.my/storage/mediastatementandspeech/2021092820_official_translation_speech_of_yab_prime_minister_tabling_of_the_twelfth_malaysia_plan_2021_2025.pdf.

Johnson, Lamar. 2024. "BlackRock Targeted for Greenwashing in ClientEarth Complaint." *ESG Dive*, 2024. https://www.esgdive.com/news/blackrock-targeted-clientearth-greenwashing-lawsuit-amf-esma-sustainable-funds/730919/.

Kanitkar, Tejal, Akhil Mythri, and T. Jayaraman. 2024. "Equity Assessment of Global Mitigation Pathways in the IPCC Sixth Assessment Report." *Climate Policy* 24 (8):1129–48. https://doi.org/10.1080/14693062.2024.2319029.

Kuik, Cheng-Chwee. 2021. "Getting Hedging Right: A Small-State Perspective." *China International Strategy Review* 3 (2):300–315. https://doi.org/10.1007/s42533-021-00089-5.

Kurmayer, Nikolaus J. 2023. "New EU Carbon Tariff: German Industry Slams Bureaucratic Burden – Euractiv." *EURACTIV*, 2023. https://www.euractiv.com/section/climate-environment/news/new-eu-carbon-tariff-german-industry-slams-bureaucratic-burden/.

Lafaye de Micheaux, Elsa. 2017. *The Development of Malaysian Capitalism : From British Rule to the Present Day*. Strategic Information And Research Development Centre.

Lakhani, Nina. 2023. "'Worthless': Chevron's Carbon Offsets Are Mostly Junk and Some May Harm, Research Says." *The Guardian*, 2023, sec. Environment. https://www.theguardian.com/environment/2023/may/24/chevron-carbon-offset-climate-crisis.

Lee, Keun. 2024. *Innovation-Development Detours for Latecomers: Managing Global-Local Interfaces in the de-Globalization Era*. Cambridge, United Kingdom ; New York, NY: Cambridge University Press.

Lee, Sheryl, Ishika Mookerje, and Christopher Udemans. n.d. "The Climate Short: Hedge Funds Pile Up Huge Bets Against Green Future." *Bloomberg.Com*. Accessed November 6, 2024. https://www.bloomberg.com/graphics/2024-hedge-funds-climate-change-green-energy-stocks/.

Luttwak, Edward N. 1990. "From Geopolitics to Geo-Economics: Logic of Conflict, Grammar of Commerce." *The National Interest* 20 (20):17–23.

Mearsheimer, John J. 2001. *The Tragedy of Great Power Politics*. W.W. Norton & Company.

Mearsheimer, John J., and Sebastian Rosato. 2023. *How States Think: The Rationality of Foreign Policy*. Yale University Press. https://doi.org/10.2307/jj.5666733.

Meijer, Bart H., and Maytaal Angel. 2024. "EU Proposes to Delay Landmark Anti-Deforestation Law by 12 Months." *Reuters*, 2024. https://www.reuters.com/world/europe/eu-proposes-12-month-delay-deforestation-regulation-2024-10-02/.

Malay Mail. 2023. "Nik Nazmi: Govt to Spend US$3m Green Climate Fund Grant on Climate Change National Adaptation Plan." Malay Mail. 2023. https://www.malaymail.com/news/malaysia/2023/12/05/nik-nazmi-govt-to-spend-us3m-green-climate-fund-grant-on-climate-change-national-adaptation-plan/105939.

MIDA. 2024. "Navigating the EU's Carbon Border Policy MIDA and Alliance Bank Host CBAM Workshop for Malaysian Businesses." *MIDA | Malaysian Investment Development Authority*, 2024. https://www.mida.gov.my/media-release/navigating-the-eus-carbon-border-policymida-and-alliance-bank-host-cbam-workshop-for-malaysian-businesses/.

Ministry of Economy. 2023. "National Energy Transition Roadmap (NETR)." https://ekonomi.gov.my/sites/default/files/2023-08/National%20Energy%20Transition%20Roadmap.pdf.

Ministry of Environment and Water. 2021a. "'Malaysia's Update of Its First Nationally Determined Contribution'." https://unfccc.int/sites/default/files/NDC/2022-06/Malaysia%20NDC%20Updated%20Submission%20to%20UNFCCC%20July%20202 1%20final.pdf.

———. 2021b. "STATEMENT BY MR. TUAN IBRAHIM TUAN MAN HONOURABLE MINISTER OF ENVIRONMENT AND WATER MALAYSIA FOR COP-26/CMP-16/CMA-3 RESUMED HIGH-LEVEL SEGMENT 9-10 NOVEMBER 2021." 2021. https://unfccc.int/sites/default/files/resource/MALAYSIA_cop26cmp16cma3_HLS_EN.pdf.

Ministry of Finance. 2024. "Budget Speech 2025." 2024. https://belanjawan.mof.gov.my/pdf/belanjawan2025/ucapan/ub25.pdf.

MITI. 2024. "iESG." Www.Miti.Gov.My. 2024. https://www.miti.gov.my/index.php/pages/view/9849.

NL Times. 2023. "ING and ABN AMRO Involved in €100 Billion Fossil Fuel Bonds since Paris Agreement | NL Times." *NL Times*, 2023. https://nltimes.nl/2023/09/26/ing-abn-amro-involved-eu100-billion-fossil-fuel-bonds-since-paris-agreement.

NRES. 2024a. "CONSULTATION PAPER Proposed Rang Undang-Undang Perubahan Iklim Negara ('RUUPIN')." 2024. https://www.nres.gov.my/ms-my/pustakamedia/Penerbitan/NRES%20Consultation%20Paper%20Rang%20Undang%20Undang%20Perubahan%20Iklim%20(RUUPIN).pdf.

———. 2024b. "National Climate Change Policy 2.0." https://www.nres.gov.my/ms-my/pustakamedia/Penerbitan/National%20Policy%20on%20Climate%20Change%202.0.pdf.

Nurul Farhana Abdul Shukor, and Yin Shao Loong. 2024. "Navigating the Geopolitics of the New Collective Quantified Goal to Reach a Consensus."

Obayashi, Yuka, and Katya Golubkova. 2023. "Japan, Petronas to Discuss Storing Japanese CO2 in Malaysian Sites." *Reuters*, September 27, 2023, sec. Climate & Energy. https://www.reuters.com/sustainability/climate-energy/japan-petronas-discuss-storing-japanese-co2-malaysian-sites-2023-09-27/.

Our World In Data. 2021. "Population." Our World in Data. 2021. https://ourworldindata.org/grapher/population.

Pardikar, Rishika. 2024. "Modelling Injustice: South Experts Call for Climate Model Paradigm Shift | African Arguments." African Arguments. 2024. https://africanarguments.org/2024/04/modelling-injustice-south-experts-call-for-climate-models-paradigm-shift/.

Ritchie, Hannah. 2023. "How Much of Global Greenhouse Gas Emissions Come from Plastics?" *Our World in Data*. https://ourworldindata.org/ghg-emissions-plastics.

Ritchie, Hannah, Pablo Rosado, and Max Roser. 2023. "CO_2 and Greenhouse Gas Emissions." *Our World in Data*. https://ourworldindata.org/co2-and-greenhouse-gas-emissions#all-charts.

Ritchie, Hannah, Max Roser, and Pablo Rosado. 2024. "Energy Production and Consumption." Our World in Data. 2024. https://ourworldindata.org/energy-production-consumption.

Shaikh, Anwar. 2016. *Capitalism: Competition, Conflict, Crises*. Oxford New York, NY: Oxford University Press.

Stern, Nicholas Herbert. 2007. *The Economics of Climate Change: The Stern Review*. London: Cambridge university press.

Studwell, Joe. 2013. *How Asia Works: Success and Failure in the World's Most Dynamic Region*. New York: Grove Atlantic.

Tooze, Adam. 2024. "Great Power Politics." *London Review of Books*, November 7, 2024. https://www.lrb.co.uk/the-paper/v46/n21/adam-tooze/great-power-politics.

UNCTAD. 2021. “A European Union Carbon Border Adjustment Mechanism: Implications for Developing Countries.” https://unctad.org/publication/european-union-carbon-border-adjustment-mechanism-implications-developing-countries.

———. 2024. “World Investment Report.” https://unctad.org/system/files/official-document/wir2024_en.pdf.

UNEP. 2024. “Emissions Gap Report 2024.” file:///C:/Users/User/Downloads/EGR2024.pdf.

UNFCCC. 2021. “Nationally Determined Contribution Communicated to the UNFCCC by the Republic of the Philippines.” 2021. https://unfccc.int/sites/default/files/NDC/2022-06/Philippines%20-%20NDC.pdf.

———. 2024. “Report of the Conference of the Parties Serving as the Meeting of the Parties to the Paris Agreement on Its Fifth Session, Held in the United Arab Emirates from 30 November to 13 December 2023. Addendum. Part Two: Action Taken by the Conference of the Parties Serving as the Meeting of the Parties to the Paris Agreement at Its Fifth Session.” 2024. https://unfccc.int/documents/637073.

United Nations. 1992. *Framework Convention on Climate Change.* https://unfccc.int/resource/docs/convkp/conveng.pdf.

Westervelt, Amy. 2024. “Oil Companies Sold the Public on a Fake Climate Solution — and Swindled Taxpayers out of Billions.” Vox. 2024. https://www.vox.com/climate/363076/climate-change-solution-shell-exxon-mobil-carbon-capture.

Winkler, David. 2022. “Pollution for Sale: Lobbying, Allowance Allocation and Firm Outcomes in the EU ETS.” *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4114641.

World Bank. 2020. *Global Investment Competitiveness Report 2019/2020: Rebuilding Investor Confidence in Times of Uncertainty*. Washington, DC: World Bank. https://doi.org/10.1596/978-1-4648-1536-2.

World Meteorological Organization (WMO). 2024. “Global Temperature Is Likely to Exceed 1.5°C above Pre-Industrial Level Temporarily in next 5 Years.” 2024. https://wmo.int/media/news/global-temperature-likely-exceed-15degc-above-pre-industrial-level-temporarily-next-5-years.

World Trade Organization (WTO). n.d. “WTO Trade Concerns.” Accessed November 6, 2024. https://tradeconcerns.wto.org/en/stcs/details?imsId=148&domainId=CTG.

WWF. 2022. “'Where Did All the Money Go?" - EU ETS Revenues Report 2022.” https://wwfeu.awsassets.panda.org/downloads/ets_revenues_report_2022___web___final.pdf.

Yang, Yang, and Sarah Holder. 2024. “Big Banks Are Cooling on Climate Change Promises.” Bloomberg.Com. Bloomberg. 2024. https://www.bloomberg.com/news/articles/2024-04-01/big-banks-are-cooling-on-climate-change-promises.

Yin, Shao Loong. 2022. “National Climate Strategy: A Balanced Approach.” https://www.krinstitute.org/assets/contentMS/img/template/editor/Working%20Paper%200422%20-%20National%20Climate%20Strategy%20A%20Balanced%20Approach.pdf.

Zalani, Anis. 2024. “‘What Are Data Centres, and How Come Malaysia Is Able to Attract Billions in Tech Investments for Them?’” *Malay Mail*, 2024. https://www.malaymail.com/news/malaysia/2024/10/14/what-are-data-centres-and-how-come-malaysia-is-able-to-attract-billions-in-tech-investments-for-them/153620.

CHAPTER

03

CHAPTER 3

MAKING SENSE OF CLIMATE DATA

3.1 Objectives of Climate Data

It is unequivocal that human activities release greenhouse gases, which have driven global warming and disrupted the climate system, significantly impacting human societies and ecosystems.

Climate change is coined a "super wicked problem" for policymaking[122]. The problem is inherently complex, involving an intricate web of interactions across social and natural systems. Proposed solutions may result in unintended and perverse impacts. Scientific uncertainties also muddle attempts to understand the problem and design solutions. However, the risk of not addressing climate change inevitably leads to even greater cumulative impacts.

The climate change problem often cuts against the grain of simplistic policy approaches or planning responses. For instance, the fact that fossil fuel burning is both a cause of climate change and essential for the development of millions of people with unequal needs means that collective action to address the source of the problem can be politically tricky. Putting a straitjacket on emissions can lead to unintended socioeconomic effects that are devastating for those in the developing world.

On the other hand, the cost of inaction is immeasurably high. Climate change drives up the likelihood of extreme events and compound hazards. The interconnectedness of the global system means that adverse climate hazards can cascade risks across sectors and regions, leading to complex and unpredictable outcomes[123]. For example, abnormal flooding events can affect plant growth, disrupt food supply and influence global food prices.

Uncertainties about climate impacts and impacts of policy interventions hamper response strategies and planning[124]. Scientists, practitioners and policymakers are confronted with challenges in effective response planning under deep uncertainties and climate constraints. Nonetheless, scientific knowledge about climate change is indispensable for policymaking.

The Intergovernmental Panel on Climate Change (IPCC) was established for this purpose. The UN body reviews and assesses scientific information for governments to develop climate policies. Information about climate change is disseminated through periodic assessment reports, reviewing findings from international scientific communities and climate data monitored by observation networks.

A vital aspect of this knowledge is the temporal dimension: the ability to foresee the risk of future climate action or inaction while also understanding the past pathways that have led to the current climate crisis. Tools like integrated assessment models (IAMs)—computer models designed to simulate human and Earth system interactions—are used to inform decision-making. They are used to project and evaluate different courses of action under a range of assumptions about socioeconomic, institutional and technological developments to inform strategic decisions towards long-term climate goals[125]. Decisions related to climate change are reliant on climate data, however, climate data can appear impenetrable, with little connection to physical or human realities.

---

[122] Levin et al. (2009)
[123] IPCC (2022a); New et al. (2022)
[124] Sprinz (2023)
[125] Hare, Brecha, and Schaeffer (2018)

This chapter addresses two types of climate-related data: emissions and risk data. Emissions data tell us about the source driver of climate change and risk data about the adverse effects of climate impact on human systems.

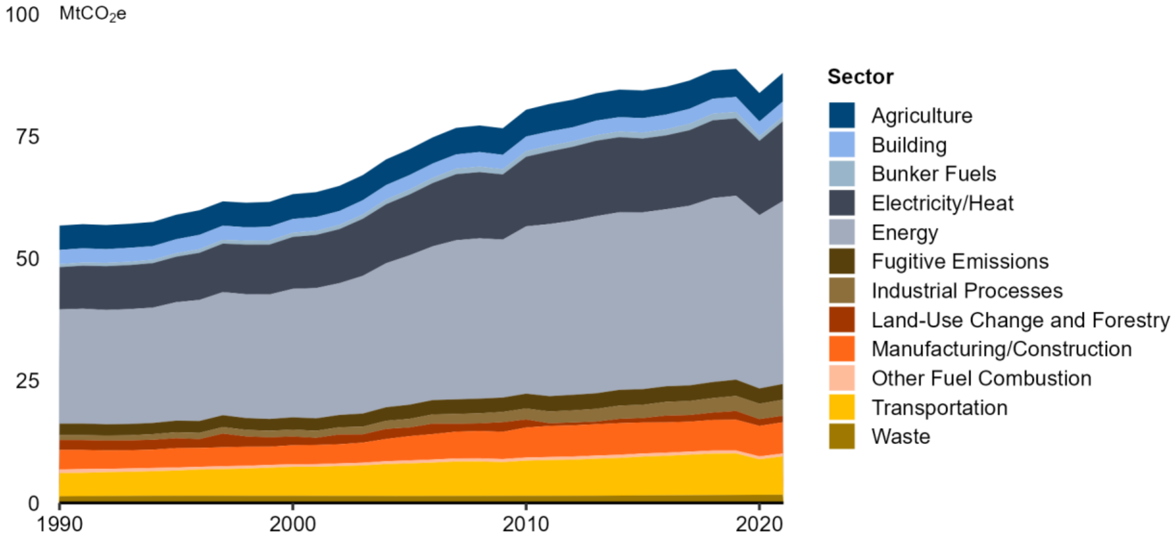
3.2 Reading Emissions

Information on greenhouse gas (GHG) emissions is crucial for two reasons with respect to the global climate objective:

1. Baseline knowledge of the state of anthropogenic influence on the climate system
2. Strategic planning of pathways towards achieving a low-emissions sustainable future

Human-induced or anthropogenic emissions have contributed to over half of the global temperature rise in the second half of the 20th century[126]. While historically, both fossil fuel burning and land use activities like deforestation have contributed to cumulative emissions, today, the majority of emissions come from fossil fuel burning. In 2020, the energy and power sector is the biggest contributor to annual emissions, followed by transportation and manufacturing (Figure 3.1).

Figure 3.1: Annual CO_2 emissions by economic sector, 1990 – 2020 ($MtCO_2e$)



Source: Climate Watch (2024); KRI visualisation

This breakdown shows us where mitigation should be prioritised. Effective mitigation would require scaling back fossil fuel burning and conserving and enhancing natural carbon pools. However, there are profound technical and political challenges associated with shifting away from fossil-based energy systems (see Chapter 5).

[126] Bindoff et al. (2013)

Box 3.1: What does carbon mean exactly?

"Carbon" is often used as a shorthand to refer to either just carbon dioxide (CO_2) or greenhouse gases in general[127]. This tendency to conflation sometimes impedes our understanding of climate change as a phenomenon and, at worst, lends a hand to proposals of false solutions based on unfounded science. For instance, advocates of removing atmospheric carbon dioxide through offsets simplified the complex carbon cycle process, incentivising rent extraction through unverifiable carbon offset projects with inflated values.

Greenhouse gases (GHG) are gases that absorb solar energy and re-emit heat into the atmosphere. Unbridled human emissions have lead to the accumulation of GHGs in the atmosphere at a rate unmatched by natural sequestering processes. As cumulative amounts of GHGs entrap more heat in the atmosphere, the consequential warming allows the atmosphere to hold more water vapour. Water vapour retains heat in the atmosphere, thus reinforcing the warming cycle. Some long-run natural cycles, such as carbon sequestration by the oceans, also lead to ocean warming, further reinforcing the feedback.

There are many types of influential GHGs, each with a different global warming potential (GWP). This is measured in units of carbon dioxide equivalent. When one says: "methane is x tonnes of carbon dioxide equivalent (tCO_2e)", it indicates a scalar measurement which also measures the capacity of methane to cause temperature rise compared to CO_2. The direct GHGs targeted by the Kyoto Protocol include seven gases: CO_2, methane (CH_4), nitrous oxide (N_2O), halogenated gases and fluorocarbons (F-gases). This category of GHGs is referred to as "Kyoto gases" owing to their coverage by the Kyoto Protocol. The Paris Agreement, in contrast, does not delimit targeted gases but allows countries to set GHG mitigation policies by themselves through nationally determined contributions (NDCs). However, the Kyoto gases have remained in the scope of most NDCs.

CO_2 is the predominant GHG, simply by virtue of the sheer amount of human-emitted CO_2 and the pervasiveness of CO_2 in many human activities[128]. The gas is a long-lived GHG, which is chemically stable and persists in the atmosphere over centuries, leading to long-term influence on climate[129]. Other gases like CH_4 are also part of the carbon cycle—the natural biogeochemical process controlling carbon flow on Earth. Hence, "carbon" is often synonymised with the main GHGs of which mitigation is crucial.

As we shall see, the carbon cycle that regulates the stock and flow of carbon in the Earth is complex. The large timescale at which the cycle balances carbon fractions between reservoirs and the climate feedback that determines climate impacts produce uncertainties. Solutions based on pricing and trading offsets can obfuscate the many issues of durability and grossly simplify the uncertainties that long-term carbon sinks imply[130]. Besides, trading emissions allowances and offsets can, if not contribute to actual mitigation, impose deeper inequitable outcomes for developing countries, especially vulnerable groups (See Chapter 5).

[127] Brander (2012)
[128] Chandler (2017)
[129] IPCC et al. (2007)
[130] Hausfather (2023)

3.2.1. Anthropogenic emissions in the carbon cycle

Anthropogenic emissions have continued to rise since the pre-industrial period. In 2022, the annual global GHG emissions were estimated to be around 55GtCO_2e, 28% larger than just two decades ago and 28 times above pre-industrial levels[131]. CO_2 emissions were 40.7GtCO_2e in the same year, contributing to nearly three-quarters of total annual GHG emissions (74%).

The long lifetime of CO_2 and the complexity of long-run climate response requires us to consider cumulative emissions. Global cumulative CO_2 emissions are around 2550GtCO_2e (695±70GtC including all sources)[132]; of this amount, around 44% remains in the atmosphere. This is known as the airborne fraction[133]. The remaining is taken up by "reservoirs" of the Earth systems. These are natural biogeochemical cycles that sequester and store carbon in the ocean and terrestrial ecosystems[134]. The ocean and land sinks have grown in size over the past decades due to corresponding increases in anthropogenic emissions. These sinks are themselves sensitive to climate change. For example, the drawdown of carbon by the ocean can lead to ocean acidification and deoxygenation, affecting marine ecosystems.

The natural carbon cycle circulates carbon between three reservoirs: the atmosphere, ocean and terrestrial biosphere. This natural flow of carbon represents ten times that of human emissions[135]. Absent human influence, the natural carbon flux balances itself across a long timescale. Anthropogenic emissions occur on top of this active natural carbon cycle, tipping the balance of the natural cycle[136]. This is mainly a result of removing carbon from geologic reservoirs (fossilised carbon) and releasing it into the atmosphere at a rate faster than the planet's sinks can sequester[137].

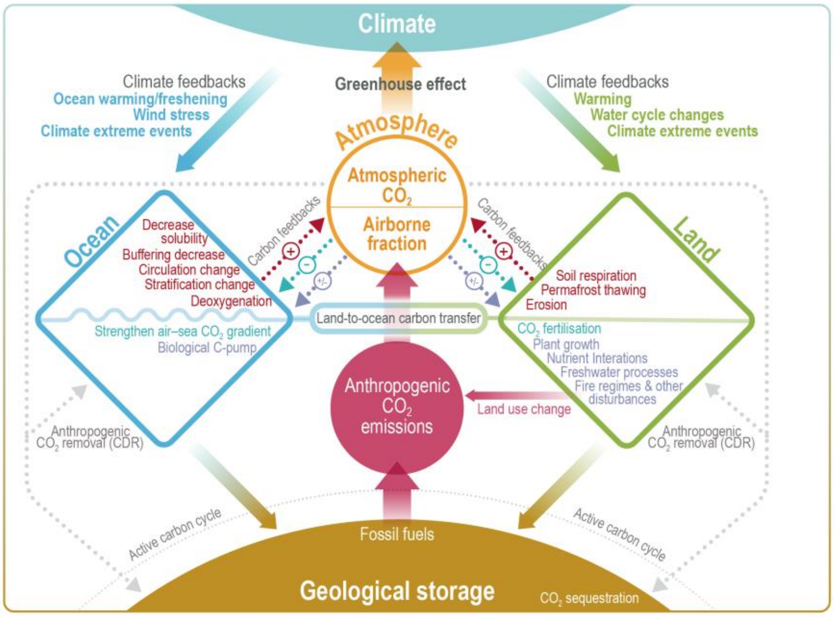
The carbon imbalance caused by carbon accumulation in the atmosphere results in warmer global temperatures, as atmospheric carbon is good at absorbing and re-emitting heat energy, a process also known as "radiative forcing"[138]. The rate at which temperature rises in response to carbon emissions is known as the "climate sensitivity" to CO_2[139], expressed as the Transient Climate Response to Cumulative Carbon Emissions (TCRE). TCRE is the average global warming expected around the time of a doubling in CO_2. It measures the short-term effect of carbon emissions. IPCC assessment estimated the likely range for TCRE to be 1.0 – 2.3°C per 1000GtC, or 0.45°C per 1000GtCO_2. Current cumulative emissions correspond to observed warming of around 1.19°C higher than the pre-industrial period (2014 – 2023-decade average)[140].

Equilibrium Climate Sensitivity (ECS) is the eventual steady-state-warming once the planet equilibrates at a higher level of CO_2, which takes thousands of years[141]. ECS defines the long-term warming limit. ECS estimates are often higher than Transient Climate Response (TCR) and have a larger uncertainty due to uncertainties in associated climate feedback. The IPCC reports the likely range of ECS at 2.5°C to 4.0°C, and it is virtually certain that ECS is larger than 1.5°C[142]. This means

131 Forster et al. (2024)
132 Friedlingstein et al. (2023)
133 Ibid.
134 Canadell et al. (2021)
135 Moseman (2024); Hannah (2011)
136 Archer et al. (2009)
137 Moseman (2024)
138 Frecht (2021)
139 Nijsse, Cox, and Williamson (2020)
140 Forster et al. (2024)
141 Paytner (n.d.); Hausfather (2019)
142 P. Forster et al. (2021)

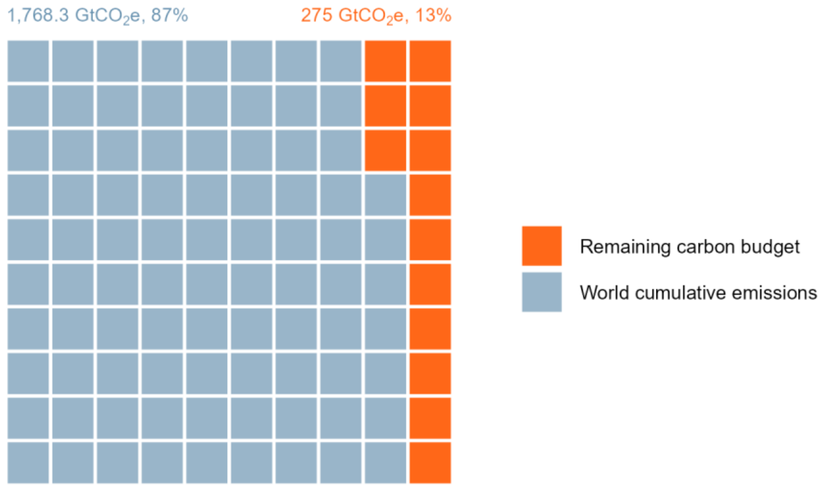
that a doubling of CO_2 emissions would lead to an eventual temperature increase above 1.5°C over the long-term even if temperature do not immediately rise.

Figure 3.2: Key compartments, processes and pathways that govern historical and future CO_2 concentrations and carbon-climate feedbacks through the coupled Earth system



Source: IPCC (2021)

Figure 3.3: Remaining carbon budget and world cumulative fossil fuel emissions in 2022



Source: Friedlingstein et al. (2023); KRI's visualisation
Note: Cumulative land-use change emissions are omitted due to higher uncertainties. The GCB estimate gives a median of 220GtC from three models.

The carbon budget translates the temperature goals of the Paris Agreement to a quantifiable, actionable emissions limit. The remaining carbon budget (RCB) represents the total amount of CO_2 that can still be emitted in the future while keeping to the 1.5°C temperature target[143]. This limit is

[143] Matthews et al. (2020)

based on our best knowledge of climate sensitivity, which has been improving but is still clouded by uncertainties. **The RCB was estimated to be 500GtCO_2e for a 50% chance of keeping within the 1.5°C temperature goal in 2019[144]. The budget has since shrunk to 275GtCO_2e at the start of 2023, giving a remaining 7 years if the same rate of emissions as 2023 continues.**

3.2.2. Approaching the interpretation of data

There are many approaches to the reading and accounting of human emissions. These "emission concepts"[145] help interpret emissions data for different objectives, such as attributing responsibility or making policy decisions. This section addresses four types of emissions concepts:

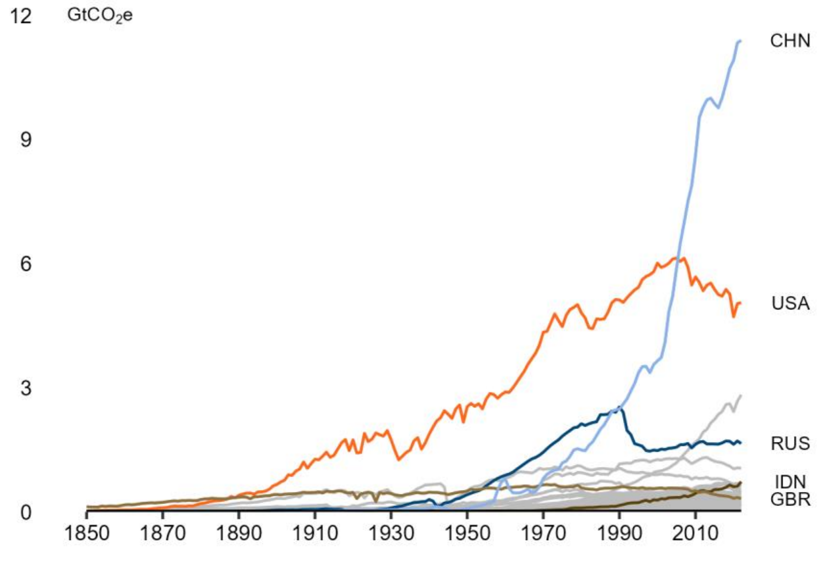
1. Annual emissions
2. Cumulative emissions
3. Per capita emissions
4. Net emissions

Annual emissions

Excluding the effects of naturally occurring carbon fluxes, anthropogenic fossil fuel emissions have used up 87% of the carbon budget since 1850 (Figure 3.3). However, historical emissions have not been equal across all regions. Shifts in concentrations of emissions from one area to another internationally also reflect the changes in global development over the years.

Figure 3.4 shows the annual fossil fuel emissions by country. The US has been the top emitter throughout the 20th century, followed by the UK until the 1950s before being surpassed by Russia. Towards the latter half of the 20th century, China experienced rapid growth in emissions and overtook the US as the top emitter in 2000 until today.

Figure 3.4: Annual fossil fuel emissions by country, 1850 – 2022



Source: Friedlingstein et al. (2023)

[144] IPCC (2018a)
[145] Darwili and Schröder (2023)

Emissions data can be carved up in many ways to present different aspects of the same picture. Annual emissions chart is a popular way of highlighting the trend in simultaneous change in emissions, inversely, it also indicates the extent of absolute emissions reduction that humans can achieve at a time assuming no constraints.

While annual emissions show a snapshot of anthropogenic emissions, historical annual emissions tell us about the trends of emissions growth overtime. However, annual data can obscure the historical responsibility of global warming. Without historical knowledge of the source of anthropogenic climate change, groups are free to pollute a common atmospheric resource wantonly and not be accountable for it. While groups with low responsibility are forced to take up similar burdens of solving a problem they did less to create, but were disproportionately affected by.

Cumulative emissions

CO_2 has a long lifetime in the atmosphere. As humans emit CO_2 on top of the natural balancing process, the additional CO_2 continues to trap heat in the atmosphere for hundreds of years before being removed by sinks[146]. The build-up of the airborne fraction of human emissions increases the concentration of GHGs in the atmosphere. Our current atmospheric concentration of 420ppm is 1.3 times higher than in 1960[147]and 1.5 times higher than pre-industrial levels (287ppm). Growth in concentrations represents the rate of emissions unmatched by the natural sequestering process, a consequence of accumulation. The boom in fossil fuel use and increased deforestation, both a consequence of global industrialisation, are the primary drivers of global warming[148].

Cumulative emissions thus represent a fuller picture of the human cause of climate change. The total cumulative anthropogenic emissions from fossil fuel since the pre-industrial era were 477±25GtC (1749GtCO_2 until 2022)[149]. Not all countries emit the same amount. Thus, not all countries contributed equally to climate change. In fact, the distribution of cumulative emissions is much more skewed than annual absolute emissions. Figure 3.6 shows the distribution of countries by cumulative emissions. As the fat-tailed distribution suggests, very few countries emitted way higher than the rest.

Of all countries, the US contributed 426GtCO_2e in cumulative fossil fuel CO_2 emissions, accounting for nearly a quarter of the world total (Figure 3.5). On the other hand, China has climbed the ranks to second place in just five decades. Russia, Japan and countries in Europe with a history of industrial development rank among the top emitters. Whereas most of the world only contributed to a small share of this combined cumulative emissions. Compared to the high emitters who are often developed, advanced economies, these small emitters are developing countries climbing the developmental ladder and many still struggle to provide basic living standards. They are also in regions with higher climate risks, which compound human vulnerabilities in these countries[150].

[146] The atmospheric lifetime of CO_2 is defined as "the mean persistence time of a perturbation to the CO_2 concentration of the atmosphere", this is estimated to be 50 – 200 years after a doubling of atmospheric CO_2. (Archer et al., 2009)
[147] Data from the earliest recorded surface concentration in Mauna Loa Observatory.
[148] Dhakal et al. (2022)
[149] Friedlingstein et al. (2023)
[150] IPCC (2022a)

Figure 3.5: Cumulative CO_2 emissions from fossil fuel by country, 1850 – 2022

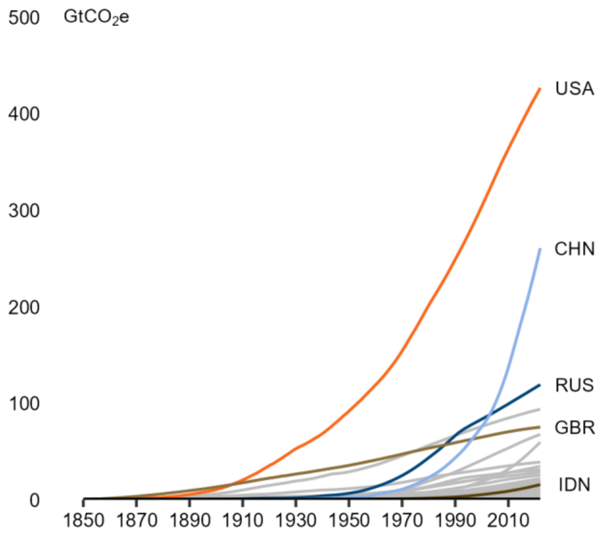
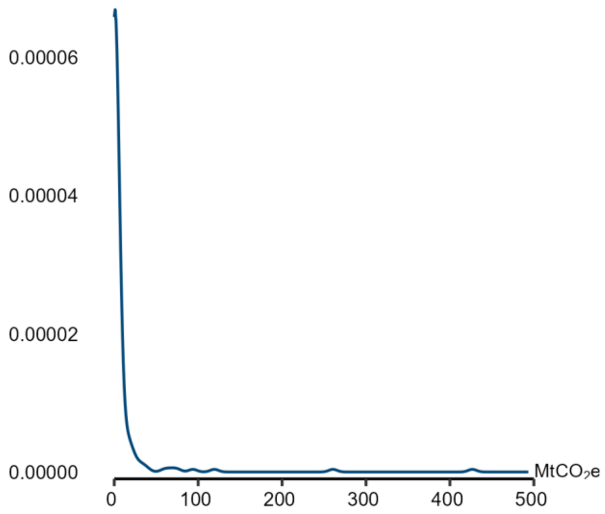


Figure 3.6: Figure 3.6: Kernel density distribution of cumulative emissions by country, 2022



Source: Friedlingstein et al. (2023)

In some respects, cumulative emissions paint a story of inequity. As we shall see, the ability of developed countries to pursue carbon-intensive development in the past has resulted in the current impasse. The pollution of past industrialisation, in the form of long lifetime GHG, has a bearing on the lives of future generations. The inter-generational injustice of climate change suggests that past decisions have consequences that present and future generations must bear. To complicate things more, growing global inequality adds another dimension of injustice. Future generations of poorer countries will bear the brunt of climate change due to past pollution done by rich countries, whilst climate action can involve “making life today for the lower-middle class [...] of developing countries more expensive, in the hope of improving the living conditions of yet-unborn future humans, most of whom will be foreigners”[151].

Per capita emissions

Under the current development model, due to their expanding population and growing economies, developing countries will inevitably see bigger emissions in the future[152]. This has led to international pressure calling for developing countries to step up mitigation efforts and apply the same carbon constraint burden upon some countries that have yet to pursue industrialisation. This argument appears tenable because some middle-income developing countries, like China and India, who took on carbon-intensive development pathways, are now unmatched in absolute emissions.

However, the incredible rate of carbon-intensive industrialisation also lifted a vast swathe of populations out of poverty and raised their standard of living. As of 2023, China and India house 3.14 times and 3.17 times respectively more people than Europe[153]. If emissions were part and parcel of development, emissions in this corner of the world serve to develop more people than emissions elsewhere, and if each individual in the world is assigned an equal right to atmospheric resource,

[151] Pisani-Ferry (2023)
[152] See Fengler, Gill, and Kharas (2023)
[153] World Bank (n.d.)

many in the developing world still only appropriated a little share of their right as compared to those in the developed world[154].

Per capita emissions represent the emissions of an average person in a country or a region. It is one of the many ways to compare countries' responsibilities for climate change[155]. The measure also points to the concept of emission rights, which argues for the individual claim to atmospheric commons[156]. Atmospheric commons alludes to the atmosphere as a common resource shared globally, including the services the atmosphere provides, such as acting as a sink for pollution. In fairness, every person should have an equal share of the global atmospheric commons[157]. However, as the atmospheric commons[158] shrinks, the distribution of the remaining carbon space should reflect fairness[159].

Figure 3.7: Territorial-based carbon emissions per capita, 1990 – 2022

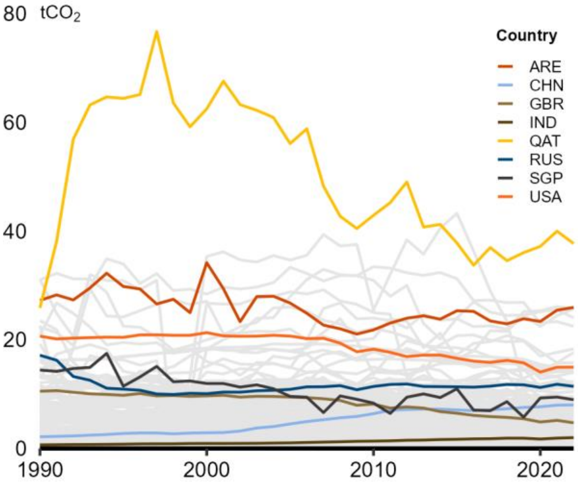
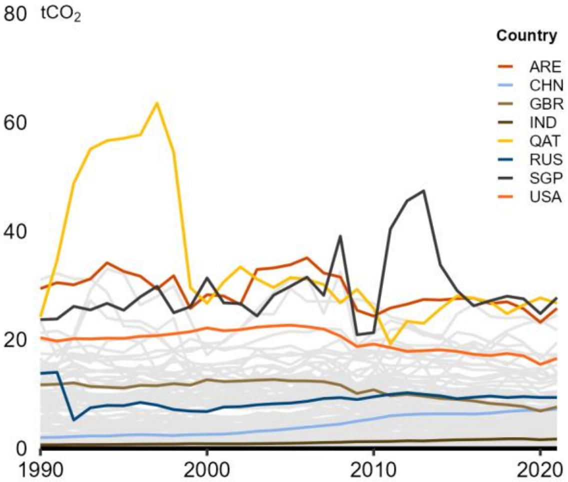


Figure 3.8: Consumption-based carbon emissions per capita, 1990 – 2022



Source: Friedlingstein et al. (2023); KRI visualisation

Territorial emissions are produced within a territorial boundary, usually indicating emissions from production activities. Since 1990, per capita territorial emissions in China and India have doubled from 2.2tCO_2 and 0.7tCO_2 respectively[160] (Figure 3.7). However, emissions per person in these countries remain lower than in advanced economies, such as the US (14.9tCO_2). Per capita emissions in many developed countries have fallen, yet they remain larger than in most developing countries. Oil producing gulf countries with small populations rank highest in territorial per capita emissions, as the vast emissions from their fossil fuel production activities are shared among relatively few people.

Territorial emissions, however, do not fully capture the movement of emitting activities over time. Since the 1980s, trade liberalisation in most of the world has shifted key production activities across

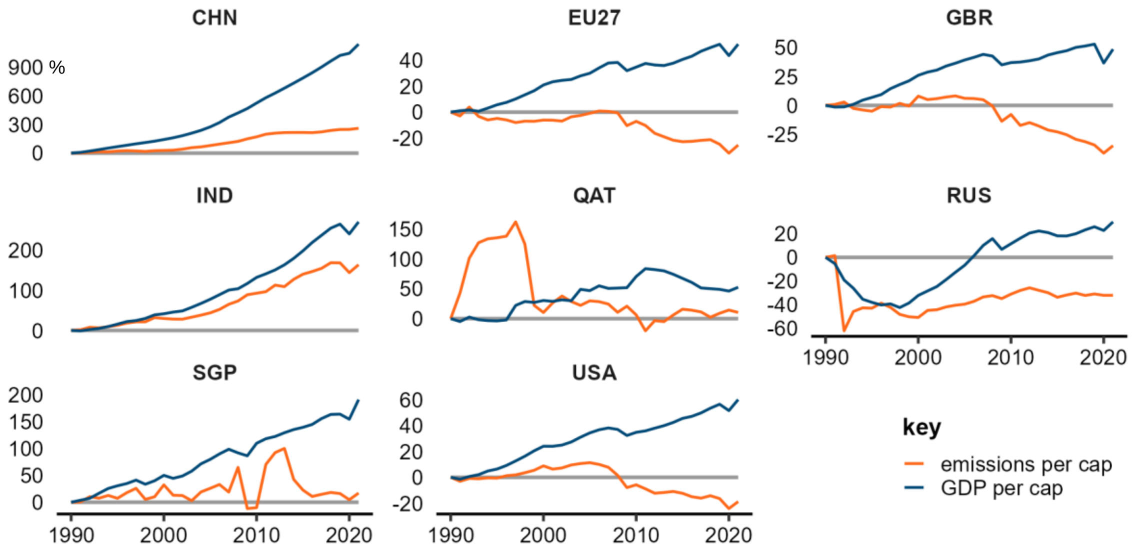
[154] Fanning and Hickel (2023)
[155] Vigna and Friedrich (2023)
[156] Pickering and Barry (2012); see Chapter 5
[157] The international law declared atmosphere as a global common—a non-excludable and subtractable resource. As there are many services derived from the atmosphere, one of which being a reservoir for carbon pollution, all individuals in the world are entitled to the services.
[158] This can be viewed synonymously as the remaining carbon budget or carbon space, but we refer here to the various atmospheric services.
[159] See Chapter 5.
[160] Large variations show up in the dataset for countries before the 1960s, small island colonies with little population exhibit large per capita territorial emissions, which could reflect the colonial economy at the time.

the globe[161]. The period saw a relocation of production activities from developed countries to developing countries[162]. This "transfer" of production emissions from one country to another is calculated through trade-embodied emissions (EET) or consumption-adjusted emissions (CBA). From 1990 to 2008, the net emissions transfer from developed to developing countries increased fourfold from 0.4 to 1.6GtCO_2e (17% annual growth rate)[163].

This means that the emissions needed to produce the goods consumed by a developed country individual are effectively moved off to another country, reducing the balance of territorial or production emissions of developed countries. To account for offshoring, consumption-based emissions are often used. As opposed to territorial or production emissions, which include all emissions that "take place within a country's territorial boundaries and include exports but omit imports", per capita consumption-based emissions account for the emissions embedded in "domestic final consumption and include imports"[164] (Figure 3.8).

The role of trade in shifting emissions patterns cannot be understated, but whether trade directly affects emissions reductions in some countries remains a debate. The trend in trade specialisation during the early 2000s has rendered countries of the Global South "factories of the world". As developing countries specialised in producing carbon-intensive trade goods, the carbon-intensive production in these countries has supported low-cost consumption and the expansion of capital in the world economy. At the same time, developed countries moved to import carbon-intensive traded goods while exporting low-emissions, high-value goods during the same period, which contributed to lowering their emission intensity. However, studies have also shown that some developed countries have achieved "genuine" decoupling, irrespective of trade composition and imbalance[165].

Figure 3.9: Change in consumption-based emissions per capita and GDP per capita relative to baseline, 1990 – 2022 (per cent)



Source: Friedlingstein et al. (2023); World Bank (n.d.); KRI calculations and visualisation

[161] Rodrik (2011)
[162] Meng et al. (2023)
[163] Peters et al. (2011)
[164] Bhattacharya, Inekwe, and Sadorsky (2020)
[165] Wu, Ma, and Schröder (2022)

As developed countries grew to import higher emission goods, the growth in consumption emissions offsets declining territorial emissions[166]. However, there is a second part to this equation. Technological advancements in advanced economies have improved the emissions efficiency of their economic production. Relying on territorial emissions alone led researchers to conclude that emissions reduction in advanced countries resulted from technological improvements, which points to emissions decoupling[167]. Decoupling refers to economic growth at lower emissions. Figure 3.9 shows that some countries are able to ensure economic growth while reducing emissions. However, since they remain positively emitting, the downward changes in these developed countries are not large enough to make a dent at the aggregate level.

Considering all of the above together, we get a fuller representation of the global responsibility of climate change. This is important for both (1) determining the fair burdens of each country towards solving climate change and (2) deciding on a just strategy towards sustainable development.

Net emissions

Major GHGs like CO_2 and CH_4 are part of the carbon cycle. Territorial ecosystems such as forests, wetlands and drylands within national boundaries act as reservoirs that absorb atmospheric carbon. Hence, GHG accounting also considers sinks part of a country's emissions balance.

Plants comprise the majority of terrestrial ecosystems[168]. They remove CO_2 from the atmosphere through photosynthesis and respiration. The carbon is stored away in living biomass such as stems, branches, leaves, fruits, litter, deadwood and soil organic matter through this dynamic. This carbon storage in biomass is called "carbon stock". The ability of living biomass to sequester carbon varies by species, climate and temporal-spatial factors. Usually, carbon stock in forests takes at least a decade to saturate (reaching maximum carbon storage potential)[169]. Natural and human disturbances affect the carbon storage potential of forests. For example, land use activities such as deforestation and afforestation change the carbon stock and sequestration potential of forest land. In countries like Indonesia, heavy deforestation is a leading source of national emissions.

Net emissions inform this dynamic of carbon stock-flow[170]. When accounting in absolute emissions, we disregard the carbon flux by focusing on the airborne fraction. Net emissions consider this flux and human's role in influencing the carbon cycle. In national GHG accounting, natural carbon sinks within a territory's Land Use, Land-Use Change and Forestry (LULUCF) sector can offset carbon emissions. These sinks, such as forests, absorb and store carbon dioxide from the atmosphere—a process known as carbon removal. When calculating a territory's climate impact, these negative emissions are subtracted from absolute emissions to determine net emissions.

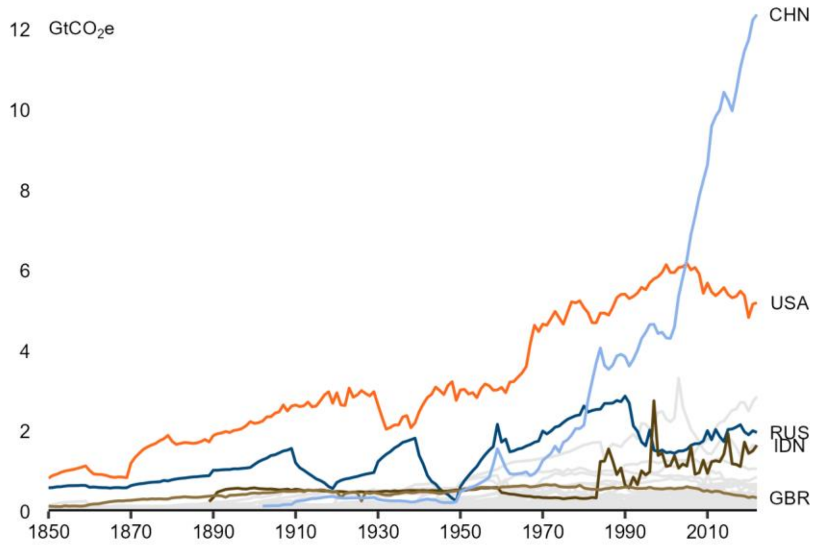
Globally, nearly one-third of anthropogenic emissions are removed by terrestrial sinks[171]. Because of human land use and deforestation, the terrestrial sinks have shrunken overtime. Figure 3.10 shows

---

[166] This is known as the "trade sourcing effect". (Ibid.)
[167] Jiborn et al. (2018)
[168] Santoro et al. (2021)
[169] IPCC et al. (2000)
[170] Indeed, the emissions flux of the terrestrial sinks have to be negative, that is, the sinks are positively sequestering carbon, to be considered a sink. Emissions from biomass burning, agricultural land conversion et cetera can lead to positive emissions from land use, making net emissions higher than absolute emissions.
[171] Nabuurs et al. (2022)

the annual net emissions by countries. Notice that although net emissions represent a marginal change to fossil fuel emissions for some countries, they heavily skew the emissions of others.

Figure 3.10: Annual net CO_2 emissions by country, 1850 – 2022



Source: Friedlingstein et al. (2023); KRI visualisation

Carbon dioxide removals (CDR) through carbon sinks are important for meeting country NDCs and the Paris Agreement goal of emissions reductions. Article 4 of the UNFCCC requires country parties to report removals in addition to sources of anthropogenic GHG. The article also asks country parties to promote sustainable management, conservation and enhancement of carbon sinks. For most countries, absolute territorial emissions are fairly low compared to the few top emitters. Their managed ecosystems are a significant portion of the world's carbon sink.

IPCC has recognised protection and restoration of ecosystems as an essential measure to address climate change[172], not only in mitigating emissions but also in providing enhanced ecosystem services that improve resilience against climate change impact. However, if applied injudiciously, there are also potential trade-offs with food security and livelihoods[173].

Generally, net emissions from land use change are estimated by multiplying the area of land-use change by an emission factor or removal factor[174]. This factor varies according to types of biomass, plant species and other factors. The knowledge of land-use change, however, presents another set of uncertainties. Countries report LULUCF emissions as part of their National GHG Inventories (NGHGIs), which are periodically submitted to UNFCCC. Independent global assessments also estimate land use emissions through bookkeeping models, dynamic global vegetation models (DGVMs) and remote-sensing approaches using satellite imagery of land cover changes[175]. There are wide gaps between NGHGI data and global assessments due to inconsistencies between the approaches in representing land-use change, incomplete or inaccurate estimation of LULUCF fluxes and conceptual differences[176].

[172] IPCC (2022a); (2022b)
[173] IPCC (2022b), D.1.6
[174] Herold et al. (2019)
[175] Pongratz et al. (2021)
[176] Grassi et al. (2021)

These accounting uncertainties make it challenging for global strategies to fully account for country responsibilities and mitigation measures to rest on land-based CO_2 removal.

3.2.3. Net Zero and long-term uncertainties of climate response

Net-zero emissions has become "almost an article of faith" in the pursuance of climate goals[177]. Many countries and organisations have committed to net zero targets. While it was not spelt out in international treaties, the Paris Agreement alluded to the concept in Article 4 as "a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases".

Net zero emissions involve a balance between anthropogenic GHG emissions and anthropogenic GHG removals over a specified period. This balance can be achieved by reducing emissions and enhancing these gases' removal from the atmosphere. At the point of net balance, it is assumed that any further increase in emissions would be immediately removed by an equivalent increase in anthropogenic sinks, eliminating the human factor on the natural carbon cycle. This is the short-run balance achieved through human intervention.

Practically, the lag between short and long-run climate response is a crucial uncertainty of what net zero means for global temperatures. As noted in 3.2.1, climate sensitivities are estimated in the short term (TCRE) and the long term (ECS). The long-term global temperature change caused by carbon emissions or removals now is called a "warming commitment".

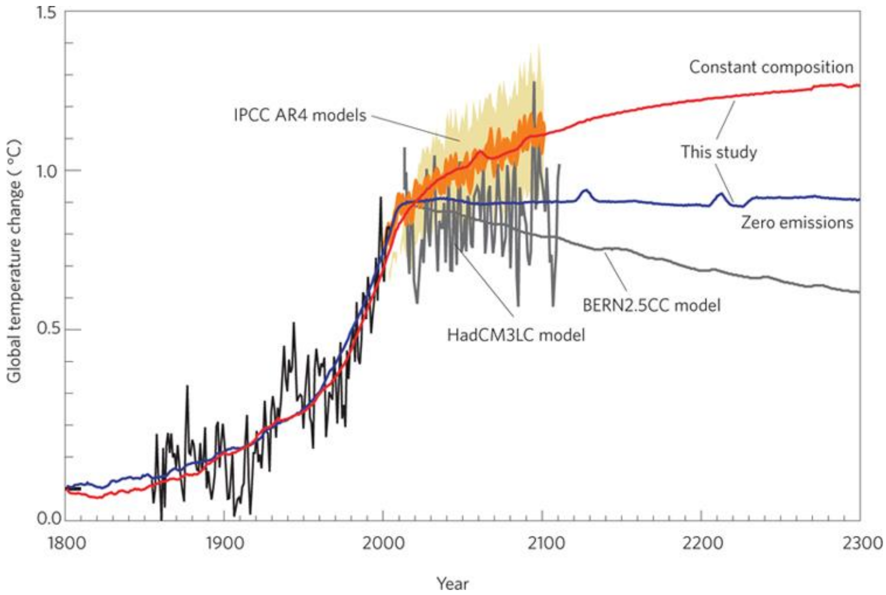
Should human emissions stop increasing, the atmospheric concentration of carbon will stay the same well into the future. This type of warming commitment is called the "constant composition commitment". Models showed that global temperatures will continue to warm under this commitment trajectory[178]. This bears implications on absolute emissions reduction targets relative to a base year, committed by many country NDCs such as the UK and the US, as these targets only ensure emissions stop increasing at a certain level, but not altogether.

The warming commitment for net zero emissions is called "zero emissions commitment". Improved climate modelling has shown that when net anthropogenic GHG emissions reaches zero, the atmospheric concentration of GHG will fall as ocean sinks continue to draw down atmospheric carbon[179]. The best estimates show global temperature will stay relatively constant for an extended period[180].

---

[177] M. R. Allen et al. (2022)
[178] Matthews and Weaver (2010); Huntingford, Williamson, and Nijsse (2020)
[179] This of course imply further impact on marine ecosystems and oceanic circulation.
[180] Matthews and Weaver (2010); M. R. Allen et al. (2022)

Figure 3.11: Two representations of climate commitment



Source: Matthews and Weaver (2010)

Indeed, holding global temperature constant does not eliminate the continuation of climate impacts. As the long timescale at which the climate system takes to adjust the current thermal imbalance, the repercussions of that imbalance will continue to be felt as the climate moves towards the new state of equilibrium (at a higher temperature than pre-industrial levels)[181]. Irrespective of temperature change, adverse climate impact will continue to affect humans and other lives. Net zero, at best, holds the likelihood of unmanageable, cascading impact at a lower level than otherwise.

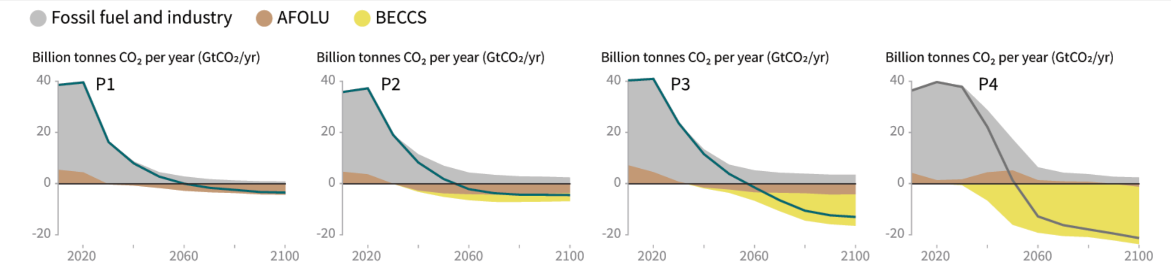
Theoretically, net zero is the best-case scenario, given the immediate reduction of all emissions is impossible for a significant part of the world. Socio-politically, net zero targets have proliferated over the years without a governing framework[182], given the expansion of Voluntary Carbon Market (VCM) options alongside Emissions Trading Systems (ETS) that allow removals trading. Technologies of carbon dioxide removals (CDR) such as direct air capture as well as Carbon Capture, Utilisation and Storage (CCS and CCUS) have also captured the attention of national governments and investors.

[181] This is a different steady-state of earth system at a higher temperature, this has implications for ecosystems on earth.
[182] M. R. Allen et al. (2022)

Box 3.2: CDR as a means to Net Zero – how viable?

IPCC's model pathways for limiting warming to 1.5°C generally include CDR as a component. This is typically a combination of bioenergy with carbon capture and storage (BECCS) and changes to agriculture, forestry and other land use (AFOLU) such as afforestation and reforestation. IAMs often assume a bigger share of BECCS in modelled pathways, simply because the scale of removals needed to balance the emissions from fossil fuel is greater than practical AFOLU sinks[183].

Figure 3.12: Breakdown of contributions to global net CO_2 emissions in four illustrative model pathways



Source: IPCC (2018)

Carbon sinks must prove durability. Currently, most anthropogenic removals are from land carbon sinks through afforestation, reforestation, or land-use transitions[184]. Biological carbon stocks like forests are transient. The natural growth cycle of plants temporarily removes carbon from the atmosphere. They are not safe from risks of disruption and reversal, such as die-backs, fires and a host of hazards exacerbated by climate change[185]. Currently, increased climate extremes and other factors have reduced the size and efficiency of land carbon sinks[186]. In the case when direct disruption does not occur, the durability of terrestrial carbon storage is put under test over centuries to come.

Under a net zero pathway, anthropogenic sinks play a role in holding emissions in balance. Humans thus need to design technologies and institutions that maintain their durability for a timespan longer than most current companies operate. Most forest credits today are certified under a crediting period of less than 100 years, within which the sinks' integrity is monitored for reversal risks[187,188]. National governments can step in to institutionalise conservation, but their effectiveness will be highly contingent.

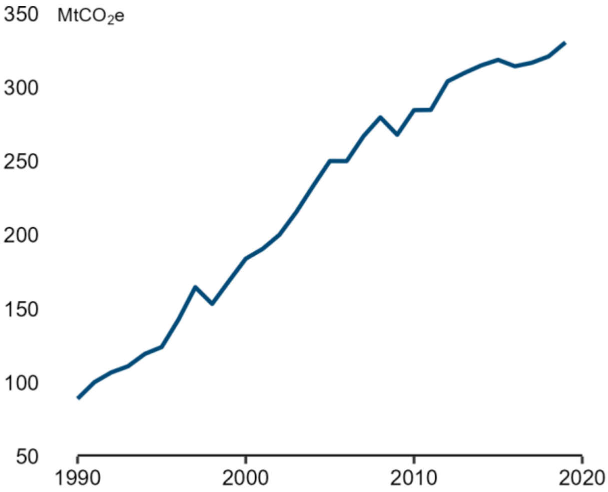
3.2.4. Malaysian national emissions in context

As a part of the non-Annexed party obligations, Malaysia reports its emissions through the Biennial Update Report and National Communications to the Convention. The NGHGI is reported from 1990 to 2019 (as of NC4, 2024). This section takes a look at the national emissions data.

---

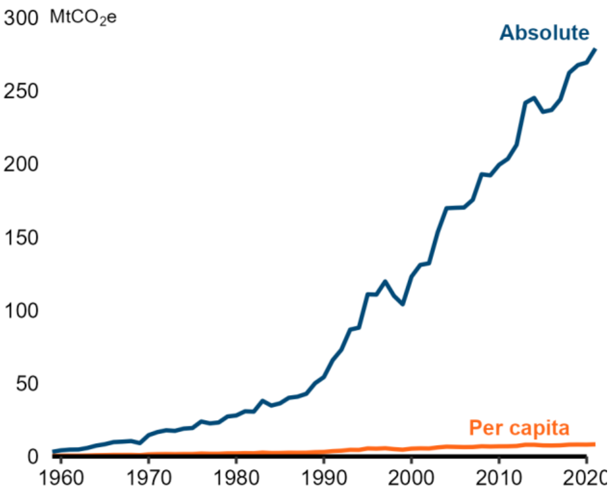
[183] Brack and King (2021)
[184] Friedlingstein et al. (2023)
[185] *World Ocean Review* (2024)
[186] Sharma et al. (2023); Penuelas (2023)
[187] Different certification standards have different required minimum, most commonly for 40 years.
[188] Canham (2021)

Figure 3.13: GHG emissions 1990 – 2019 (NGHGI)



Source: NRES (2023), KRI visualisation

Figure 3.14: CO_2 emissions 1960 – 2020 (GCB) [189]



Source: Friedlingstein et al. (2023), KRI visualisation

Absolute GHG emissions in Malaysia have grown more than two-fold from 89.1MtCO_2e in 1990 to 330.4MtCO_2e in 2019 (270%, Figure 3.13). When stretched further back, we saw that CO_2 emissions truly picked up from 1980 onwards (Figure 3.14). This growth coincides with the period of industrial development of the country. Growing population and energy use contributed to this increase in emissions but also uplifted incomes and standard of living for many. In per capita terms, each citizen would have emitted 0.5tCO_2 in 1960 and 8.2tCO_2 in 2019[190]. Within the same period, GDP per capita grew by more than seven times[191].

When broken down by sectors, it is evident that energy use has contributed the most to emissions (Figure 3.15). The growth in energy use especially has a great influence over the emissions growth of Malaysia. From 1990 to 2019, energy sector emissions almost tripled (290%), as compared to emissions directly from other sectors (Figure 3.16). Most of the emissions can be traced to the energy industries, which accounted for 47% in 1990 and grew to 54% in 2019, followed by the transport sector as well as manufacturing and construction sector (Figure 3.17).

[189] Malaysian NGHGI only reports emissions from 1990 to 2019 as of 2024. We use the Global Carbon Project national emissions dataset for emissions up to 1959. As described in section 3.2.1, differences between NGHGI and independent compiled databases remain, the data reported here should be viewed as such.
[190] Territorial emissions per capita. Friedlingstein et al. (2023)
[191] World Bank (n.d.)

Figure 3.15: Annual CO_2 emissions by sector, 1990 – 2019

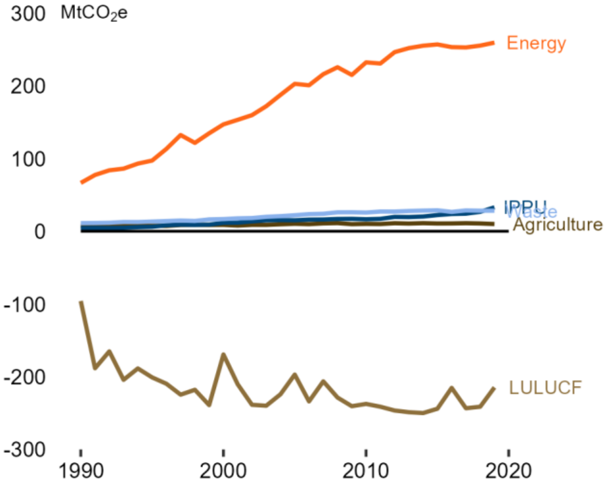
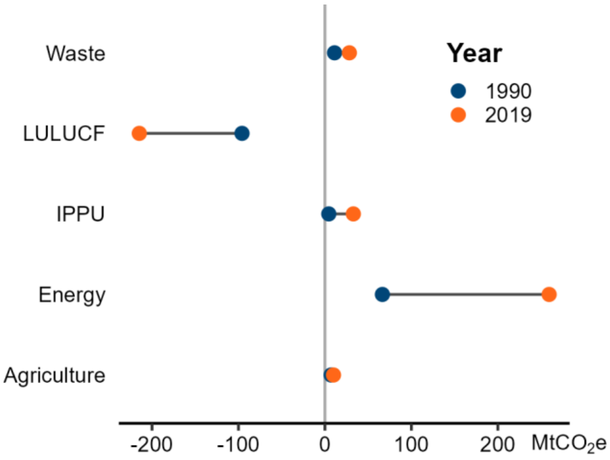


Figure 3.16: CO_2 emissions change by sector, 1990 and 2019



Source: NRES (2023), KRI visualisation

On the flip side, absolute emissions are absorbed by land-based carbon reservoirs such as forests in our LULUCF sector. This drawdown is reported as removals. These are negative emissions which offset absolute emissions as net emissions. From 1990 onwards, reported removals have grown by 124% from -95.9 to -215MtCO_2e in 2019. Removals reflect the net changes of carbon stock in territorial carbon pools. These carbon pools are biomass that sits above and below ground and soil organic carbon. Five main types of land use are accounted, including forest land, crop land, grassland, wetlands and settlements. Removals from forest land, which have increased by around 30% from 1990 to 2019, have contributed the most to this enhancement.

Figure 3.17: Share of energy subsector CO_2 emissions, 2019

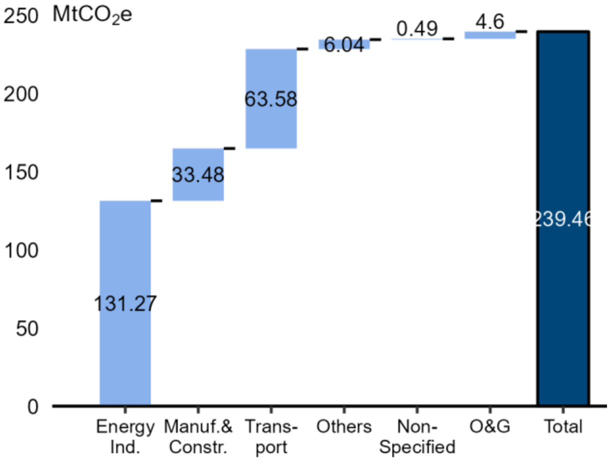
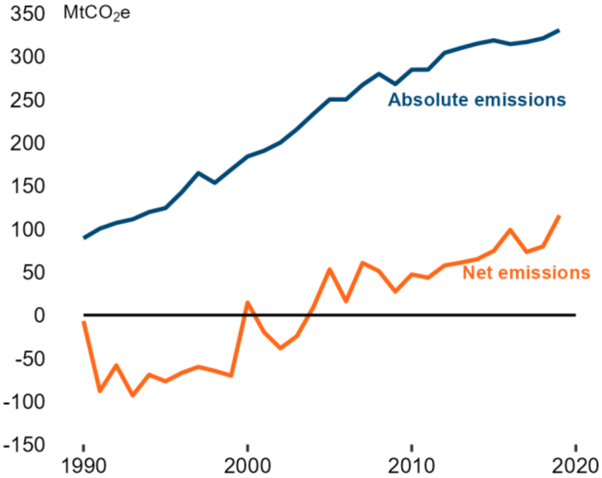


Figure 3.18: Absolute emissions and net emissions (incl. LULUCF), 1990 – 2019



Source: NRES (2023); KRI visualisation

If we consider the national absolute emissions removed by the existing carbon sinks, total net emissions stood at 115.64MtCO_2e in 2019, nearly half of absolute emissions (Figure 3.18). Territorial carbon stocks are important because they represent an integral part of the carbon cycle and support developing countries' contribution towards emissions reduction. They also provide essential ecosystem services like watershed regulation, biodiversity and much more.

There are several implications with the use of emissions removals for achieving climate goals: emissions removals need to prove (1) the durability of carbon sinks, (2) additionality and (3) absence of leakage. As discussed in Box 3.2, national governments can play a crucial role in ensuring carbon sinks durability. While challenging, the conservation and expansion of land carbon sinks are crucial for the nation to meet its climate goals and improve ecosystem integrity.

Malaysia's emissions growth reflects its history of economic growth, which is emblematic of many developing countries. The nation must judiciously plan its emissions and sinks as it moves towards a sustainable, climate-resilient development pathway. Regardless of the performance on emissions goal, the risks of climate impact will persist due to the longevity of climate response. This means that planning for resilience will remain critical well into the future.

3.3 Evaluating Climate Risk

Emissions are the source of climate change, while its effects pose risks to human and ecological systems. Human emissions have disrupted the Earth's energy balance by introducing excessive climate forcers into the atmosphere (see Section 3.2.1).

Radiative imbalance directs excess energy into different reservoirs such as the atmosphere, the ocean, land and cryosphere[192]. Increased Earth energy imbalance contributes to significant climate impacts, including rising sea levels, altered ocean currents and intensified tropical cyclones. Excess heat disrupts oceanic and atmospheric circulation, leading to shifts in weather patterns and amplifying hydrological extremes—causing dry areas to become drier and wet areas to experience heavier rainfall. Warmer oceans fuel more intense hurricanes, while warmer land surfaces heighten risks of wildfires and heat waves[193].

Climate risk describes the "potential for adverse consequences for human or ecological systems" due to climate change[194]. Data on climate risks are essential for understanding how climate change impacts people. While observational measurements of climate variables—such as precipitation and temperature—offer insights into climate patterns, they become meaningful only when paired with information about human vulnerabilities. Together, these data reveal how climate impacts intersect with the unique risk communities face.

This section examines projected climate patterns in Malaysia and explores the connections between these projections and associated risks. It first opens with a discussion on the complexity of capturing climate risk (Section 3.3.1) before exploring further Malaysia's potential climate risks in the agricultural and public health sectors (Section 3.3.2).

3.3.1. The complexity of capturing climate risk

The recent Intergovernmental Panel on Climate Change (IPCC) report employs a sophisticated climate risk model that integrates multiple dimensions of climate impacts, vulnerabilities and adaptive capacities[195]. Climate risk arises from the dynamic relationship between climate-related

[192] von Schuckmann et al. (2020)
[193] Trenberth (2020)
[194] Reisinger et al. (2020)
[195] IPCC (2022a)

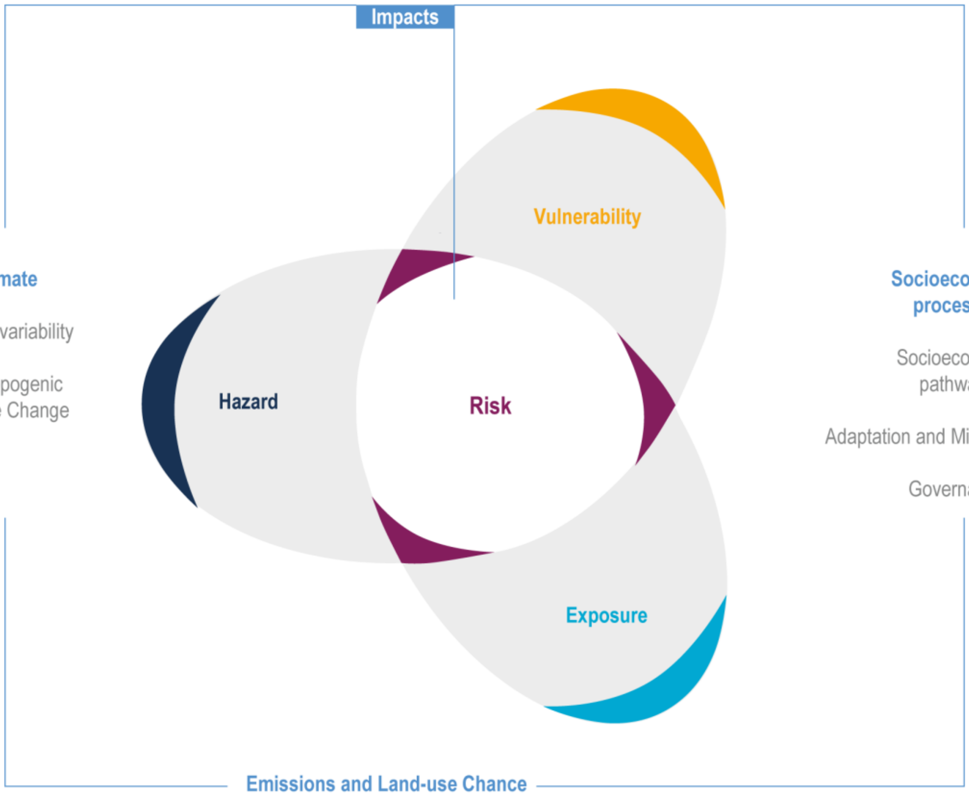
hazards, the exposure of human and natural systems to those hazards, and the vulnerability of those systems[196]. The definition of hazards, exposures and vulnerability is defined in Table 3.1 below.

Table 3.1: Definitions of hazards, exposures and vulnerability as outlined in the IPCC report

Hazard	Current and future climate conditions. These conditions will determine the likelihood of an area being affected by extreme events (e.g. heatwaves or floods) or slow-onset events (e.g. sea-level rise).
Exposure	The presence of people, livelihoods, species or ecosystems; environmental functions, services and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected
Vulnerability	The propensity to be adversely affected. It encompasses two main elements: • Sensitivity: The degree of which one is affected by climate variability • Adaptive capacity: The ability to adapt to potential damage or respond accordingly to climate events

Source: IPCC (2022a)

Figure 3.19: The IPCC model of climate risk



Source: Extracted from IPCC (2022a)

The IPCC model of climate risk (see Figure 3.19) underscores the interconnectedness of various systems—such as environmental, social and economic—highlighting how changes in one area can influence others[197]. It also alludes to how the impacts of climate change can vary significantly across different sectors, systems and social groups. Some sectors, regions and communities can be more vulnerable to climate change due to their inherent sensitivity or have limited capacity to adapt – often

[196] IPCC (2022a)
[197] Ibid.

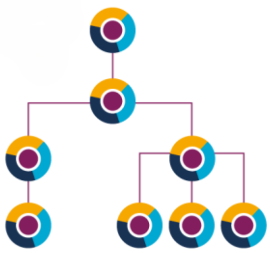
linked to existing inequalities[198]. Thus, even when faced with similar hazards or exposure, those areas and communities with more significant vulnerabilities face larger climate risks.

Identifying vulnerable areas and mapping socially vulnerable communities is essential in developing the overall climate risk landscape. The intersectionality between socioeconomic and climatic elements further highlights that managing climate risk is not only a scientific concern but a social one. Hence, climate adaptation should not be limited to managing hazards but must equally improve the adaptative capacity of affected communities.

The dynamic and complex behaviours of climate risk

The evolving understanding of climate risks highlights that it is not linear—meaning that the relationship between changes in the climate system and the resulting impacts is not a simple, proportional one[199]. Instead, climate risks can be characterised by complex interactions, feedback loops and thresholds, leading to unpredictable and disproportionate outcomes[200]. Climate risks rarely occur in isolation. Instead, they often interact in a variety of ways. Examples of the complexity of climate risk relationships are as follows.

Table 3.2: Variations of climate risk relationships and its definition

Compounding risk	
a) Unidirectional  b) Bi-directional 	This illustrates the intensification of risk when multiple risk factors coincide. It can be, • Unidirectional: where one risk factor amplifies another; or • Bi-directional: where several factors can interact and mutually reinforce each other
Cascading risk	
	Cascading risks can be depicted through a chain reaction, where one event triggers a sequence of subsequent events, each amplifying the overall impact. For instance, a drought might lead to crop failures, followed by food shortages, which may impact nutritional intake and thus negatively impact public health.
Aggregating risk	
	This represents the cumulative impact of multiple independent risk factors that, while unrelated, can combine to create a larger, more significant risk. For example, a coastal community might face simultaneous risks from sea-level rise, storm surges and saltwater intrusion, all contributing to a heightened overall risk.

Source: Extracted from IPCC (2022a) Figure 1.4

Moreover, the IPCC Sixth Assessment Report's (AR6) model of climate risk can also include risks coming from the responses themselves. Human actions and decisions play a crucial role in shaping climate risks and contributing to their non-linearity[201]. For example, maladaptation, where actions

[198] Ibid.
[199] IPCC (2022a)
[200] Ibid.
[201] IPCC (2022a)

intended to reduce climate risk inadvertently increase vulnerability, can create feedback loops that worsen outcomes.

The interplay of hazards, exposure and vulnerability, compounded by the potential for maladaptation and cascading effects, creates a complex and dynamic risk landscape. This complexity underscores the need for comprehensive risk assessments that account for these non-linear interactions and the potential for unforeseen consequences. Traditional approaches that rely on linear projections and historical data may not adequately capture the full range of potential outcomes, particularly those associated with high-impact, low-probability events or the crossing of critical thresholds. Hence, a comprehensive climate risk framing is needed to provide a more nuanced understanding of vulnerabilities and potential adaptation strategies.

3.3.2. Capturing Malaysia's climate risk

Malaysia's current climate patterns and projections

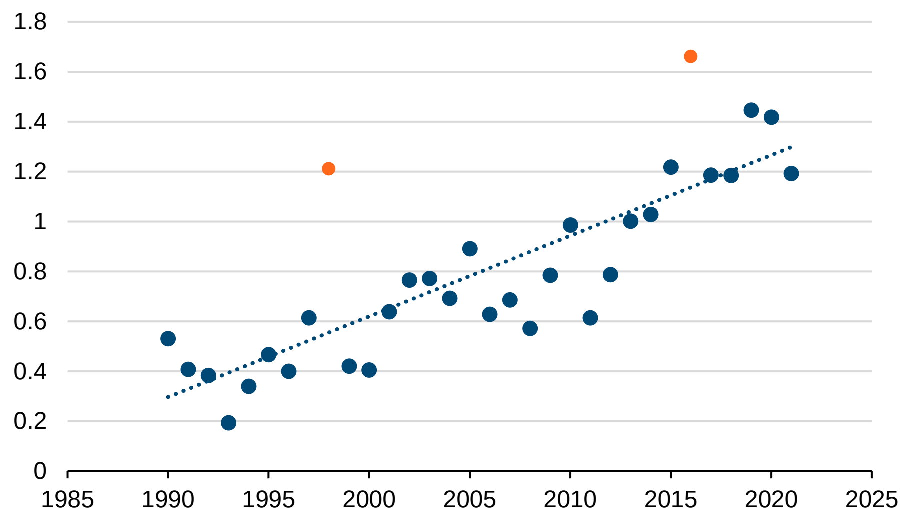
This subsection explores Malaysia's projected climate conditions and changes under various emissions scenarios. The modelled climate data is derived from the Coupled Model Intercomparison Project-Phase 6 (CIMP6), the foundational data used in the IPCC's AR6 climate projections. The CIMP6 projections are shown through four Shared Socioeconomic Pathway (SSP) scenarios, defined by a cumulative measure of all GHG emission pathways and levels by 2100.

Malaysia's temperature projections

Keeping the variance of temperature gains in mind, it is then vital to contextualise how Malaysia's climatic patterns have evolved in the past few decades. Figure 3.20 shows that Malaysia has faced increasing annual surface temperature in the past three decades. Notably, from 2013 onwards, Malaysia's surface temperature has been at least 1°C higher than the average surface temperature during the 1951 – 1980 period. Concurrently, Malaysia's minimum and maximum temperatures have increased, which is in line with the findings from the IPCC report, which predicted an increase in hot extremes in the Southeast Asia region.

It is also worth noting that the annual surface temperature change was significantly higher during 1998 and 2016 (marked in orange), which reported a 1.21°C and 1.66°C temperature gain, respectively. One of the most significant influences on Malaysia's temperature is the El Niño-Southern Oscillation's (ENSO) El Niño phase, which tends to result in higher average temperatures and decreased precipitation. 1998 and 2016 were among the years in which Malaysia experienced an El Niño phase and, thus, explains the sharp rise in temperature gain in its adjacent years.

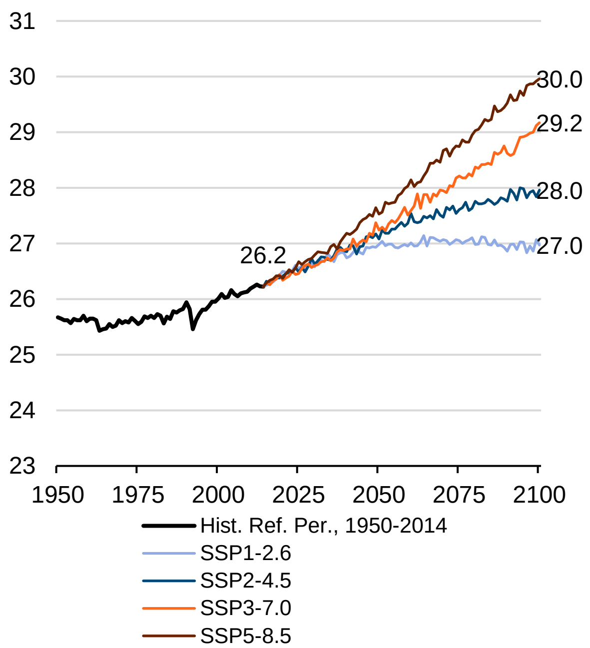
Figure 3.20: Malaysia's annual surface temperature change, 1951 – 2021 (℃)



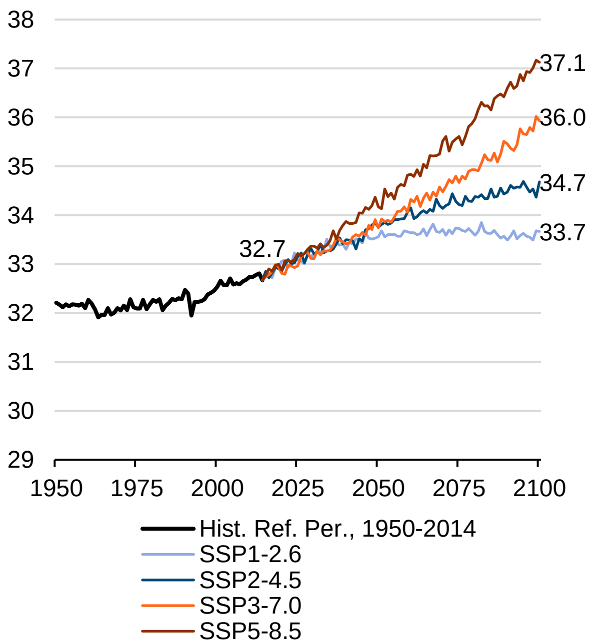
Source: World Bank (2023)
Note: Points highlighted in orange were years with strong El Nino events

Figure 3.21: Malaysia's average mean and maximum temperature projections based on different emission scenarios, 1950 – 2100 (℃)

i) Mean temperature



ii) Maximum temperature



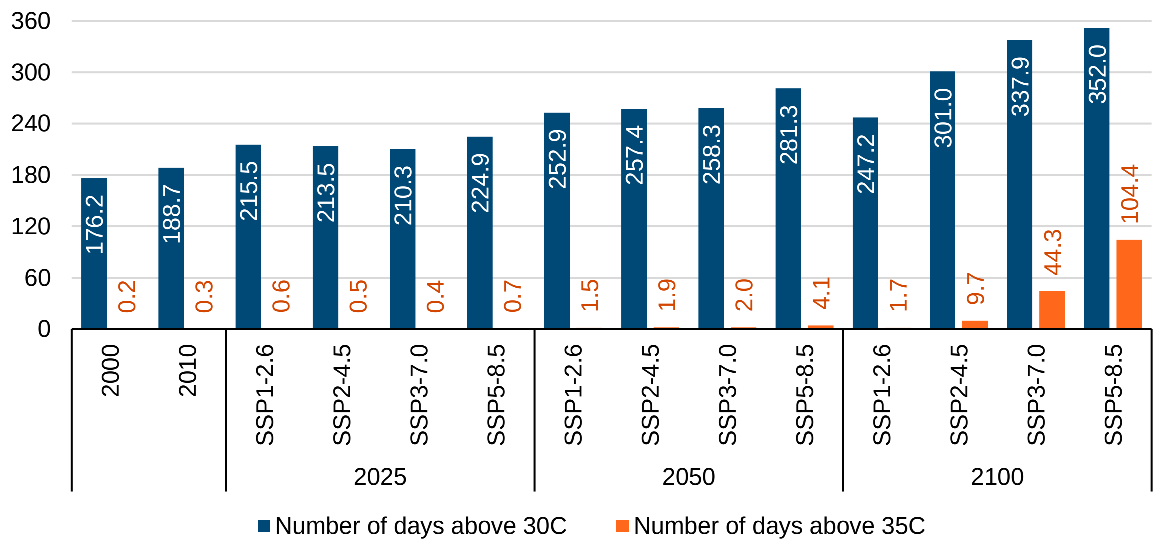
Source: World Bank (2023)

In addition to Malaysia's past temperature increase, it is projected that Malaysia's mean temperature will increase regardless of the emissions scenario. Emissions scenarios are representative future trajectories of emissions level with corresponding temperature rise used in integrated assessment modelling (IAMs). The CMIP6 model ensemble uses five standard scenarios known as Shared Socioeconomic Pathways (SSPs), each representing a range of temperature levels and its corresponding climatic projections. Even under the most positive emissions scenario, where global emissions will reach net zero by 2050 (SSP1-2.6), Malaysia's average mean temperature will still increase to 27.0°C by 2100. Meanwhile, if the total emissions continue to rise, Malaysia could face mean temperatures between 29.2°C – 30.0°C by 2100.

Aside from Malaysia's observed temperature gains in the past few decades, Malaysia's weather patterns are influenced by the monsoon season and the ENSO. Typically, ENSO's effect on Malaysia leads to drier than usual conditions during El Niño and wetter than usual conditions during La Niña[202]. As a result, there are slight annual, seasonal and monthly variations in Malaysia's temperature, with some days and months being much hotter than others.

Malaysia's projected temperature increase is also expected to be accompanied by higher maximum temperatures (Figure 3.21) as well as having more days in which the average temperature exceeds 30°C or 35°C (Figure 3.22). While the intensity of the temperature increase depends on the world's emissions scenario, even the most positive outlook (SSP1-2.6) projects that Malaysia's average maximum temperature will increase. At SSP2-4.5, if global emissions begin decreasing in 2050, Malaysia may experience an average maximum temperature of 34.7°C compared to its current average of 32.7°C.

Figure 3.22: Projected number of days with temperature above 30℃ and 35℃, by warming scenario, for 2025, 2050 and 2100



Source: World Bank (2023)

Malaysia's precipitation projections

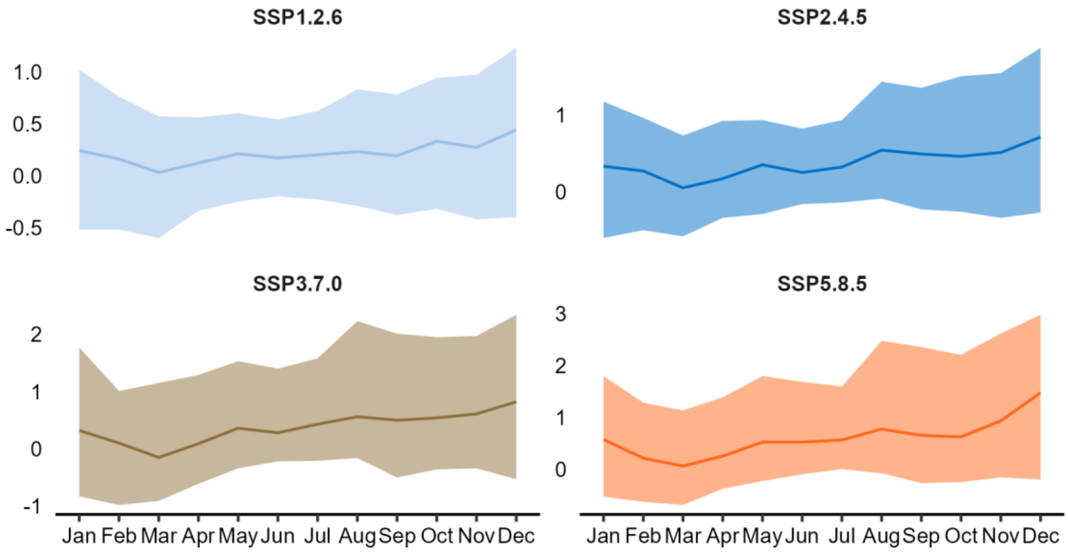
In addition to rising temperatures, recent projections show that Malaysia's average rainfall or precipitation will likely increase across all emissions scenarios in varying intensities. Under the SSP1-2.6, which aligns with keeping global warming under 1.5°C by 2100, Malaysia could expect more stable precipitation patterns than other scenarios (Figure 3.23). While there may still be a slight

[202] M. L. Tan et al. (2021)

increase in total rainfall due to warmer atmospheric temperatures (which increases water vapour), the changes would likely be more moderate.

However, in other higher emissions scenarios, Malaysia will likely experience greater disruptions to its precipitation patterns. For example, both SSP3-7.0 and SSP5-8.5 projected precipitation patterns showed a more significant deviation from the historical reference period. In both emissions scenarios, it shows that there is a decrease in precipitation between Malaysia's drier months between February and April but shows a greater increase during Malaysia's monsoon periods between October and December. This highlights that higher emissions scenarios can lead to more extreme precipitation events—with wetter wet seasons and drier dry seasons.

Figure 3.23: Projected climatology for Malaysia's Precipitation >20mm for 2080 – 2099 against the historical reference period, by emissions scenario (days)



Source: World Bank (n.d.); KRI visualisation
Notes: Coloured area represents upper and lower bound of 90% confidence interval

Malaysia's potential climate risks

As detailed above, climate change is expected to increase Malaysia's average temperature and precipitation. This can heighten Malaysia's exposure to various climate hazards such as floods and sea level rise, which will be discussed further in the following chapter. However, given the complexity of climate risk and its interaction with other socioeconomic variables, the discussion of climate risk should go beyond the subgrouping of climate hazards and be examined by sectors.

Below, we explore Malaysia's potential climate risk in two main sectors, namely, (1) agriculture and food security and (2) public health. While these two sectors are assessed separately in this subsection, it should be noted that some of the climate risks discussed can be interrelated and compounded by one another. An example is that food security can impact public health, as food scarcity due to climate can negatively impact nutrition.

It is also important to highlight that while this section only covers two sectors, it is non-exhaustive. There may be various other direct and indirect climate impacts on both the agricultural and public health sectors that are not discussed in this section. Climate risk is also expected to impact other sectors not mentioned in this section, such as how Malaysia's economy, infrastructure, productivity and social welfare can all be exposed to climatic impacts. Regardless, this section offers insight into the complexity and multitude nature of climate risk in the case of Malaysia.

Climate risks in Malaysia's agriculture and food security

Malaysia faces numerous climate risks in its agriculture sector. Rising temperatures are projected to decrease yields for staple crops like rice, potentially leading to shortfalls in domestic production[203]. For instance, a 2°C temperature increase could reduce rice yields by 0.36 tonnes per hectare, resulting in an estimated annual economic loss of RM162.53 million in the rice industry[204]. Moreover, climate-induced pest and disease dynamics changes can impact crop health and yields. This can lead to an increased reliance on imports.

Changes in precipitation patterns add another layer of complexity to Malaysia's climate risks in the agricultural sector. Variability in rainfall can lead to droughts and floods, particularly affecting rain-fed rice cultivation in low-altitude regions[205]. Droughts, often associated with El Niño events, can severely impact agricultural production, leading to water shortages for irrigation and reduced rice yields[206]. On the other hand, floods can cause extensive damage to crops and agricultural infrastructure, as seen in the 2007 floods in Johor, Negeri Sembilan, Melaka and Pahang, resulting in an estimated RM84 million in agricultural losses[207]. These events affect crop yields, disrupt the supply chain and impact rural livelihoods.

Climate change can also directly and indirectly impact poultry and livestock production. Poultry is vulnerable to warmer temperatures, suppressing their appetite and leading to lower average weight gain[208]. Meanwhile, climate change can affect the output of the crops used in animal feed, leading to lower availability of nutrients for the livestock[209]. Rising temperatures could also lead to heat stress among dairy animals, impacting milk yield, reproductive performance and even death in extreme cases[210].

Rising temperatures can also impact Malaysia's fisheries. Warmer ocean temperatures, acidification and deoxygenation, driven by climate change, are reducing fish stocks and altering fish migration patterns[211,212]. The maximum catch potential of tropical fish stocks in exclusive economic zones is estimated to decline by up to 40% by 2050 under the SSP5-8.5 emissions scenario[213]. Hence, climate-driven reductions in fisheries production and changes in fish-species composition can significantly affect the livelihoods of coastal communities that rely heavily on fishing[214].

Fisheries production through aquaculture is also projected to decrease due to climate change. Research has found that inland aquaculture in Southeast Asia is highly vulnerable due to climate-

[203] Vaghefi et al. (2010)
[204] Vaghefi et al. (2010)
[205] B. T. Tan et al. (2021)
[206] Al-Amin and Alam (2015)
[207] Al-Amin et al. (2011)
[208] Gardir Singh and Wai Jing Fong (n.d.)
[209] Koneswaran and Nierenberg (2008)
[210] Das et al. (2016)
[211] Muhammad et al. (2016)
[212] Lam et al. (2020)
[213] Ibid.
[214] Blasiak et al. (2017)

driven changes in precipitation levels, flooding and salinity inundation due to rising sea levels[215]. This, in turn, can negatively impact Malaysia’s ability to meet its self-sufficiency levels in seafood production.

The combined effects of climate on Malaysia’s agricultural and fisheries sector can likely lead to higher food prices, impacting affordability and potentially increasing undernourishment in Malaysia[216]. Hence, climate change significantly threatens Malaysia's food security by reducing agricultural productivity and disrupting supply chains.

Climate risks in Malaysia’s public health sector

Climate change poses significant public health challenges in Malaysia. Rising temperatures lead to increased heat-related illnesses[217], particularly affecting the elderly and those with pre-existing health conditions[218]. Heatwaves can exacerbate chronic diseases, strain healthcare systems and result in higher mortality rates. Moreover, the urban heat island effect—where cities experience higher temperatures than surrounding areas—further intensifies health risks, particularly in rapidly urbanising regions[219].

In addition to heat-related issues, climate change can exacerbate the prevalence of vector-borne diseases such as dengue fever and malaria[220]. Changes in temperature and rainfall patterns can expand the habitats of disease-carrying mosquitoes, leading to increased transmission rates of vector-borne diseases[221]. Malaysia has already witnessed fluctuations in dengue outbreaks correlated with climatic conditions[222] and as the climate continues to change, the risk of new disease emergence and spread increases[223]. This shift threatens public health and places additional burdens on healthcare systems already struggling to manage existing diseases.

Furthermore, the increased frequency of floods due to climate change can also heighten the risk of water-borne related diseases. Floodwaters can carry pathogens from sewage systems, agricultural runoff and waste sites into rivers, lakes and groundwater, contaminating drinking water sources[224,225]. Meanwhile, contaminated water can spread rapidly among people in close quarters (such as those in flood evacuation centres), raising the risk of widespread outbreaks of diseases[226].

The impact of climate change on food security also poses a significant public health risk. The disruption of agricultural production due to climate change can lead to food shortages and malnutrition. Malnutrition, particularly among children, can result in stunted growth, weakened immune systems and increased infection vulnerability[227]. This situation creates a vicious cycle, where

[215] Intergovernmental Panel On Climate Change (Ipcc) (2023)
[216] Mahmood, Rajaram, and Guinto (2022)
[217] IPCC (2022a)
[218] Kovats and Hajat (2008)
[219] Wouters et al. (2017)
[220] IPCC (2022a)
[221] Ibid
[222] Hii et al. (2016)
[223] Wang et al. (2023)
[224] Shafii et al. (2023)
[225] Yavarian, Shafiei-Jandaghi, and Mokhtari-Azad (2019)
[226] See, Nayan, and Rahaman (2017)
[227] De and Chattopadhyay (2019)

health deteriorates due to inadequate nutrition and can further impact productivity and economic output.

Climate change is likely to exacerbate mental health issues in the region. Natural disasters, intensified by climate change, can lead to displacement, loss of livelihoods and trauma, contributing to increased anxiety, depression and post-traumatic stress disorder (PTSD)[228]. The psychological toll of extreme weather events can be profound, particularly in communities that face recurrent disasters[229,230,231]. Addressing the mental health implications of climate change is crucial for fostering resilience and recovery, highlighting the need for integrated public health approaches encompassing physical and psychological well-being.

3.3.3. Discussion: What it means to capture Malaysia's climate risk

Accurately capturing Malaysia's climate risk is crucial as it forms the foundation of an effective climate action, encompassing adaptation, mitigation and the pursuit of sustainable development. The section highlights how climate change can bring impacts beyond climate hazards and extreme weather events—that everyday production and activities are also exposed to various risks brought on by climate change. However, it is important to note that the examples above are non-exhaustive and offer a glimpse into some of the literature exploring the risks in those sectors.

To be climate-resilient, we must first have an accurate picture of what we need to be resilient to. Thus, it is vital for Malaysia to accurately quantify the potential declines in production, economic losses and disruptions to supply chains attributed to climate change. Additionally, by identifying and quantifying the sectors and regions most vulnerable to climate change impacts, policymakers can prioritise climate action to improve the adaptive capacity of those sectors and regions.

Furthermore, accurately capturing climate risks can empower Malaysia to anticipate and prepare for potential losses and damages. Residual risks, those remaining after adaptation efforts, can lead to exceeding adaptation limits and result in irreversible losses and damages. Accurately assessing these risks can facilitate the development of early warning systems, risk transfer mechanisms and financial instruments to address these challenges.

In assessing Malaysia's climate risk, it is essential to understand and consider the complex and cascading nature of climate risks. Climate risk can differ across regions and its impacts can cascade across regions and systems—leading to a network of direct and indirect climate impacts between various sectors. The interconnectedness between risk and response within climate action also highlights the need to consider the risks associated with mitigation and adaptation measures (see Chapter 4 and 5). Hence, a comprehensive grasp of climate risk can aid in evaluating the effectiveness of our country's climate responses. This can enable Malaysia to implement policies and actions that reduce vulnerabilities, enhance resilience and promote sustainable development in a changing climate.

[228] IPCC (2022a)
[229] Ibid.
[230] "IN FOCUS: 'When the Sky Gets Dark, My Stomach Will Sink' - Trauma for Recurring Flood Victims in Malaysia - CNA" (n.d.)
[231] Othman et al. (2022)

3.4 References

Al-Amin, Abul Quasem, and Gazi Mahabubul Alam. 2015. "Impact of El-Niño on Agro-Economics in Malaysia and the Surrounding Regions: An Analysis of the Events from 1997-98." *Asian Journal of Earth Sciences* 9 (1):1–8. https://doi.org/10.17311/ajes.2016.1.8.

Al-Amin, Abul Quasem, Walter Leal, Abdul Hamid Jaafar, and Zabawi Abdul Ghani. 2011. "Assessing the Impacts of Climate Change in the Malaysian Agriculture Sector and Its Influences in Investment Decision." *IDOSI Publications* 7 (2):225–34.

Allen, Myles R., Pierre Friedlingstein, Cécile A. J. Girardin, Stuart Jenkins, Yadvinder Malhi, Eli Mitchell-Larson, Glen P. Peters, and Lavanya Rajamani. 2022. "Net Zero: Science, Origins, and Implications." *Annual Review of Environment and Resources* 47 (Volume 47, 2022). Annual Reviews:849–87. https://doi.org/10.1146/annurev-environ-112320-105050.

Archer, David, Michael Eby, Victor Brovkin, Andy Ridgwell, Long Cao, Uwe Mikolajewicz, Ken Caldeira, et al. 2009. "Atmospheric Lifetime of Fossil Fuel Carbon Dioxide." *Annual Review of Earth and Planetary Sciences* 37 (1):117–34. https://doi.org/10.1146/annurev.earth.031208.100206.

Bhattacharya, Mita, John N. Inekwe, and Perry Sadorsky. 2020. "Consumption-Based and Territory-Based Carbon Emissions Intensity: Determinants and Forecasting Using Club Convergence across Countries." *Energy Economics* 86 (February):104632. https://doi.org/10.1016/j.eneco.2019.104632.

Bindoff, N.L., P.A. Stott, K.M. AchutaRao, M.R. Allen, N. Gillett, D. Gutzler, K. Hansingo, et al. 2013. "Detection and Attribution of Climate Change: From Global to Regional." In *Climate Change 2013: The Physical Science Basis*, edited by T.F. Stocker, D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, and P.M. Midgley. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.

Blasiak, Robert, Jessica Spijkers, Kanae Tokunaga, Jeremy Pittman, Nobuyuki Yagi, and Henrik Österblom. 2017. "Climate Change and Marine Fisheries: Least Developed Countries Top Global Index of Vulnerability." *PLoS ONE* 12 (6):e0179632. https://doi.org/10.1371/journal.pone.0179632.

Brack, Duncan, and Richard King. 2021. "Managing Land-Based CDR: BECCS, Forests and Carbon Sequestration." *Global Policy* 12 (S1):45–56. https://doi.org/10.1111/1758-5899.12827.

Brander, Matthew. 2012. "Greenhouse Gases, CO2, CO2e, and Carbon: What Do All These Terms Mean?" Econometrica. https://ecometrica.com/knowledge-bank/insights/greenhouse-gases-co2-co2e-and-carbon-what-do-all-these-terms-mean/.

Canadell, J.G., P.M.S. Monteiro, M.H. Costa, L. Cotrim da Cunha, P.M. Cox, A.V. Eliseev, S. Henson, et al. 2021. "Global Carbon and Other Biogeochemical Cycles and Feedbacks." Edited by V. Masson-Delmotte, P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, et al. *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK and New York, NY, USA: Cambridge University Press. https://doi.org/10.1017/9781009157896.007.

Canham, Charles D. 2021. "Rethinking Forest Carbon Offsets." *Cary Institute of Ecosystem Studies* (blog). May 19, 2021. https://www.caryinstitute.org/news-insights/feature/rethinking-forest-carbon-offsets.

Chandler, David L. 2017. "Explained: Greenhouse Gases." *MIT News*, January 30, 2017. https://news.mit.edu/2017/explained-greenhouse-gases-0130.

Climate Watch. 2024. Washington D.C.: World Resources Institute.

Darwili, Aldy, and Enno Schröder. 2023. "On the Interpretation and Measurement of Technology-Adjusted Emissions Embodied in Trade." *Environmental and Resource Economics* 84 (1):65–98. https://doi.org/10.1007/s10640-022-00725-7.

Das, Ramendra, Lalrengpuii Sailo, Nishant Verma, Pranay Bharti, Jnyanashree Saikia, null Imtiwati, and Rakesh Kumar. 2016. "Impact of Heat Stress on Health and Performance of Dairy Animals: A Review." *Veterinary World* 9 (3):260–68. https://doi.org/10.14202/vetworld.2016.260-268.

De, Partha, and Nandita Chattopadhyay. 2019. "Effects of Malnutrition on Child Development: Evidence from a Backward District of India." *Clinical Epidemiology and Global Health* 7 (3):439–45. https://doi.org/10.1016/j.cegh.2019.01.014.

Dhakal, S., J.C. Minx, F.L. Toth, A. Abdel-Aziz, M.J. Figueroa Meza, K. Hubacek, I.G.C. Jonckheere, et al. 2022. "Emissions Trends and Drivers." Edited by P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, et al. *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK and New York, NY, USA: Cambridge University Press. https://doi.org/10.1017/9781009157926.004.

Fanning, Andrew L., and Jason Hickel. 2023. "Compensation for Atmospheric Appropriation." *Nature Sustainability*, June. Nature Publishing Group, 1–10. https://doi.org/10.1038/s41893-023-01130-8.

Fengler, Wolfgang, Indermit Gill, and Homi Kharas. 2023. "Making Emissions Count in Country Classifications." *Brookings* (blog). September 7, 2023. https://www.brookings.edu/articles/making-emissions-count-in-country-classifications/.

Forster, P., T. Storelvmo, K. Armour, W. Collins, J.-L. Dufresne, D. Frame, D.J. Lunt, et al. 2021. "The Earth's Energy Budget, Climate Feedbacks, and Climate Sensitivity." Edited by V. Masson-Delmotte, P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, et al. *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK and New York, NY, USA: Cambridge University Press. https://doi.org/10.1017/9781009157896.009.

Forster, Piers, Chris Smith, Tristram Walsh, William F. Lamb, Robin Lamboll, Bradley Hall, Mathias Hauser, et al. 2024. "Indicators of Global Climate Change 2023: Annual Update of Key Indicators of the State of the Climate System and Human Influence." *Earth System Science Data* 16 (6). Copernicus GmbH:2625–58. https://doi.org/10.5194/essd-16-2625-2024.

Frecht, Sarah. 2021. "How Exactly Does Carbon Dioxide Cause Global Warming? – State of the Planet." *State of the Planet* (blog). February 25, 2021. https://news.climate.columbia.edu/2021/02/25/carbon-dioxide-cause-global-warming/.

Friedlingstein, Pierre, Michael O'Sullivan, Matthew W. Jones, Robbie M. Andrew, Dorothee C. E. Bakker, Judith Hauck, Peter Landschützer, et al. 2023. "Global Carbon Budget 2023." *Earth System Science Data* 15 (12). Copernicus GmbH:5301–69. https://doi.org/10.5194/essd-15-5301-2023.

Gardir Singh, Dr. Moktir Singh, and Dr. Rachel Wai Jing Fong. n.d. "Livestock Breeding Related to Climate Change in Malaysia: A Perspective of the Malaysian Swine and Poultry Sector." *Department of Veterinary Science Malaysia*.

Grassi, Giacomo, Elke Stehfest, Joeri Rogelj, Detlef van Vuuren, Alessandro Cescatti, Jo House, Gert-Jan Nabuurs, et al. 2021. "Critical Adjustment of Land Mitigation Pathways for Assessing Countries' Climate Progress." *Nature Climate Change* 11 (5):425–34. https://doi.org/10.1038/s41558-021-01033-6.

Hannah, Lee. 2011. "Chapter 2 - The Climate System and Climate Change." In *Climate Change Biology*, edited by Lee Hannah, 13–52. London: Academic Press. https://doi.org/10.1016/B978-0-12-374182-0.00002-9.

Hare, Bill, Robert Brecha, and Michiel Schaeffer. 2018. "Integrated Assessment Models: What Are They and How Do They Arrive at Their Conclusions." *Climate Analytics* 8 (4). https://ca1-clm.edcdn.com/assets/climate_analytics_iams_briefing_oct2018.pdf.

Hausfather, Zeke. 2019. "Explainer: How Scientists Estimate Climate Sensitivity." *Carbon Brief*, June 19, 2019. https://www.carbonbrief.org/explainer-how-scientists-estimate-climate-sensitivity/.

———. 2023. "Forest Carbon's Back-End Durability Problem." *The Climate Brink* (blog). May 25, 2023. https://www.theclimatebrink.com/p/forest-carbons-back-end-durability.

Herold, Martin, Sarah Carter, Valerio Avitabile, Andrés B. Espejo, Inge Jonckheere, Richard Lucas, Ronald E. McRoberts, et al. 2019. "The Role and Need for Space-Based Forest Biomass-Related Measurements in Environmental Management and Policy." *Surveys in Geophysics* 40 (4):757–78. https://doi.org/10.1007/s10712-019-09510-6.

Hii, Yien Ling, Rafdzah Ahmad Zaki, Nasrin Aghamohammadi, and Joacim Rocklöv. 2016. "Research on Climate and Dengue in Malaysia: A Systematic Review." *Current Environmental Health Reports* 3:81–90. https://doi.org/10.1007/s40572-016-0078-z.

Huntingford, Chris, Mark S. Williamson, and Femke J. M. M. Nijsse. 2020. "CMIP6 Climate Models Imply High Committed Warming." *Climatic Change* 162 (3):1515–20. https://doi.org/10.1007/s10584-020-02849-5.

"IN FOCUS: 'When the Sky Gets Dark, My Stomach Will Sink' - Trauma for Recurring Flood Victims in Malaysia - CNA." n.d. Accessed November 7, 2024. https://www.channelnewsasia.com/asia/malaysia-monsoon-floods-ptsd-climate-change-world-mental-health-day-2981061.

IPCC. 2018. *Global Warming of 1.5°C: IPCC Special Report on Impacts of Global Warming of 1.5°C above Pre-Industrial Levels in Context of Strengthening Response to Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*. 1st ed. Cambridge University Press. https://doi.org/10.1017/9781009157940.

———. 2022a. "Summary for Policymakers." In *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, by H.-O. Pörtner, S. Langsdorf, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, et al., edited by H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A.

Alegría, M. Craig, et al., 3–33. Cambridge, UK: Cambridge University Press. 10.1017/9781009325844.001.

———. 2022b. "Summary for Policymakers." Edited by P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, et al. *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK and New York, NY, USA: Cambridge University Press. https://doi.org/10.1017/9781009157926.001.

IPCC, Bert Metz, Ogunlade Davidson, Peter Bosch, Rutu Dave, and Leo Meyer, eds. 2007. *Climate Change 2007: Mitigation of Climate Change: Contribution of Working Group Iii to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge ; New York: Cambridge University Press.

IPCC, Robert T. Watson, Ian R. Noble, Bert Bolin, N. H. Ravindranath, David J. Verardo, and David J. Dokken, eds. 2000. *Land Use, Land-Use Change, and Forestry: A Special Report of the IPCC ; Published for the Intergovernmental Panel on Climate Change*. UK: Cambridge University Press.

Jiborn, Magnus, Astrid Kander, Viktoras Kulionis, Hana Nielsen, and Daniel D. Moran. 2018. "Decoupling or Delusion? Measuring Emissions Displacement in Foreign Trade." *Global Environmental Change* 49 (March):27–34. https://doi.org/10.1016/j.gloenvcha.2017.12.006.

Koneswaran, Gowri, and Danielle Nierenberg. 2008. "Global Farm Animal Production and Global Warming: Impacting and Mitigating Climate Change." *Environmental Health Perspectives* 116 (June):578–82. https://doi.org/10.1289/ehp.11034.

Kovats, R. Sari, and Shakoor Hajat. 2008. "Heat Stress and Public Health: A Critical Review." *Annual Review of Public Health* 29:41–55. https://doi.org/10.1146/annurev.publhealth.29.020907.090843.

Lam, Vicky W. Y., Edward H. Allison, Johann D. Bell, Jessica Blythe, William W. L. Cheung, Thomas L. Frölicher, Maria A. Gasalla, and U. Rashid Sumaila. 2020. "Climate Change, Tropical Fisheries and Prospects for Sustainable Development." *Nature Reviews Earth & Environment* 1 (9). Nature Publishing Group:440–54. https://doi.org/10.1038/s43017-020-0071-9.

Levin, K., B. Cashore, Steven Bernstein, and G. Auld. 2009. "Playing It Forward: Path Dependency, Progressive Incrementalism, and the 'Super Wicked' Problem of Global Climate Change." *IOP Conference Series: Earth and Environmental Science* 6 (50):502002. https://doi.org/10.1088/1755-1307/6/50/502002.

Mahmood, Jemilah, Nadia N Rajaram, and Renzo R Guinto. 2022. "Addressing Food Insecurity and Climate Change in Malaysia: Current Evidence and Ways Forward." *The Malaysian Journal of Medical Sciences : MJMS* 29 (6):1–5. https://doi.org/10.21315/mjms2022.29.6.1.

Matthews, H. Damon, Katarzyna B. Tokarska, Zebedee R. J. Nicholls, Joeri Rogelj, Josep G. Canadell, Pierre Friedlingstein, Thomas L. Frölicher, et al. 2020. "Opportunities and Challenges in Using Remaining Carbon Budgets to Guide Climate Policy." *Nature Geoscience* 13 (12). Nature Publishing Group:769–79. https://doi.org/10.1038/s41561-020-00663-3.

Matthews, H. Damon, and Andrew J. Weaver. 2010. "Committed Climate Warming." *Nature Geoscience* 3 (3). Nature Publishing Group:142–43. https://doi.org/10.1038/ngeo813.

Meng, Jing, Jingwen Huo, Zengkai Zhang, Yu Liu, Zhifu Mi, Dabo Guan, and Kuishuang Feng. 2023. "The Narrowing Gap in Developed and Developing Country Emission Intensities Reduces Global Trade's Carbon Leakage." *Nature Communications* 14 (1). Nature Publishing Group:3775. https://doi.org/10.1038/s41467-023-39449-7.

Ministry of Natural Resources, Environment and Climate Change. 2022. "Malaysia's Fourth Biennial Update Report under the United Nations Framework Convention on Climate Change." Ministry of Natural Resources, Environment and Climate Change. https://unfccc.int/sites/default/files/resource/MY%20BUR4_2022.pdf.

Moseman, Andrew. 2024. "How Much Carbon Dioxide Does the Earth Naturally Absorb? | MIT Climate Portal." MIT Climate Portal. January 26, 2024. https://climate.mit.edu/ask-mit/how-much-carbon-dioxide-does-earth-naturally-absorb.

Muhammad, Mahazan, Khairuddin Idris, Effi Helmy Ariffin, Hayrol Shaffril, Bahaman Abu Samah, and Turiman Suandi. 2016. "The Impact of Climate Change on Small-Scale Fisherman in Malaysia." *The Social Sciences* 11 (September):3352–56. https://doi.org/10.3923/sscience.2016.3352.3356.

Nabuurs, G-J., R. Mrabet, A. Abu Hatab, M. Bustamante, H. Clark, P. Havlík, J. House, et al. 2022. "Agriculture, Forestry and Other Land Uses (AFOLU)." Edited by P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, et al. *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK and New York, NY, USA: Cambridge University Press. https://doi.org/10.1017/9781009157926.009.

New, M., D. Reckien, D. Viner, C. Adler, S.-M. Cheong, C. Conde, A. Constable, et al. 2022. "Decision-Making Options for Managing Risk." Edited by H. O. Pörtner, D. C. Roberts, M. Tignor, E. S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, et al. *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK and New York, NY, USA: Cambridge University Press. https://doi.org/10.1017/9781009325844.026.

Nijsse, Femke J. M. M., Peter M. Cox, and Mark S. Williamson. 2020. "Emergent Constraints on Transient Climate Response (TCR) and Equilibrium Climate Sensitivity (ECS) from Historical Warming in CMIP5 and CMIP6 Models." *Earth System Dynamics* 11 (3). Copernicus GmbH:737–50. https://doi.org/10.5194/esd-11-737-2020.

Othman, Farrah, Sharfizie Sharip, Syazliana Kasim, Nor' Azurah Md Kamdari, and Farrah Nadia Baharuddin. 2022. "Flooding: The Mental, Social and Health Effects of Flood Disasters." *International Journal of Academic Research in Business and Social Sciences* 12 (October). https://doi.org/10.6007/IJARBSS/v12-i10/15492.

Paytner, David. n.d. "Transient and Equilibrium Climate Sensitivity." Geophysical Fluid Dynamics Laboratory. n.d. https://www.gfdl.noaa.gov/transient-and-equilibrium-climate-sensitivity/.

Penuelas, Josep. 2023. "Decreasing Efficiency and Slowdown of the Increase in Terrestrial Carbon-Sink Activity." *One Earth* 6 (6). Elsevier:591–94. https://doi.org/10.1016/j.oneear.2023.05.013.

Peters, Glen P., Jan C. Minx, Christopher L. Weber, and Ottmar Edenhofer. 2011. "Growth in Emission Transfers via International Trade from 1990 to 2008." *Proceedings of the National Academy of Sciences* 108 (21). Proceedings of the National Academy of Sciences:8903–8. https://doi.org/10.1073/pnas.1006388108.

Pickering, Jonathan, and Christian Barry. 2012. "On the Concept of Climate Debt: Its Moral and Political Value." *Critical Review of International Social and Political Philosophy* 15 (5). Routledge:667–85. https://doi.org/10.1080/13698230.2012.727311.

Pisani-Ferry, Jean. 2023. "The Missing Macroeconomics of Climate Action." In *Greening Europe's Post-COVID-19 Recovery*, edited by Georg Zachmann, Guntram B. Wolff, and Simone Tagliapietra. Brussels, Belgium: Bruegel. https://www.bruegel.org/book/greening-europes-post-covid-19-recovery.

Pongratz, Julia, Clemens Schwingshackl, Selma Bultan, Wolfgang Obermeier, Felix Havermann, and Suqi Guo. 2021. "Land Use Effects on Climate: Current State, Recent Progress, and Emerging Topics." *Current Climate Change Reports* 7 (4):99–120. https://doi.org/10.1007/s40641-021-00178-y.

Reisinger, Andy, Mark Howden, Carolina Vera, Mathias Garschagen, Margot Hurlbert, Sylvia Kreibiehl, Katharine J. Mach, et al. 2020. *The Concept of Risk in the IPCC Sixth Assessment Report: A Summary of Cross-Working Group Discussions*. Geneva, Switzerland: Intergovernmental Panel on Climate Change. https://www.ipcc.ch/site/assets/uploads/2021/02/Risk-guidance-FINAL_15Feb2021.pdf.

Rodrik, Dani. 2011. *The Globalization Paradox: Why Global Markets, States, and Democracy Can't Coexist*. OUP Oxford.

Santoro, Maurizio, Oliver Cartus, Nuno Carvalhais, Danaë M. A. Rozendaal, Valerio Avitabile, Arnan Araza, Sytze de Bruin, et al. 2021. "The Global Forest Above-Ground Biomass Pool for 2010 Estimated from High-Resolution Satellite Observations." *Earth System Science Data* 13 (8). Copernicus GmbH:3927–50. https://doi.org/10.5194/essd-13-3927-2021.

Schuckmann, Karina von, Lijing Cheng, Matthew D. Palmer, James Hansen, Caterina Tassone, Valentin Aich, Susheel Adusumilli, et al. 2020. "Heat Stored in the Earth System: Where Does the Energy Go?" *Earth System Science Data* 12 (3). Copernicus GmbH:2013–41. https://doi.org/10.5194/essd-12-2013-2020.

See, Koh, Nasir Nayan, and Zullyadini Rahaman. 2017. "Flood Disaster Water Supply: A Review of Issues and Challenges in Malaysia." *International Journal of Academic Research in Business and Social Sciences* 7 (November). https://doi.org/10.6007/IJARBSS/v7-i10/3406.

Shafii, Nur Zahidah, Ahmad Shakir Mohd Saudi, Jyh Chyang Pang, Izuddin Fahmy Abu, Norzahir Sapawe, Mohd Khairul Amri Kamarudin, and Mohamad Haiqal Nizar Mohamad. 2023. "Association of Flood Risk Patterns with Waterborne Bacterial Diseases in Malaysia." *Water* 15 (11). Multidisciplinary Digital Publishing Institute:2121. https://doi.org/10.3390/w15112121.

Sharma, Bharat, Jitendra Kumar, Auroop R. Ganguly, and Forrest M. Hoffman. 2023. "Carbon Cycle Extremes Accelerate Weakening of the Land Carbon Sink in the Late 21st Century." *Biogeosciences* 20 (10). Copernicus GmbH:1829–41. https://doi.org/10.5194/bg-20-1829-2023.

Sprinz, Detlef F. 2023. "The Challenge of Long-Term Environmental Policy." In *Routledge Handbook of Environmental Policy*, by Helge Jörgens, Christoph Knill, and Yves Steinebach, 1st ed., 305–14. London: Routledge. https://doi.org/10.4324/9781003043843-26.

Tan, Boon Teck, Pei Shan Fam, R. B. Radin Firdaus, Mou Leong Tan, and Mahinda Senevi Gunaratne. 2021. “Impact of Climate Change on Rice Yield in Malaysia: A Panel Data Analysis.” *Agriculture* 11 (6). Multidisciplinary Digital Publishing Institute:569. https://doi.org/10.3390/agriculture11060569.

Tan, Mou Leong, Liew Juneng, Fredolin T. Tangang, Jing Xiang Chung, and R. B. Radin Firdaus. 2021. “Changes in Temperature Extremes and Their Relationship with ENSO in Malaysia from 1985 to 2018.” *International Journal of Climatology* 41 (S1):E2564–80. https://doi.org/10.1002/joc.6864.

Trenberth, Kevin E. 2020. “Understanding Climate Change through Earth’s Energy Flows.” *Journal of the Royal Society of New Zealand* 50 (2). Taylor & Francis:331–47. https://doi.org/10.1080/03036758.2020.1741404.

Vaghefi, N., M. Nasir Shamsudin, A. Makmom, and M. Bagheri. 2010. “The Economic Impacts of Climate Change on the Rice Production in Malaysia.” *International Journal of Agricultural Research* 6 (1):67–74. https://doi.org/10.3923/ijar.2011.67.74.

Vigna, Leandro, and Johannes Friedrich. 2023. “9 Charts Explain Per Capita Greenhouse Gas Emissions by Country.” *World Resources Institute* (blog). May 8, 2023. https://www.wri.org/insights/charts-explain-per-capita-greenhouse-gas-emissions.

Wang, Yawen, Shi Zhao, Yuchen Wei, Kehang Li, Xiaoting Jiang, Conglu Li, Chao Ren, et al. 2023. “Impact of Climate Change on Dengue Fever Epidemics in South and Southeast Asian Settings: A Modelling Study.” *Infectious Disease Modelling* 8 (3):645–55. https://doi.org/10.1016/j.idm.2023.05.008.

2023. “Indonesia Country Climate and Development Report.” Washington, D.C.: World Bank Group. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099042823064019635/P177245025ebd20a40ad3f0d89409039679.

———. n.d. “World Development Indicators.” World Bank. https://databank.worldbank.org/reports.aspx?source=world-development-indicators.

World Ocean Review. 2024. “Forests, Grasslands and Soils as Carbon Stores « World Ocean Review,” 2024. https://worldoceanreview.com/en/wor-8/harnessing-the-untapped-potential-of-terrestrial-ecosystems/forests-grasslands-and-soils-as-carbon-stores/.

Wouters, Hendrik, Koen De Ridder, Lien Poelmans, Patrick Willems, Johan Brouwers, Parisa Hosseinzadehtalaei, Hossein Tabari, Sam Vanden Broucke, Nicole P. M. van Lipzig, and Matthias Demuzere. 2017. “Heat Stress Increase under Climate Change Twice as Large in Cities as in Rural Areas: A Study for a Densely Populated Midlatitude Maritime Region.” *Geophysical Research Letters* 44 (17):8997–9007. https://doi.org/10.1002/2017GL074889.

Wu, Ran, Tao Ma, and Enno Schröder. 2022. “The Contribution of Trade to Production-Based Carbon Dioxide Emissions.” *Structural Change and Economic Dynamics* 60 (March):391–406. https://doi.org/10.1016/j.strueco.2021.12.005.

Yavarian, Jila, Nazanin Zahra Shafiei-Jandaghi, and Talat Mokhtari-Azad. 2019. “Possible Viral Infections in Flood Disasters: A Review Considering 2019 Spring Floods in Iran.” *Iranian Journal of Microbiology* 11 (2):85.

CHAPTER

04

CHAPTER 4

ADVANCING CLIMATE ADAPTATION IN MALAYSIA

The era of global warming has ended; the era of global boiling has arrived. Leaders must lead. No more hesitancy. No more excuses. No more waiting for others to move first. There is simply no more time for that. It is still possible to limit global temperature rise to 1.5 degrees Celsius and avoid the very worst of climate change. But only with dramatic, immediate climate action.

António Guterres, 27 July 2023

4.1 Introduction

When António Guterres, the Secretary General of United Nations, proclaimed that we are now entering the era of global boiling, the world witnessed the hottest July ever recorded in 2023[232]. The World Meteorological Organisation (WMO) has also reported that there is a high probability that average global temperatures will exceed 1.5°C above pre-industrial levels temporarily until 2028[233].

As the world grapples with record breaking temperatures and escalating impacts of climate change, Malaysia has begun experiencing unprecedented extreme events like the Peninsula flood in December 2021, debris flows and extended droughts. Despite contributing less than 1% to global greenhouse gas emissions, Malaysia has primarily pursued emissions reduction and a net zero goal.

The nation has witnessed the devastating aftermath of extreme climate events in recent times. Historical evidence and climate projections indicate that responding to water-related extreme events, especially flood mitigation and intervention for sea level rise, plays an important role in shaping the long-term planning and implementation of adaptation in Malaysia. These incidents act as critical reminders that adaptation must be prioritised in Malaysia's climate strategies to protect its people and economy. Advancing adaptation as a key climate action to achieve resilience would facilitate the shift to a balanced climate policy framework[234].

This chapter delves into the necessity of adaptation within Malaysia's climate policy, analysing current adaptation responses to manage flood and sea level rise, discussing the gaps in the adaptation measures, and recommends a way forward to ensure that Malaysia not only reduces its emissions but also makes adaptation a priority.

4.2 The Neglect of Adaptation in Global Climate Discussions

The discussion on climate change, rooted in the understanding that human activities contribute to global warming, has historically prioritised mitigation over adaptation in the global policy framework. The focus on emission reduction targets leads to the neglect or "bias against adaptation"[235]. While reducing emissions is essential, it has been pursued at the expense of building resilience, especially in developing countries and vulnerable regions that are most at risk. The

[232] United Nations (2023)
[233] World Meteorological Organisation (WMO) (2024)
[234] Pereira, Mohd Khairul Zain, and Rajib Shaw (2022)
[235] Pielke (1998); (2005); Dryzek, Norgaard, and Schlosberg (2013)

imbalance leaves developing countries ill-prepared to face the increasing frequency of extreme climate events and long-term risks.

The IPCC Sixth Assessment Report unequivocally links human activities to climate change, sounding the alarm that the global average surface temperature has already increased by 1.19°C compared to pre-industrial levels. Changes to the earth's natural cycles have led to widespread extreme climate events and disproportionately impact vulnerable communities in developing countries. The growing severity of climate impacts and irreversible damages highlight the urgency for comprehensive adaptation strategies. However, the bias against adaptation has resulted in insufficient support for developing countries and neglects the concurrent need for robust adaptation strategies along with mitigation[236].

It also highlights the broader issue of inequity in global climate governance. Those least responsible for emissions bear the brunt of climate impacts, stressing the imbalance in the current global climate policy to address the needs of vulnerable developing countries and marginalised groups[237]. Without immediate and comprehensive adaptation measures, developing countries will face irreversible losses that mitigation efforts alone cannot prevent.

Prioritising adaptation ensures that future strategies not only aim to reduce emissions but also build resilience to inevitable climate impacts. Adaptation must become a central focus of global climate discussions, not merely an afterthought. Given this context, understanding how adaptation is positioned in the global climate policy framework is essential to developing more balanced strategies that reduce emissions and adapt to the impacts of climate change.

4.2.1. Adaptation within the climate policy framework

Adaptation is an iterative process of adjustment to current or expected climate change impacts as illustrated in Figure 4.1[238]. Unlike mitigation, adaptation essentially comprises context specific, local issues that respond to evolving risks at regional and global scales[239]. The Paris Agreement plays an important role in formalising adaptation within international law, marking a shift in global policy from the mitigation-centric Kyoto Protocol. Articles 6, 7, 8 and 11 of the Paris Agreement emphasize the need to enhance adaptive capacity, strengthen resilience and reduce vulnerability to climate change. This framing of adaptation as a dynamic, context-specific process signals a more holistic climate strategy.

As negotiations evolve over the years, the international community has gradually increased its focus on adaptation with notable achievements illustrated in Figure 4.2. The elements relating to adaptation in the Paris Agreement are compiled and illustrated in Figure 4.3. However, this acknowledgment has not been matched by sufficient financial commitments or coordinated actions. Without stronger mechanisms, adaptation risks becoming a secondary consideration in national climate agendas, despite its status in international agreements.

One of the unique challenges of adaptation within the global policy framework is that it does not have a specific, universally agreed-upon target like mitigation. This presents a challenge for global policy, where the absence of clear adaptation goals leads to inconsistent funding and political prioritisation.

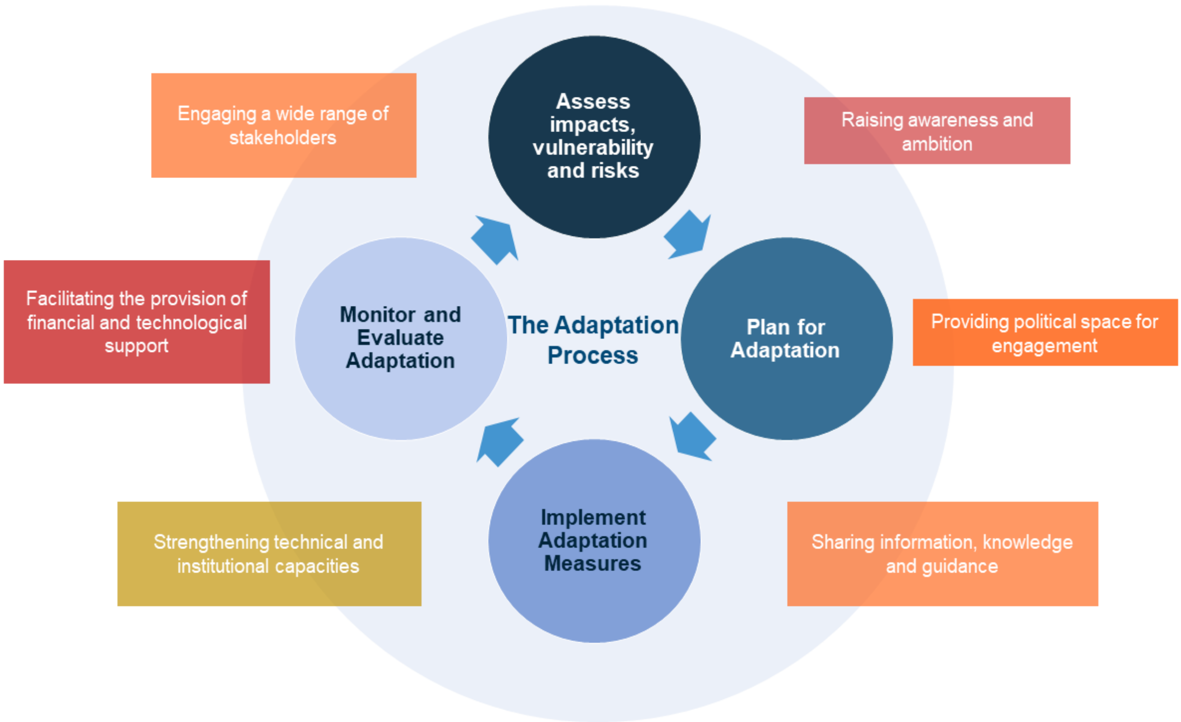
[236] Araos et al. (2021)
[237] IPCC (2022)
[238] Ibid.
[239] Dovers and Hezri (2010), Dryzek, Norgaard, and Schlosberg (2013)

The iterative nature of adaptation also highlights the need for continuous support, which many vulnerable countries lack.

The Paris Agreement introduces a loosely defined global goal to drive political action and finance, emphasising that adaptation must be country-driven, gender-responsive and participatory. This flexibility enables each country to develop strategies tailored to its unique vulnerabilities and capacities. However, it also results in uneven implementation and varying degrees of prioritisation across nations.

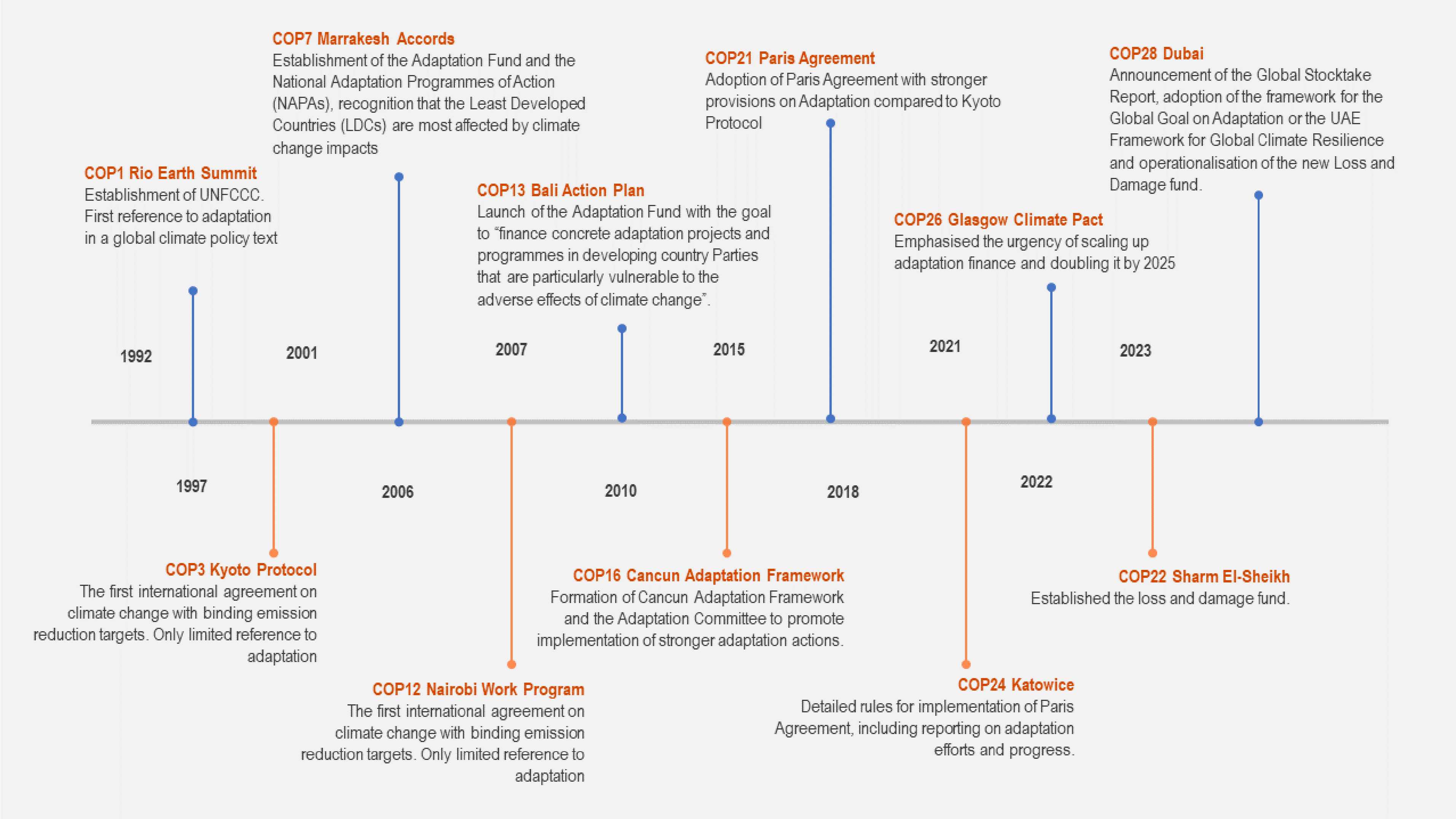
The Warsaw International Mechanism for Loss and Damage, established under the Paris Agreement, recognises that with future warming climate impacts may exceed the limits of adaptation and lead to irreversible losses. This mechanism was designed to support vulnerable countries in managing the consequences of climate impacts that cannot be mitigated or adapted to. However, just like adaptation, loss and damage remain under-supported, leaving many developing countries without the resources necessary to build resilience to inevitable climate disruptions.

Figure 4.1: The Adaptation Process



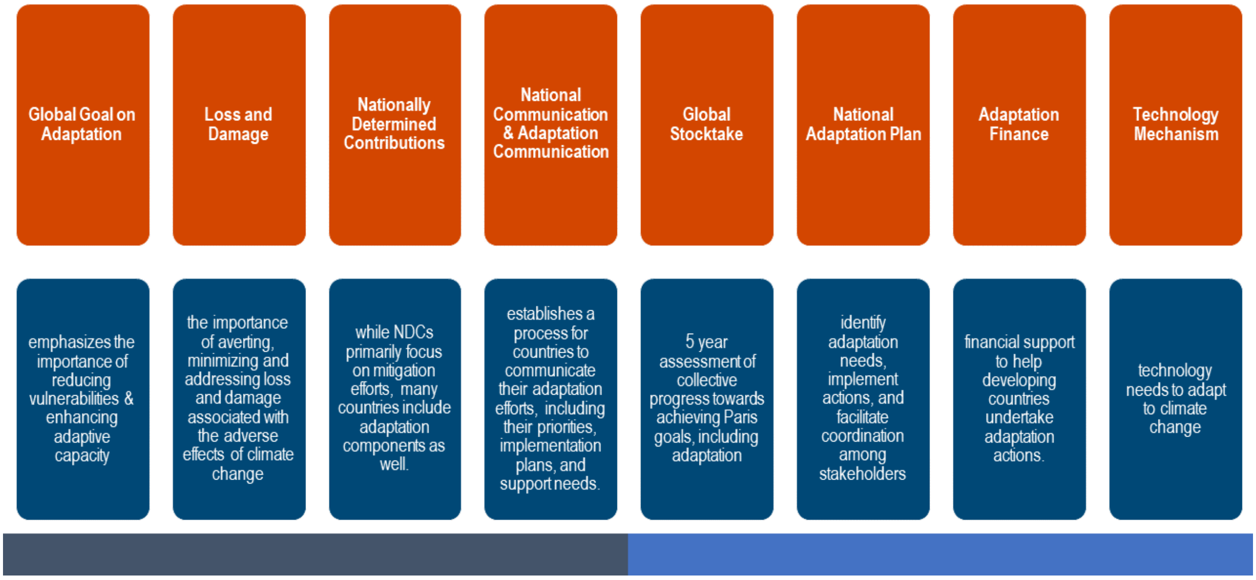
Source: UNFCCC (2020)

Figure 4.2: Adaptation milestone in climate negotiations, 1992-2023



Source: Author's compilation based on UNFCCC and the Paris Agreement

Figure 4.3: Adaptation elements in the Paris Agreement



Source: Author's compilation based on the Paris Agreement

4.2.2. Addressing Gaps in Planning & Financing for Adaptation

Climate change is a challenge that requires decision makers to anticipate future risks, respond to varying impacts that occur at different time scales and address how it exacerbates existing socio-economic vulnerabilities. While climate change affects all countries, the level of economic development, institutional capacity and non-climatic factors further influence vulnerabilities and adaptive capacities, making adaptation planning inherently complex.

The climate policy framework emphasises effective planning and financing as critical components for adaptation mainstreaming. Through the Cancun Adaptation Framework, the UNFCCC established a mechanism to assist developing countries to develop National Adaptation Plans (NAP). The NAPs are designed to address long-term climate risks and provide a roadmap for countries to mainstream adaptation into national policy, economic planning and social programs. However, adopting the NAP process is not without challenges and requires significant financing[240].

At present, 85% of countries have successfully integrated adaptation into their national level policies but with uneven progress[241]. Not enough priority is being given to reducing long term climate risks. Most adaptation measures in the NAPS are fragmented, small scale, incremental, sector-specific and too focused on planning rather than implementation[242]. To date, only 54 countries have submitted their NAPs, largely due to challenges in securing financing and accessing financial facilities[243].

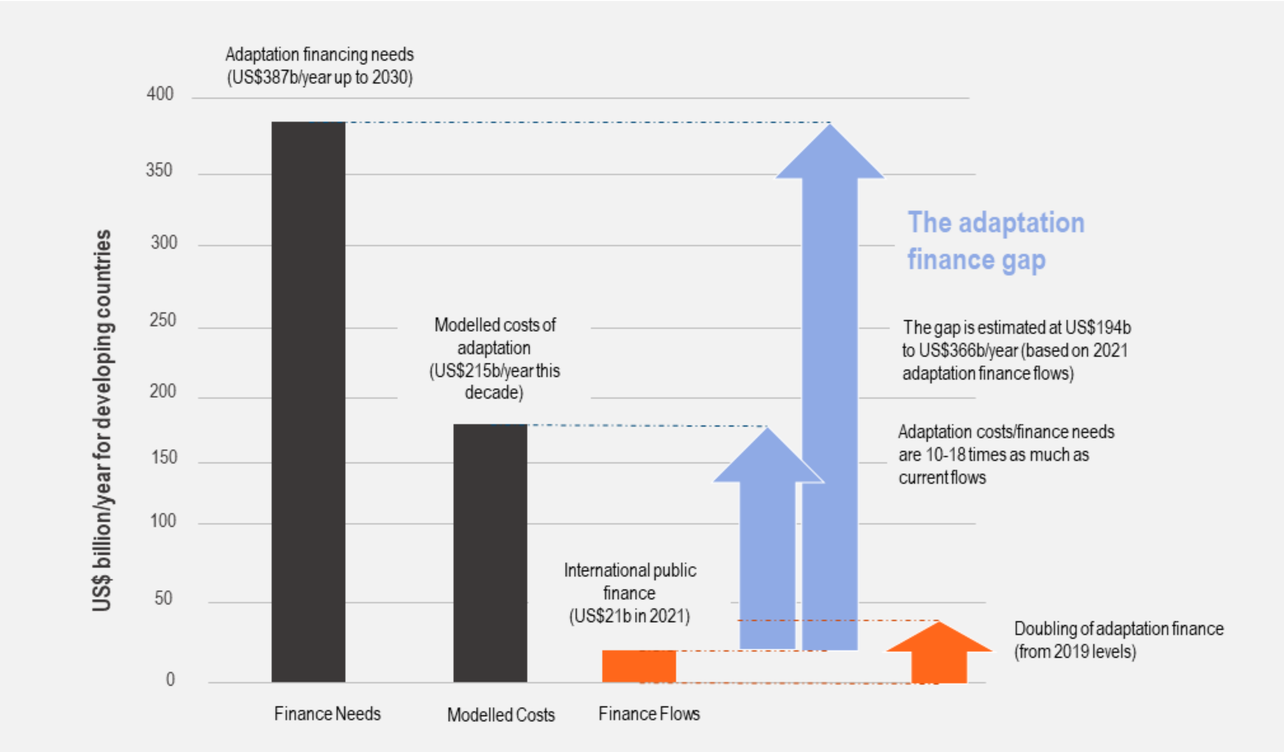
Financing adaptation is crucial for making progress on the plans. The development and implementation of NAPs require substantial financial investment at every phase. While some countries rely on domestic sources, many depend on bilateral or multilateral partnerships and international financial mechanisms like the Green Climate Fund (GCF), Least Developed Countries

[240] NAP Global Network (2017)
[241] United Nations Environment Programme (2023); IPCC (2022)
[242] UNFCCC (2023)
[243] UNFCCC (2023); NAP Central (2024)

Fund (LDCF) and Special Climate Change Fund (SCCF). However, despite these mechanisms, financing remains inadequate and countries often face significant obstacles in accessing these funds.

Financing for adaptation has lagged behind mitigation, leading to a persistent finance gap as illustrated in Figure 4.4. Developing countries require between $194 billion and $366 billion annually to meet adaptation needs, yet even doubling current funding levels would still leave an estimated gap of $387 billion per year by 2030[244]. This shortfall affects developing countries' ability to plan and implement effective adaptation measures. The global financial support for adaptation is not only insufficient but also unevenly distributed, with much of the focus on Africa while Asia, the most populous and climate-vulnerable continent, remains underfunded.

Figure 4.4: The Adaptation Finance Gap



Source: UNEP (2023)

Prioritising adaptation is vital in Asia as the impacts of climate change are increasingly severe. In 2023 alone, 80% of the recorded 79 disasters were related to flood and storm events, with over 2,000 fatalities[245]. Despite these alarming statistics, Asia remains underrepresented in adaptation financing, with only a third of the $113 billion in climate finance between 2013 and 2020 allocated to adaptation efforts[246]. However, most NAP development programmes are focused in Africa, leaving Asia underrepresented. So far, only a handful of countries from Asia have submitted their NAPs[247]. This highlights the difficulties to accelerate adaptation planning in Southeast Asia, including Malaysia. The progress of adaptation in ASEAN members is compiled in Table 4.1:

[244] United Nations Environment Programme (2023)
[245] World Meteorological Organisation (WMO) (2024)
[246] Roy (2022)
[247] Matsuo et al. (2023)

Table 4.1: Key features and other information on adaptation in the 10 members of ASEAN

Country	Key Features of NAPs	Regional Collaboration and Support	Key Challenges and Gaps	NAP Submission
Brunei	Focus on community-based approaches and protecting biodiversity.	Participates in regional knowledge-sharing platforms and workshops.	Needs more robust funding mechanisms and community engagement.	No
Cambodia	Emphasis on agriculture, water resources adaptation and community involvement.	Gains from experiences shared by other ASEAN members.	Lacks comprehensive monitoring and evaluation systems.	Yes Cambodia NAP
Indonesia	Targets coastal and marine adaptation, integrates local knowledge systems.	Contributes to and benefits from ASEANadapt and other initiatives.	Faces challenges in scaling up successful local adaptations.	No National Action Plan for Climate Change Adaptation National Adaptation Plan Adaptation Communication
Laos	Prioritizes forestry and agricultural sectors, includes local communities in planning.	Benefits from regional platforms for adaptation knowledge exchange.	Requires improved access to climate finance and technical support.	No NAPA
Malaysia	Comprehensive NAP focusing on urban, energy and water sectors.	Leads in some regional climate finance strategies.	Needs to enhance sub-national engagement and coordination.	No
Myanmar	Focuses on agriculture and rural development, includes traditional knowledge.	Limited due to political challenges but engages when possible.	Needs significant external support and capacity building.	No NAPA
Philippines	Emphasizes community-based disaster risk reduction and management strategies.	Actively shares lessons and strategies across ASEAN.	Struggles with integrating adaptation into local development plans.	No Adaptation Priorities National Climate Change Action Plan
Singapore	Advanced urban adaptation strategies, focuses on technology and innovation.	Provides technical expertise and support for regional projects.	Challenges with long-term sustainability of adaptation measures.	No Adaptation Efforts
Thailand	Integrates health, tourism and agricultural sectors into its adaptation strategies.	Plays a crucial role in regional adaptation planning and funding.	Needs more focused efforts on vulnerable coastal regions.	Yes NAP
Vietnam	Prioritizes delta and coastal zone adaptations, involves extensive community participation.	Significant contributor to knowledge sharing in the region.	Requires enhanced climate science integration into planning.	No Report of the NAP

Source: Author's compilation based on NAP Central, UNFCCC

Scaling up adaptation would contribute to a more balanced climate effort. Addressing the adaptation finance gap requires a global cooperative effort to mobilise funds from international, domestic and private sources, while at the same time exploring innovative funding mechanisms. Furthermore, financing the efforts to enhance governance, facilitate knowledge sharing, encourage technology transfer and capacity building are also essential to support adaptation measures at the local and regional levels.

While global climate discussions have increasingly recognised the importance of adaptation, translating these principles into national policy and actions remains a significant challenge. For countries like Malaysia, the global adaptation framework provides a valuable reference, but implementing context-specific strategies is crucial to address the unique climate risks it faces. The following section, 4.3, will explore Malaysia's current adaptation efforts, examining how global insights are being adapted to the country's specific vulnerabilities and socio-economic conditions.

4.3 The State of Climate Adaptation in Malaysia

Participation in multilateral environmental agreements has driven the development and formulation of climate policy in Malaysia. Malaysia has been actively participating in climate negotiations since the United Nations Conference on Environment and Development (UNCED) or Rio Earth Summit in 1992. As a result, the National Policy on Climate Change 2009 (NPCC 2009) was put in place, followed by integration with the country's development plan to achieve climate resilient development in the 10th Malaysia Plan (2011-2015)[248].

The policy direction for integrated and balanced adaptation and mitigation measures is consistent with Malaysia's position as a developing country[249]. However, there is a growing concern amongst experts that the national strategy is too heavily focused on mitigation efforts leaving adaptation fragmented across multiple ministries[250]. This has led to a lack of coherence, coordination and local participation in adaptation efforts. The top-down approach limits the engagement of state and local governments, communities and the private sector, resulting in adaptation strategies that do not fully address local vulnerabilities or long-term climate risks.

Moreover, the focus on managing short-term, high-cost disasters like floods has overshadowed the need for proactive planning to address slow-onset events, such as rising sea levels and temperature increases, which pose long-term socio-economic risks. The absence of integrated governance, financing mechanisms and localised adaptation strategies exacerbates Malaysia's vulnerability, threatening infrastructure, livelihoods and overall resilience to climate change.

4.3.1. Climate Vulnerability Background

Malaysia is blessed with abundant rainfall, averaging between 2,000mm to 4,000mm annually. Its land area covers over more than 330,000km^2, Malaysia has 189 major river basins with extensive coastline stretching over 8,840km^2 and 879 islands. Its climate is influenced by the northeast and southwest monsoons. Both geography and equatorial climate have great influence in shaping how

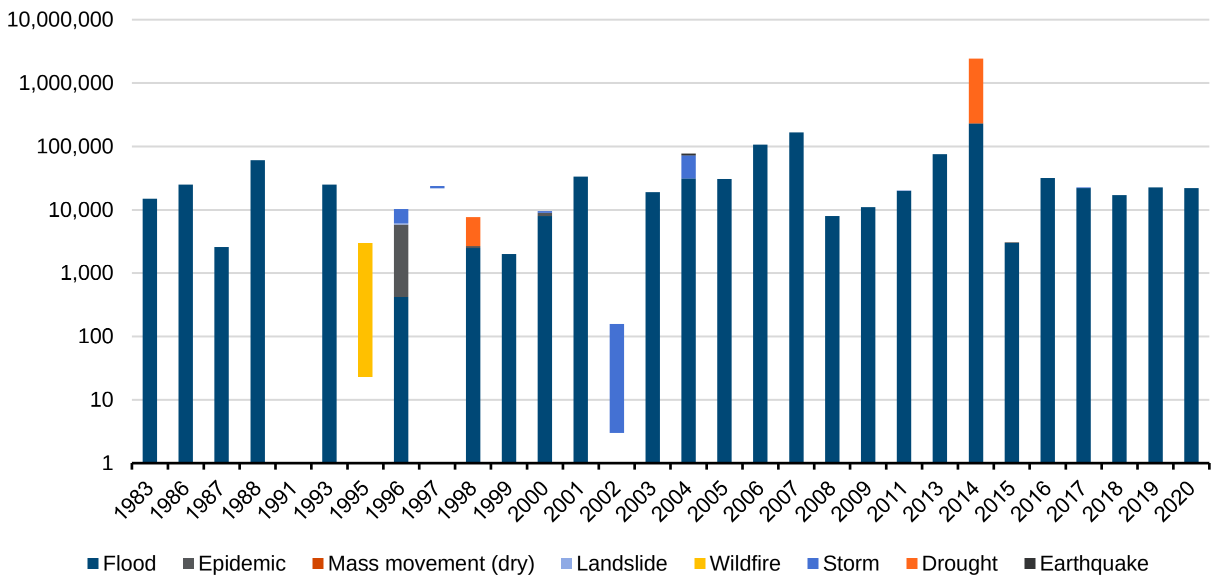
[248] Adnan A. Hezri and Mohd. Nordin Hasan (2006); Adnan A. Hezri (2016); Ministry of Natural Resources and Environment (2009); Economic Planning Unit (2010)
[249] Sands (1992)
[250] Pereira, Mohd Khairul Zain, and Rajib Shaw (2022)

the country is experiencing climate change and manages its impacts. With climate change, Malaysia could experience temperature increases of between 1.7°C to 2.1°C and corresponding rainfall increases of between 14.8% to 25.4% by the end of the century[251].

Malaysia's geography, land-use pattern and climate profile make it particularly prone to flooding. According to the Fourth National Communication (NC4) on climate change, 144 of its 189 major river basins are flood-prone. Climate change would affect up to 18.2% more areas in the Peninsula [252]. Meanwhile, Sabah and Sarawak are projected to experience an increase of 5.2% and 3.5%, respectively. At the same time, the northern west coast of Peninsular Malaysia will experience longer dry spells with rainfall decreasing up to 1,200 mm by mid-century. The rising sea level would continue to threaten more coastal zones, inundating areas up to 6,144km^2 and 9,295km^2 by middle and end of the century. This would impact the coasts of Sabah, Selangor and Sarawak, with more coastal flooding projected to impact the west coast of Peninsular[253].

Based on these projections, climate change has varying and localised impacts which require different interventions and strategies in Malaysia. The exposure to flood and tropical cyclones places Malaysia in the top third of countries at risk[254] and ranks lower on the scale of vulnerability and readiness[255]. This would drive other cascading impacts, poses serious risks to the environment, economy, society and exacerbates existing challenges in the country. Shifting the perspective from managing impacts and vulnerabilities to reducing risks requires a policy framework that is robust and adaptive.

Figure 4.5: Total number of people affected by natural hazards, 1980 – 2020



Source: adapted from World Bank (2021)

The impacts of climate change in Malaysia are experienced through water-related disasters, particularly floods as shown in Figure 4.5. Floods have consistently affected a significant number of people between 1980 and 2020, making it the most prevalent climate impact in Malaysia.

[251] Ministry of Natural Resources and Environmental Sustainability (2024)
[252] Ministry of Natural Resources and Environmental Sustainability (2024)
[253] Ibid.
[254] European Union Disaster Risk Management Centre (2021)
[255] Notre Dame Global Adaptation Initiative (2024)

Consequently, adaptation responses are focused on managing floods[256]. It is estimated that the annual damage from floods alone exceeds RM1 billion a year[257]. Other impacts like droughts, storms and landslides also present risks to the population, though to a lesser extent compared to floods. The figure highlights the need for a more comprehensive and proactive strategy, especially as the frequency and severity of these disasters increase due to climate change.

There is progress in policy integration between adaptation and sectoral policies, particularly in managing water-related impacts[258]. This is based on causality which allows the policy to address direct impacts on water as well as other sectors like food security, coastal management, forests, public health and the build environment[259]. Long-term proactive planning and implementation like the Storm Water Management and Road Tunnel (SMART) has proven to be effective albeit costly[260].

Effective disaster management is also crucial in responding to immediate extreme climate events[261]. Past disasters have also contributed to institutionalisation of the Special Malaysian Disaster Assistance and Rescue Team (SMART) in 1994 and the National Disaster Management Agency (NADMA) in 2014. This move reflects Malaysia's commitment in addressing the multifaceted challenges posed by disasters and increasing resilience.

Governance includes both high-level policy-making and detailed institutional arrangements, ensuring a comprehensive approach to climate resilience. The Cabinet of Malaysia, as the highest policy decision-making body on climate change, ensures that climate policies receive the necessary support for effective implementation. Currently, the policy operates under the purview of the Minister of Natural Resources and Environmental Sustainability (NRES) whilst the Ministry of Economy coordinates development planning and implementation, incorporating climate change programs into the national five-year development plans.

The establishment of the Climate Change Action Council (MyCAC) chaired by the Prime Minister in December 2020, provides strategic direction and institutional arrangement on climate change policies. This is further strengthened by the National Steering Committee on Climate Change (NSCCC) in guiding operational matters relating to the overall governance of climate change.

As a response to the increasing number of and recurring extreme climate events, the allocation for climate resilience and adaptation measures has exponentially increased with every Malaysia Plan. In the Eleventh Malaysia plan, RM7.24 billion was allocated for flood mitigation alone and the amount has increased tremendously to RM22 billion until 2030[262]. Adaptation to physical climate risks has also been integrated into financial assessments in the Climate Change and Principle Based Taxonomy by Bank Negara Malaysia that was launched on 30 April 2021[263].

The top-down approach however is not robust and has remained predominantly reactive as immediate disaster management responses[264]. The absence of a long-term adaptation plan leaves

[256] Chan (1997); (2012); Pereira, Mohd Khairul Zain, and Rajib Shaw (2022); Adnan A. Hezri (2016)
[257] Department of Irrigation and Drainage (2019)
[258] Ministry of Environment and Water, Economic Planning Unit, and Akademi Sains Malaysia (2020); Pereira, Mohd Khairul Zain, and Rajib Shaw (2022); Alizan Mahadi and Darshan Joshi (2023)
[259] Ministry of Environment and Water, Economic Planning Unit, and Akademi Sains Malaysia (2020)
[260] Adnan A. Hezri (2016)
[261] Ministry of Environment and Water, Economic Planning Unit, and Akademi Sains Malaysia (2020)
[262] Ministry of Natural Resources and Environment (2018); Ministry of Natural Resources, Environment and Climate Change (2022)
[263] Bank Negara Malaysia (2021)
[264] Chan (2012)

implementation to be carried out in silo and limited to sectoral responses. Institutional arrangements are not inclusive to states and local authorities, making planning, financing and implementing adaptation in Malaysia challenging.

Although a significant amount of the budget is dedicated to flood management, it remains unclear if this allocation is enough to fully address the risks. Furthermore, with future warming, there is uncertainty concerning the sufficiency of current adaptation measures to manage worsening impacts. The rising frequency and severity of floods point to immediate risks to life and property while also revealing the wider challenges that the nation must address in terms of adaptation and resilience. These concerns are central to Malaysia's flood management strategy which is elaborated upon in the following section.

4.3.2. Living with Floods

Malaysia's history with floods stretches back to as early as 1886, with one of the most devastating events being the 1926 Red Flood, or "Bah Merah". It has prompted the British Government to integrate disaster response with flood management to reduce loss to Malaya's economy[265]. The Klang Valley and Kuala Lumpur in particular experienced the devastating impact of the 1971 flood with over 180,000 people affected and 37 deaths. A snapshot of major floods in Malaysia from 1971 to 2021 is depicted in Table 4.2.

Flood management is a comprehensive mitigation, preparedness and adaptation approach, aimed at addressing the risks of flooding. It combines structural solutions, like dams and drainage systems and non-structural measures, such as better land-use planning and mapping of flood risks. Flood mitigation focuses on measures to reduce the direct impact and severity of floods through physical infrastructure, such as drainage systems and flood barriers.

Since 2010, Malaysia's flood management has integrated climate change factors into the infrastructure design phase. This is to prepare for more intense flooding and increased risks of extreme weather. For example, infrastructure protection level now considers a 200-year Annual Recurrence Interval (ARI) instead of the traditional 100-year ARI. Flood Management Master Plans are also developed to manage different risks for flood-prone areas.

The non-structural approach includes Integrated River Basin Management (IRBM) Plans to address water balance and land use for flood forecasting. Stormwater management in urban and suburban areas benefit from the Drainage Master Plans, which are built on the principle of "control-at-source". Meanwhile, Flood Forecasting and Warning Systems (FFWS) are used to prepare for monsoon floods, employing risk-based forecasting and impact-based warnings, though these are seen as short-term measures rather than long-term solutions for climate adaptation.

On average, Malaysia experiences 144 flood events annually[266]. This affects more than 33,000km^2 or 10.1% of its land area and puts 5.7 million population at risk. With climate change, floods not only become more extreme and frequent, but impact areas that have never flooded before. Over 5,400 high flood-risk hotspots have already been identified throughout the country[267]. Together with

[265] Chan (1997); (2012)
[266] Haziq Sarhan Rosmadi et al. (2023)
[267] Ministry of Natural Resources and Environmental Sustainability (2024) p.122–126

extreme and unusual weather, unprecedented events like the December 2021 Flood in Peninsular Malaysia would recur in the future thus prompting the urgency for improved flood management.

Table 4.2: Major floods in Malaysia, 1971-2021

Date	Location	Estimated Loss and Damages
Jan 1971	Kuala Lumpur	Fatalities: 32 people; People Displaced: 180,000
Dec 1996	Sabah	Fatalities: 238; People displaced: 39,687
Dec 2006 – Jan 2007	Johor, Malacca, Pahang and Negeri Sembilan	Fatalities: 17; People Displaced: 109,260 Loss and damage: RM 1.5b
2008	Johor	Fatalities: 28; Loss and Damage: RM 65 mil
Nov 2010	Kedah and Perlis	Fatalities: 4; People Displaced: 50,000 Loss and Damage: 45,000 hectors of rice plantations, Gov pledged RM 26 mil in aid
Dec 2014 – Jan 2015	Kelantan, Terengganu, Pahang, Perak and Perlis	Fatalities: 21; People Displaced: 400,000 Loss and Damage: RM 2.9b
2015	496 total flood cases countrywide	People Affected: 46,000; Loss and Damage: RM 30 mil
2016	404 total flood cases countrywide	Fatalities: 5; People Displaced: 95,000 Loss and Damage: RM 53 mil
2017	1239 total flood cases countrywide	People Affected: 68,000; Loss and Damage: RM 63 mil
2018	844 total flood cases countrywide	Fatalities: 2; People Displaced: 12,000 Loss and Damage: RM 44 mil
2019	535 total flood cases countrywide	Fatalities: 2; People Displaced: 49,000 Loss and Damage: RM 26 mil
2020	869 total flood cases countrywide	Peoples Displaced: 14,000 all over Malaysia
2021	1057 total flood cases countrywide	Fatalities: 10 (Johor), 6 (Kedah), 3 (Sabah), 25 (Selangor), 21 (Pahang) and 4 (Kelantan) Peoples Affected: 160,000 all over Malaysia
2022	▪ Kedah on 4 July; ▪ 81 flood incidents reported during flood in Johor, Kelantan, Pahang, Perak and Terengganu on 19 December; ▪ Kelantan and Terengganu on 25 December;	Fatalities: 4; Peoples Displaced: 500,000
2023	▪ Flood in Johor, Pahang, & Sabah in January ▪ Flood in Johor, Pahang, Melaka, Negeri Sembilan, Sarawak & Sabah Terengganu in March.	Peoples Displaced: 35,000; Loss and Damage: RM800 million countrywide

Source: OCHA Regional Office for Asia Pacific (2007); Syed Azhar (2014); Haziq Sarhan Rosmadi et al. (2023) and DOS (2024)

Flooding is by far the biggest source of climate change damage across many sectors in Malaysia[268]. Increased frequency of extreme floods like the 1-in-100-year Johor flood in 2006, the 1-in-1000-year

[268] World Bank and Bank Negara Malaysia (BNM) (2024)

Kelantan 'Bah Kuning' flood in 2014 and the December 2021 Peninsula flood could push Malaysia beyond its adaptation limits[269]. Without adaptation, flood-related losses could reach up to 4.1% of GDP in 2030. Flood management with effective adaptation would reduce the economic impact to 2.3% of GDP[270].

Reducing the damages has made flood mitigation central for building climate resilience in each development plan[271]. However, the current approach of relying on hard infrastructure to mitigate floods is costly as shown in Figure 4.6 and Figure 4.7. Cumulative spending on flood infrastructure from 1966 until 2015 amounts to USD7.12 billion. The amount committed until 2030 is estimated about 0.8% of Malaysia's GDP[272]. But this is only a fraction of the estimated RM392 billion required by the end of the century that is needed to build protective infrastructure[273]. The sheer amount needed raises the concern about long-term sustainability of current flood management strategies.

Figure 4.6: Budget allocation in USD million from 1966 until 2015

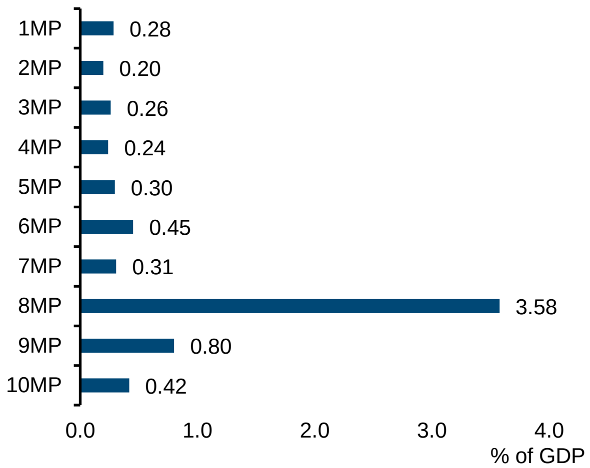
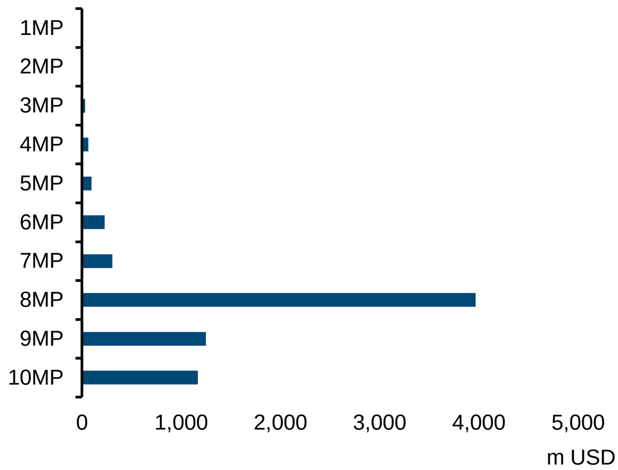


Figure 4.7: The percentage of GDP spending for flood from the 1st to the 10th Malaysia Plan



Source: adapted from Chan (2012)

While current strategies focus on hard infrastructure, they have raised concerns about their long-term effectiveness. Sustaining these measures in the face of ongoing climate change may lead to maladaptation, where solutions temporarily address immediate needs but fail to account for future, more severe risks. Further global warming will also rapidly transform Malaysia's flood risk landscape. Greater uncertainties highlight the importance of integrating climate projections into current flood risk models and policy frameworks. This means flood management has to adopt long-term measures that consider uncertainty of future climate conditions.

Moreover, vulnerabilities to floods are not equally distributed across the country. They are multidimensional and disproportionately impact low-income households, rural populations and indigenous groups. Hence shifting flood management to be more effective requires adopting a more inclusive and participatory approach. A comprehensive flood management framework should

[269] Lee (2007) and Davies (2015)
[270] World Bank and Bank Negara Malaysia (BNM) (2024)
[271] Chan (2012)
[272] Ministry of Finance (2023)
[273] Malaysiakini (2022)

consider the intersectionality of flood risk and social vulnerability, promote inclusivity, equitable action and climate justice.

Long-term flood management should adopt an integrated approach, combining river basin management, land use planning, nature-based solution and socio-economic considerations. An example of a successful programme is the Delta Programme in the Netherlands which successfully balances hard infrastructure with ecosystem-based solutions[274]. The shift from a reactive, hard infrastructure focus to integrated long-term flood management needs to address the following gaps:

i) **expanding adoption of climate change adaptation:** flood management strategies must integrate climate adaptation into all phases—planning, implementation and monitoring—to address both short- and long-term risks effectively[275];

ii) **improving communication to enhance public awareness:** public awareness of flood events and its socio-economic impacts remains insufficient. Better communication is needed between policy makers and the public is essential to foster engagement for resilience. These campaigns should focus not only on immediate flood risks but also on long-term adaptation strategies[276];

iii) **integration of river basin and land use management:** addressing long term flood risks through integration of river basin management with land use, urban planning and economic development. This ensures that development considers the risks of flood in vulnerable areas;

iv) **addressing rural development and flood risks:** rural development, including the conversion of forests to agricultural land, has increased flood risks[277]. Flood risks must be integrated into rural development planning to reduce vulnerabilities in rural areas;

v) **adopting nature-based solutions to reduce maladaptation:** The focus for infrastructure construction of levees and flood walls, while effective in the short-term, has led to maladaptation[278]. Adoption of nature-based solutions, such as restoring wetlands and floodplains, should be prioritized to reduce flood risks sustainably. These solutions offer long-term protection against floods while providing ecological benefits, such as biodiversity conservation and carbon sequestration;

vi) **improving data utilisation:** Available flood-related information is limited in scope and not widely used, leading to lack of investment from the private sector. Improving the collection and use of socio-economic data related to floods is essential for effective risk assessment and adaptation planning. This data can drive better investment from the private sector and improve decision-making;

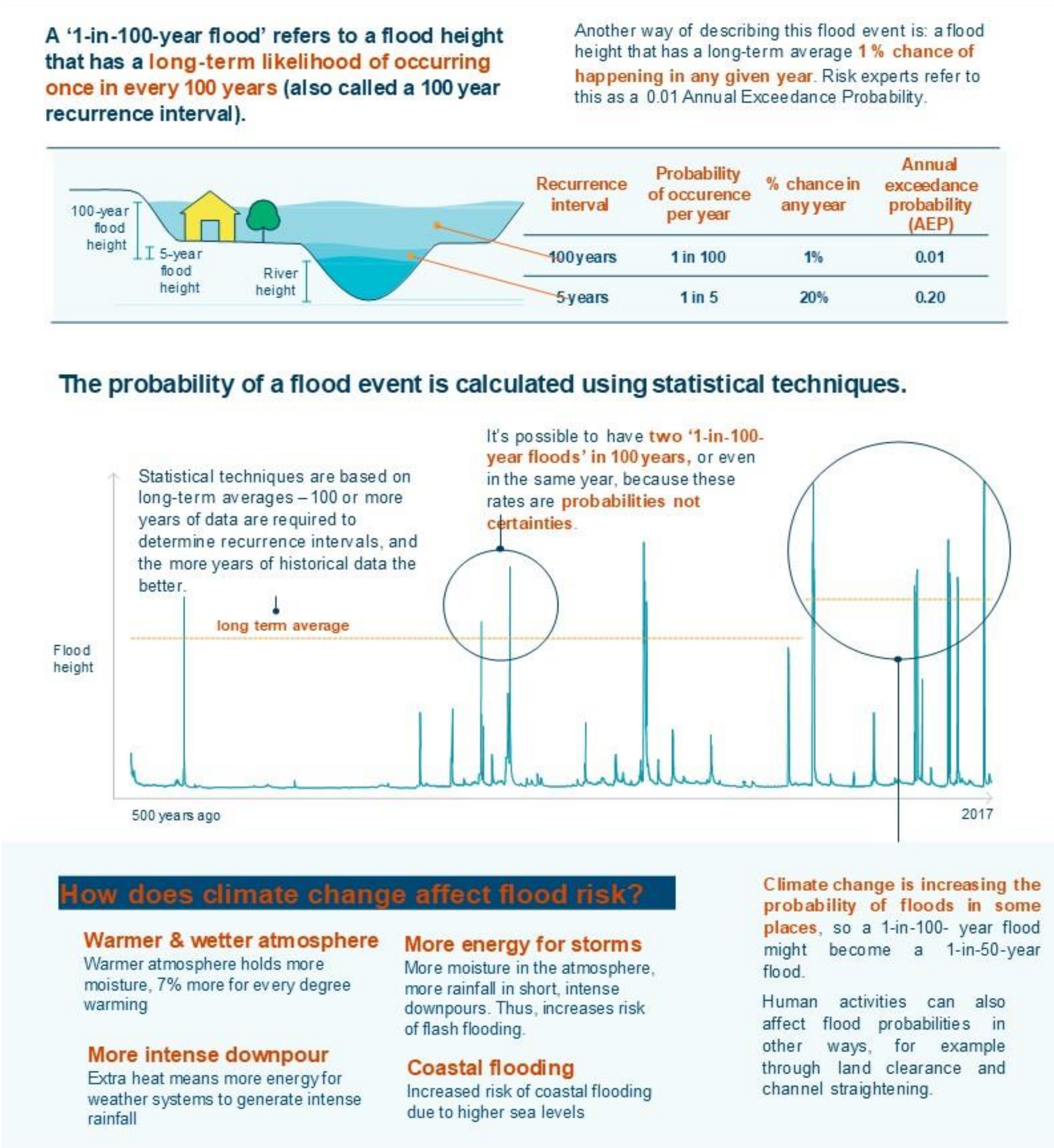
vii) **incorporate non-economic losses:** current assessment of flood impacts is focused on economic losses and paid little attention to non-economic losses such as displacement and

[274] Government of the Netherlands (2023)
[275] Ministry of Natural Resources and Environmental Sustainability (2024)
[276] Hartman et al. (2022)
[277] Ibid.
[278] Ibid.

mental health impacts[279]. Comprehensive assessments that consider how communities and households are impacted by flood is needed; and,

viii) inclusive and addresses social vulnerabilities: flood management must prioritise inclusivity, ensuring that the most vulnerable groups: low-income households, rural populations and indigenous communities, are actively consulted in flood risk management and benefit from adaptation strategies.

Figure 4.8: Climate change and flood risks



Source: adapted from Coast Adapt et al. (n.d.); Climate Council (2022)

[279] World Bank and Bank Negara Malaysia (BNM) (2024)

4.3.3. When Sea Level Rises

As Malaysia continues to adapt with frequent and intense flooding, the country must also prepare for the long-term risks associated with rising sea levels. Flooding has been a key concern for decades, but widespread impacts of sea level rise (SLR) present a more complex challenge. Sea level rise (SLR) is a slow-onset climate change impact caused by thermal expansion of seawater and melting ice sheets. This phenomenon exacerbates existing vulnerabilities and reshapes Malaysia's 8,840 kilometre coastline, economies and livelihoods. Addressing SLR will require a multifaceted approach that builds on lessons from flood management while adapting to the unique characteristics of coastal threats.

Physical changes to the coastal areas are projected to be significant. Between 1986 to 2021, the average annual SLR was 3.2 mm for Peninsular Malaysia, while Sabah, Sarawak and the Federal Territory of Labuan saw a rise of 2.9 mm annually. This would increase between 0.22 to 0.25 meters by 2050, and further increase between 0.69 to 0.73 meters by 2100[280]. SLR directly threatens coastal areas, increasing risks of storm surges, coastal flooding, erosion and saltwater intrusion, which have cascading impacts to the population and economy.

The impacts of SLR will be experienced unevenly across Malaysia's coastal regions. Low-lying areas are particularly vulnerable, with an area of 6,144 km^2 to 9,295 km^2 facing the risk of inundation by the end of the century. States that are most vulnerable to coastal inundation are Sabah, Selangor and Sarawak whilst critical and significant coastal erosion impacts face Sarawak, Sabah, Johor, Perak and Terengganu[281]. A 1-metre rise in sea level could result in the loss of 180,000 hectare of agricultural land and the destruction of 15% - 20% of mangrove forests, a natural buffer against flooding[282]. The SLR adaptation measures are shown in Table 4.3, but further actions are required to mitigate long-term risks.

Table 4.3: Impact of sea level rise and adaptation measures in Malaysia

Impact to Coastal Areas		Adaptation Measures
Groundwater and saltwater intrusion into freshwater aquifers can compromise groundwater quality	i) Preliminary assessments indicate that 44 out of 2,017 tube wells could be vulnerable to SLR by 2030, increasing to 68 wells by 2050. ii) This intrusion threatens both drinking water supplies and agricultural irrigation, impacting food security.	i) Continuous groundwater level and quality monitoring at selected deep-seated tube wells is important. This includes the installation of telemetry systems to measure parameters such as conductivity, water level, temperature, total dissolved solids and salinity. ii) Development of new wells in areas less susceptible to saltwater intrusion.
Coastal erosion and inundation affect natural habitats and disrupt human settlements and infrastructure	i) The west coast of Peninsular Malaysia is particularly vulnerable, with significant coastal inundations projected by 2100. ii) In Sabah, the Kudat-Sandakan coastline is at risk, while in	i) Building and upgrading seawalls, revetments and other coastal defences to protect vulnerable areas from erosion and inundation. ii) Integrated Shoreline Management Plans (ISMP):

[280] Ministry of Natural Resources and Environmental Sustainability (2024)
[281] Ibid.
[282] Sofia Ehsan et al. (2019); Tan (2022)

	Sarawak, the Miri-Bintulu and Bintulu-Sejingkat coastlines face similar threats.	Developing and implementing ISMPs that include assessing risks of coastal erosion and supporting adaptive measures
Increased flood risks endanger lives, property and economic activities in these regions.	i) Malaysia has identified 5,496 flood hotspots and with the projected increase in sea levels, the extent of flood-prone areas is expected to rise. ii) By 2100, 8.9% of the country's 232,001 km² flood-prone area could be at risk, compared to 6.5% currently.	i) Improving the management of water resources to ensure the resilience of groundwater supplies and reduce the risks of saltwater intrusion. ii) Implementing EWS and Supervisory Control and Data Acquisition (SCADA) systems for real-time monitoring and early warnings iii) Reviewing and updating design standards for flood relief centres to ensure safety and resilience against future floods.
Rice Production	i) Major granary areas like MADA, KADA and IADA Barat Laut Selangor could see reductions in average rice yields by 16.0-39.2% during the main season and 7.2-30.1% during the off-season by the late century. ii) Flood assessments project an additional 7,929 hectares of flood-prone rice fields by 2100, with SLR further inundating 42,303 hectares.	i) Introducing flood-resistant crop varieties and adjusting farming practices to cope with changing climate conditions. ii) Improving water use efficiency in irrigated fields through techniques such as modified alternate wetting and drying and developing submergence-tolerant rice varieties
Oil Palm and Rubber Plantations	Flood-prone areas in these plantations are expected to increase, with rubber plantations in Pahang among the most affected by extreme rainfall. SLR will further impact the productivity and viability of these plantations.	i) Developing more productive and climate-resilient varieties of oil palm and rubber. ii) Adopting regional and seasonal climate change modelling approaches to enhance the resilience and productivity of these crops.
Urban and Coastal Infrastructure	Projections indicate that by 2100, 116 coastal towns and cities could be affected by SLR, with 99,774 hectares of built environment at risk. This inundation threatens residential areas, commercial buildings and public infrastructure, necessitating significant adaptation measures.	i) Incorporating climate resilience into urban planning and infrastructure development to ensure that cities and critical infrastructure can withstand the impacts of SLR. ii) Enhancing flood defences and incorporating climate change factors into the design and construction of new infrastructure.
Transportation Networks	Flood and SLR assessments project that by 2100, 1,325 kilometres of roads, including the Pan Borneo Highway and 183.5 kilometres of railway sections could be flood-prone. Key ports and airports, including the Penang International	i) Upgrading and reinforcing transportation infrastructure to withstand increased flood risks and SLR. ii) Relocating or elevating critical infrastructure such as ports and airports to higher ground.

	Airport, are also at risk of SLR inundation.

Source: Ministry of Natural Resources and Environmental Sustainability (2024)

Coastal flooding and erosion have already resulted in significant losses. For instance, the late 2006 to early 2007 coastal flooding in Johor caused losses estimated to be RM3.24 billion. A subsequent La Niña event in Johor caused RM323.32 million in palm oil production losses and RM52.28 million in road repairs from 2011 to 2012[283]. Some of the losses and damages recorded so far are illustrated in Table 4.4.

Table 4.4: Loss and Damages from coastal flooding and erosion

Coastal Extreme Events	Damages (Value in RM) & Land Loss (Hectares)
Coastal Flooding (2006-2007), Johor	Infrastructure: RM350 million Economic: RM2.4 billion Agricultural: RM84 million Transport: RM147 million Hydraulic Structures: RM260 million Source: Sofia Ehsan et al. (2019)
Coastal Flooding (2011-2012, La Nina), Johor	Palm Oil Production Loss: RM155.10 million (2011) RM168.22 million (2012) Infield Road Repairs: RM25.80 million (2011) RM26.48 million (2012) Source: Sofia Ehsan et al. (2019)
Coastal Erosion, Selangor	2,558ha out of 27,600ha of Selangor coastal area Source: Ahmad et al (2021)
Coastal Erosion, Batu Pahat, Johor	Erosion: 415.47ha of Johor coastal area Sedimentation: 68.5 ha of Johor coastal area Source: Hamizah Ahmad et al. (2021)

Source: Sofia Ehsan et al. (2019); Hamizah Ahmad et al. (2021)

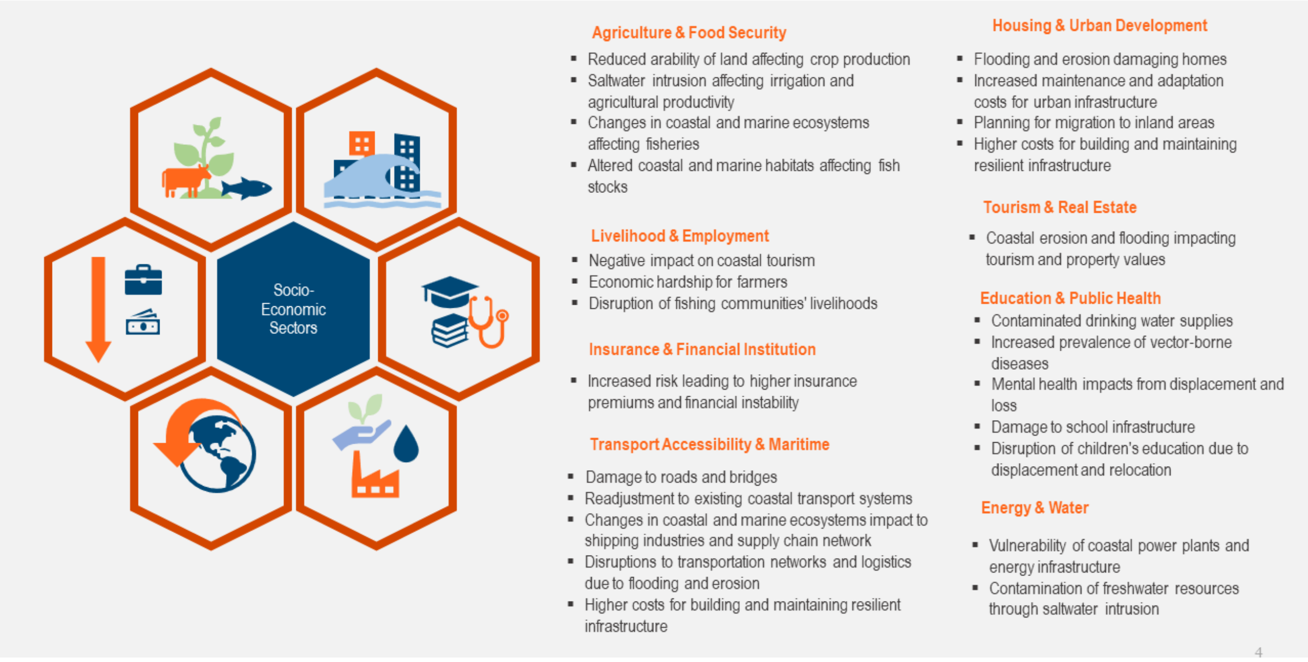
It is estimated that 60% of Malaysia's population lives in coastal areas. Vulnerabilities to SLR are unevenly distributed across Malaysia. Rural and low-income coastal populations will be the most exposed to its impacts. In states like Kelantan and Terengganu, where livelihoods depend heavily on fisheries and agriculture, saltwater intrusion and loss of arable land threaten food security and economic stability. These challenges call for equitable adaptation measures that prioritize the needs of the most affected communities. The socio-economic impacts from SLR are illustrated in Figure 4.9.

Malaysia's coastal zones play a substantial socio-economic significance, where the west coast of the Peninsula is among the most developed in Southeast Asia. Economic impact from SLR could be devastating for the three most vulnerable states. Selangor, which contributes more than 25% of Malaysia's GDP, faces long term risks to its economy[284]. Sabah, the poorest state in Malaysia, may see

[283] Sofia Ehsan et al. (2019)
[284] Ibid.

its development potentially impacted while Sarawak is already experiencing sinking cities due to SLR[285].

Figure 4.9: How SLR impacts socio-economic sectors



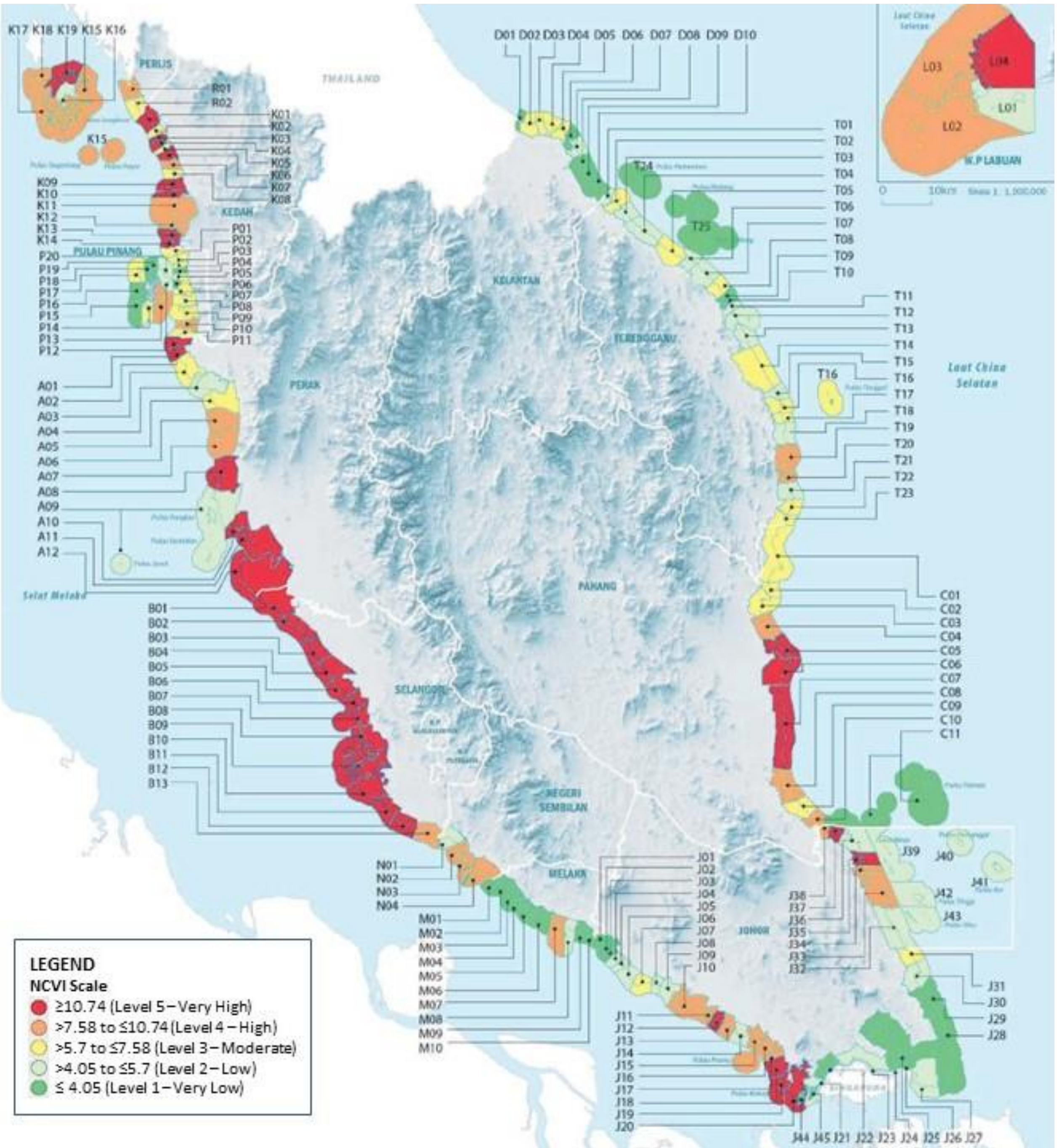
Source: Author's compilation

Adapting to SLR requires Malaysia to urgently look into the complexity of financing resilience across different scales and periods of implementation. The Asian Development Bank (ADB) estimated that Malaysia needs about 12% of its GDP in 2050 to protect its coasts. It has also placed Malaysia as on the top 15 countries that have high national adaptation cost[286]. Another assessment estimated that Malaysia needs USD5.75 billion by 2030 to address the economic impacts of SLR[287]. It is estimated that the annual cost to manage SLR is USD161 million with adaptation measures, and USD655 million without adaptation measures[288].

Malaysia has begun adopting the principles of Integrated Coastal Zone Management (ICZM) to address increasing threats against coastal populations and biodiversity. However, poor planning and design of coastal development worsens erosion[289]. Climate change further increases the vulnerabilities of these areas and ICZM has to manage long term risks and integrate adaptation into coastal management[290]. The National Coastal Vulnerability Index (NCVI) in 2022 classified 72 out of 175 areas as very high to highly vulnerable, a staggering 41% of Malaysia's coastline, as illustrated in Figure 4.10. This vulnerability highlights the urgent need for coastal management to be made more adaptive and resilient.

[285] Green Sarawak (n.d.); Jane Moh (2024)
[286] ADB (2017) and Asuncion and Lee (2017)
[287] Sarkar et al. (2014)
[288] Ibid.
[289] Hiew (1994)
[290] National Hydraulic Research Institute of Malaysia (NAHRIM) (2019)

Figure 4.10: More than 41% of Malaysian coastline considered as very high and highly vulnerable in NCVI



Source: excerpted from PlanMalaysia (n.d.)

Box 4.1: Challenges of addressing sea level rise

Managing direct impacts:

a) The increased frequency of coastal flooding and extreme weather conditions necessitates robust infrastructure and early warning systems to protect lives and property. This includes the construction and maintenance of seawalls, levees and other protective structures, as well as the development of effective evacuation plans; and

b) SLR contributes to long-term phenomena such as coastal inundation, severe erosion and saltwater intrusion. These changes gradually degrade coastal ecosystems and human settlements, requiring sustained efforts in land-use planning and the implementation of nature-based solutions like mangrove restoration and beach nourishment.

Governance and Coordination:

a) The current governance framework for SLR adaptation is fragmented, with different agencies responsible for various aspects of coastal management. This can lead to inefficiencies and inconsistencies in policy implementation. For example, the Department of Irrigation and Drainage handles infrastructure protection, while PlanMalaysia oversees coastal land use, resulting in potential overlaps and gaps in responsibility; and

b) Effective adaptation to SLR demands integrated policies that align with national, regional and local plans. The existing sectoral approach often fails to consider the interconnectedness of climate impacts, leading to siloed responses that may not address the full scope of the problem.

Socio-economic Consideration:

a) Addressing SLR requires a localized and inclusive adaptation strategy that takes into account the intersectionality of climate change and social impacts. Vulnerable communities, including low-income groups, indigenous populations and those with limited access to resources, are disproportionately affected by SLR. Policies must be designed to protect these communities by considering their specific needs and challenges; and

b) Building resilience against SLR involves not only physical infrastructure improvements but also economic diversification. Communities must be equipped with alternative livelihoods and economic opportunities to reduce their dependency on climate-vulnerable sectors like agriculture and fisheries.

Financial and Resource Constraints:

a) Securing adequate funding for SLR adaptation projects remains a significant challenge. While international climate finance mechanisms exist, accessing these funds can be complex and competitive. There is also a need for greater involvement of the private sector and innovative financing mechanisms, such as resilience bonds, to bridge the funding gap; and

b) Effective adaptation requires building the capacity of local governments and communities. This includes training and equipping them with the necessary technical expertise to plan, implement and monitor adaptation measures. Enhancing local capacity ensures that adaptation strategies are sustainable and responsive to changing conditions.

Long-Term Vision and Sustainability:

a) While immediate protective measures are essential, it is equally important to plan for long-term sustainability. This involves climate-proofing existing infrastructure, investing in research and development of new technologies and fostering a culture of resilience within communities; and

b) Adaptation strategies must be dynamic and flexible to respond to evolving climate conditions and socio-economic contexts. This requires an adaptive governance framework that promotes continuous learning, stakeholder engagement and iterative policy adjustments.

Despite ongoing efforts, current governance to address SLR remains fragmented. Coastal management is divided between Federal and State powers. Administration of land and water, including coastal zones, are under the purview of the States. At national level, coastal management is primarily divided into spatial planning, guided by the National Physical Plan (developed by PlanMalaysia), and the coastal sectors and activities management plan under the Integrated Shoreline Management Plan (developed by DID).

Coordinating this institutional arrangement is challenging. There are currently 13 acts and six guidelines relating to coastal management, but they operate in silo rather than part of an integrated framework. Climate change highlights gaps and challenges in the existing frameworks of coastal management. Planning and implementation to address long-term risks is affected by the lack of alignment between Federal and the States.

Furthermore, there is minimal engagement with affected socio-economic sectors like fisheries, tourism and agriculture. Engagement with new stakeholders is crucial to make coastal management more adaptive, participatory and inclusive. This has to go beyond government agencies but also local communities, private sector and non-governmental organisations. Engaging these stakeholders in the decision-making process would make adaptation strategies more effective and address the challenges illustrated in Figure 4.9 and Box 4.2.

4.3.4. Intersectionality of Climate and Social Impacts

There is evidence that the States are already experiencing impacts beyond their limits. Selangor contemplated declaring a climate emergency in 2022 following a series of disasters[291]. 80% of its coastal areas are already exposed to erosion and the long-term effect of SLR on its coastal resources is of grave concern. One of the most impacted by SLR is Port Klang, a crucial hub for Malaysia's international trade. SLR poses significant risks to its population, infrastructure and port operations. The population of Port Klang, numbering over 27,000 people in 2020, is vulnerable to coastal flooding, particularly in areas like Teluk Gong and Pulau Ketam[292]. These floods have caused significant distress to the local population, disrupting daily life and trade activities at the ports.

Port Klang demonstrates the intersectionality between climate change and social impacts, highlighting how environmental challenges disproportionately affect vulnerable communities. Intersectionality, a concept often used in social sciences, refers to how various social identities (such as race, gender and class) intersect to create unique modes of discrimination and privilege[293]. In the context of Port Klang, SLR and climate change exacerbate existing social inequalities and create new layers of vulnerability.

The Mah Meri tribe's situation is a clear example of how climate impacts intersect with social and cultural vulnerabilities. As an indigenous community, they face marginalisation and limited political power, making it harder for them to resist displacement and protect their ancestral lands. The intersection of their indigenous status, cultural heritage and environmental vulnerability exemplifies how climate change can deepen social inequities[294].

Port Klang's economic importance means that disruptions have wide-reaching effects. However, the economic impacts are not evenly distributed. Small businesses, low-income workers and those dependent on agriculture and fisheries are hit hardest by the flooding and infrastructure damage.

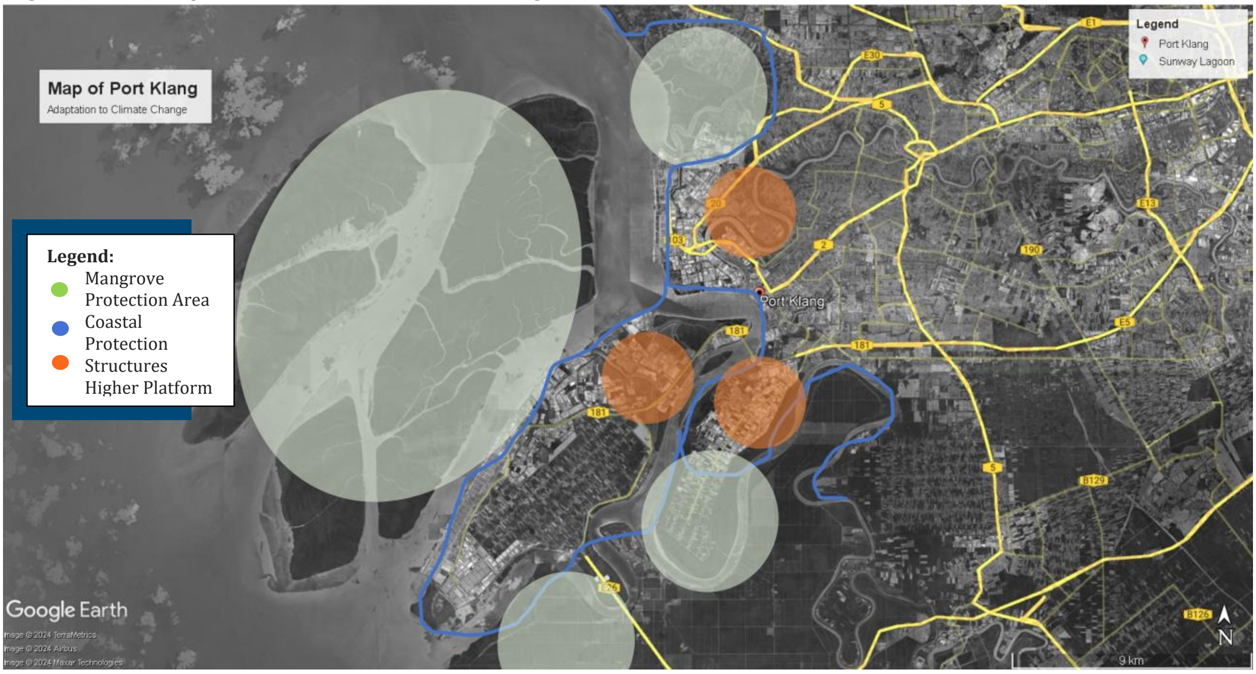
[291] Kasinathan (2022)
[292] Aidila Razak and Arulldass Sinnappan (2022)
[293] Kaijser and Kronsell (2014)
[294] Donald (2021)

These economic disparities highlight how climate impacts can intersect with economic status, exacerbating poverty and economic insecurity for the most vulnerable populations[295].

The health risks associated with flooding, such as waterborne diseases and vector-borne illnesses, disproportionately affect those with limited access to healthcare. The psychological stress of living under constant threat of flooding adds another layer of vulnerability. The intersection of environmental stressors with inadequate health infrastructure and mental health support systems shows how climate impacts are compounded by existing social and health inequalities.

Current measures to adapt SLR in Port Klang is shown in Figure 4.11. A local adaptation plan that incorporates location-specific vulnerabilities for climate, environment and socio-economic elements should be developed. A locally driven, bottom-up adaptation should be prioritised as Selangor could face severe consequences if the development for the new port in Pulau Carey were to proceed.

Figure 4.11: Adaptation measures in Port Klang



Source: Author's analysis based on NAHRIM (2019)

[295] Aidila Razak and Arulldass Sinnappan (2022)

Box 4.2: Identified Cascading Impacts from SLR in Port Klang

Port Klang's strategic importance in Malaysia's trade network cannot be overstated. Handling 13.6 million containers and maintaining connectivity with over 200 countries and 500 ports globally, its operations are integral to the national economy. The Port Klang Authority has planned a new port costing RM28 billion on Carey Island, rivalling the Tuas Port, Singapore[296]. This captures some impacts from SRL in Port Klang:

Economic Impacts

Frequent and severe flooding has caused extensive damage to infrastructure, leading to significant financial losses. The disruptions to trade and economic activities, particularly industries reliant on timely shipments like electronics and automotive manufacturing[297].

Displacement and Cultural Loss

The indigenous Mah Meri tribe, residing in coastal areas near Port Klang, faces potential displacement due to both natural and man-made changes. As sea levels rise, the tribe's traditional lands are increasingly under threat. Mah Meri tribe are already affected by the development projects for eco-tourism, leading to fears of eviction. The loss of their ancestral lands threatens their cultural heritage and disrupts their traditional way of life and livelihoods[298].

Health, psychological and Social Stress

The constant threat and occurrence of flooding have significant psychological impacts on the residents of Port Klang. Anxiety, depression and sleep disturbances are common as people cope with the stress and trauma associated with repeated flooding events. The psychological toll on the community is immense, affecting overall well-being and quality of life. Children, in particular, are vulnerable, experiencing disruptions in their education and daily routines.

Floodwaters, often contaminated with sewage and industrial waste, pose serious health risks to the local community. Stagnant water from floods creates breeding grounds for mosquitoes, increasing the risk of vector-borne diseases such as dengue fever. The community faces heightened health risks and additional burdens on the healthcare system[299].

Food Security and Agricultural Impact

Rising sea levels lead to saltwater intrusion into agricultural lands, reducing soil fertility and crop yields. This situation threatens food security and the livelihoods of farmers. Major granary areas could see reductions in rice yields by up to 39.2% during the main season by the end of the century, with additional hectares of rice fields becoming flood-prone[300].

Infrastructure and Future Developments

Coastal flooding will impact the mangrove forest of Klang Island (6,349 hectares) and the industrial areas of Port Klang and Pulau Indah (857 hectares). Based on NAHRIM's assessment, existing settlements projected to be under water as early as 2040. The plan to develop Pulau Carey into a major port may not fully consider the impact of SLR. The area is already vulnerable to coastal flooding, with 381 hectares of current agricultural land at risk[301].

[296] Socio-Economic Research Centre (n.d.)
[297] Aidila Razak and Arulldass Sinnapan (2022)
[298] Donald (2021)
[299] Aidila Razak and Arulldass Sinnapan (2022)
[300] National Hydraulic Research Institute of Malaysia (NAHRIM) (2019)
[301] Global Business Reports (2023)

4.4 The Policy Challenges

Previous sections have highlighted the gravity of climate risks in Malaysia, particularly flood and SLR. The case studies on flood management and SLR response show significant gaps in the current policy framework. While there is success in integrating adaptation into sectoral policies, it is limited, reactive and not addressing long-term risks. The existing policy framework lacks a comprehensive cross-sectoral approach, especially coordinating implementation involving the states and local authorities.

This is largely due to the challenge posed by the current governance structure. Responsibilities are fragmented among various agencies and levels of government which results in a piecemeal and reactive approach to adaptation. Furthermore, the current framework does not adequately address how climate change impacts other stakeholders involving key economic activities and the private sector, and local vulnerabilities that impact communities. While significant steps in documenting flood risks, impacts and mitigation needs have been taken, these efforts remain sector-specific and lack integration with the broader climate adaptation strategies. For instance, there is little engagement and coordination with state governments or other key sectors in developing comprehensive flood protection measures despite available long-term climate projections already prepared by NAHRIM.

Efforts to integrate adaptation in the 12th Malaysia Plan Mid-term Review were focused on the development of the Malaysia National Adaptation Plan (MyNAP), improving flood management and integration of adaptation with disaster management[302]. However, there is little alignment with sustainability and disaster risk reduction within the current policy framework. Enhancing cross sectoral integration between adaptation and disaster management with key sectors such as food security, public health, infrastructure and economic activities like tourism and agriculture is crucial for adapting to cascading impacts.

Commitment for resilience hinges on long term planning and consistent funding with robust monitoring systems for adaptation. Recent extreme floods and unprecedented disasters show that despite continued increase in budget allocation for infrastructure, the current protection level is insufficient to mitigate future disasters and uncertainties[303]. With further global warming, Malaysia would have to re-assess if the estimated RM392 billion is truly sufficient for climate resilience and explore blended options that are more viable.

The flood management case study highlighted the importance of preparing for multi-faceted climate risks. As temperatures rises, the demand for water and energy will increase, placing further strain on infrastructure and exacerbating vulnerabilities in already-affected communities. Additionally, prolonged heatwaves could lead to significant agricultural losses, compounding the socio-economic risks posed by climate change.

Although managing floods is key to adapting to climate change, this strategy has sidelined other impacts that are equally devastating in the long-term. SLR remains an afterthought and is not adequately addressed. Rising sea levels threaten vital infrastructure, such as ports and coastal cities, yet coastal management strategies are insufficient and lacking readiness for future risks. Current

[302] Ministry of Economy (2023)
[303] Ministry of Natural Resources and Environmental Sustainability (2024)

strategies are limited to protective hard infrastructure approach and lacks integration with sustainable land-use planning or urban development and nature-based strategies that could mitigate future risks. Coastal vulnerabilities also differ by region, hence the current governance structure may pose a challenge to a coordinated response to these varying risks.

Effective adaptation to SLR involves a combination of hard and soft strategies. Structural measures, such as coastal defences and seawalls, must be complemented by nature-based solutions like mangrove restoration and beach nourishment. Malaysia's shoreline management plans should integrate projections of SLR into urban development and infrastructure planning, ensuring long-term resilience.

Furthermore, the lack of granular data and local projections for different time scales are limiting the ability to fully assess potential impacts and to plan. Without updated projections of potential socio-economic damages, infrastructure costs and the broader implications of coastal migration, Malaysia risks being under-prepared for the magnitude of future challenges imposed by SLR. Greater financial commitment may be required to manage the impacts of SLR in high-risk coastal areas like Port Klang, Batu Pahat and Kedah.

Port Klang shows that there are overlapping vulnerabilities driven by socio-economic factors and climate risks, yet the engagement with local stakeholders is minimal. Communities, especially in vulnerable coastal regions, possess valuable knowledge about how their lives and livelihoods are affected by climate change. Establishing a deep understanding of how climate change aggravates existing issues, such as poverty or infrastructure gaps, is crucial for the development of effective, locally-driven adaptation strategies.

Current adaptation strategies have primarily prioritised mitigating immediate impacts associated with high economic damages. While this focus is necessary, it has resulted in the neglect of managing other climate-related risks, particularly the impacts of rising temperatures. Temperature increases, which drive heatwaves, prolonged dry spells and droughts, have not been adequately addressed in policy frameworks.

4.5 Recommendations

Malaysia faces significant challenges in managing climate risks and current strategies must evolve to address future demands. In this chapter, the recommendations are aimed at enhancing the policy framework, focusing on long-term, cross-sectoral and locally driven approach.

4.5.1. Strengthen the current policy framework for climate adaptation

i) Improve interagency coordination:
To address the challenge of fragmented governance, clear roles and responsibilities across government agencies must be established. Utilising existing platforms to coordinate climate policy integration across sectors and alignment with national, state and local priorities. The development of MyNAP must embed cross-sectoral integration mechanisms, ensuring inclusivity and participation from all levels of government;

ii) *Empower states and local governments:*
States and local governments should be encouraged and incentivised to plan and implement relevant localised adaptation strategies. This should start with engagement and providing them with knowledge, authority, resources and technical support. The integration of adaptation with state development plans would ensure that strategies are locally driven. Financial and technical support would further encourage the states to develop their adaptation plans.

iii) *Foster private sector and community participation:*
The private sector has a critical role in climate proofing infrastructure and encouraging adoption of nature-based solutions. Collaborative efforts with the private sector could potentially help identify scalable efforts across sectors and contribute to building adaptive capacity. Involvement of civil society and NGOs would further expand participation and drive community agency to be adaptive.

4.5.2. Address Long-Term Climate Change Impacts Today

i) *Develop comprehensive coastal management plans:*
There is an urgent need to include coastal management to address the long-term risk of SLR. Managing this requires starting from the most region-specific vulnerable coastal areas such as Port Klang, Batu Pahat and the Kedah coast. This is an opportunity to integrate land-use planning, coastal defence infrastructure and nature-based solutions rather than attempting a country-wide policy development.

ii) *Shift to risk-based adaptation planning:*
To enhance readiness for future climate shocks, Malaysia's adaptation approach should move from sectoral vulnerability assessments to risk-based planning. Comprehensive assessment that integrates the risks from increasing temperature like heatwaves, prolonged dry spells and droughts would help to increase our readiness for future climate shocks.

iii) *Leverage on cost-effective solutions:* Viable cost-effective solutions like nature-based approaches and utilising soft infrastructure like urban planning, risk maps and data-sharing platforms that are currently underutilised, should be integrated into flood and coastal management. This would encourage the implementation of adaptation measures to be less dependent on Federal Government and for state governments, local authorities and communities to increase their adaptive capacity.

4.6 Conclusion

Malaysia's increasing vulnerability to climate change, particularly from floods, sea level rise and rising temperatures, exposes critical gaps in the current policy framework. While there has been progress in integrating climate adaptation into sectoral policies, governance remains fragmented, with implementation scattered across multiple ministries. This lack of alignment, coordination and engagement limits the effectiveness of adaptation efforts. The current top-down approach also restricts state governments, local communities and the private sector in actively participating in shaping and implementing strategies that address local risks.

The focus on short-term, high-cost disasters like floods has overshadowed the importance of proactive planning for long-term climate impacts such as SLR and rising temperatures. These impacts pose significant socio-economic risks, particularly to coastal areas and vulnerable communities, yet they remain inadequately addressed. Without an integrated policy framework and long-term planning, climate resilient development remains a vague aim.

The case studies on flood and coastal management demonstrate the urgent need to develop a more comprehensive and inclusive adaptation framework. This requires addressing the fragmented governance, strengthening policy integration across sectors and expanding the role of States governments and local authorities in adaptation planning. Proactive measures to tackle slow-onset events, along with exploring viable cost-effective solutions like nature-based solutions and soft infrastructure, are crucial to build long-term resilience.

To move forward, Malaysia must prioritize a more participatory, risk-based and locally driven approach to adaptation. By fostering cross-sectoral collaboration, enhancing local capacity, and addressing long-term climate risks and vulnerabilities Malaysia can safeguard vital infrastructure and ensure a more resilient future.

4.7 References

ADB. 2017. "Meeting Asia's Infrastructure Needs." 0 ed. Manila, Philippines: Asian Development Bank. https://doi.org/10.22617/FLS168388-2.

Adnan A. Hezri. 2016. *The Sustainability Shift: Refashioning Malaysia's Future*. Penang: Areca Books.

Adnan A. Hezri and Mohd. Nordin Hasan. 2006. "Towards Sustainable Development? The Evolution of Environmental Policy in Malaysia." *Natural Resources Forum* 30 (1):37–50. https://doi.org/10.1111/j.1477-8947.2006.00156.x.

Aidila Razak and Arulldass Sinnapan. 2022. "When the Water Rises: A Malaysian Climate Change Story." *Malaysiakini*, August 2022. https://newslab.malaysiakini.com/climate-change/en/.

Aidila Razak and Arulldass Sinnappan. 2022. "When the Water Rises: A Malaysian Climate Change Story." Malaysiakini. August 29, 2022. https://newslab.malaysiakini.com/climate-change/en.

Alizan Mahadi and Darshan Joshi. 2023. "Malaysia." In *Financing Infrastructure for Climate-Change Adaptation in Developing East Asia*, edited by Fauziah Zen and Usha Iyer-Raniga, 74–97. ERIA Research Project Report FY2023 5. Jakarta: ERIA.

Araos, Malcolm, Kripa Jagannathan, Roopam Shukla, Idowu Ajibade, Erin Coughlan De Perez, Katy Davis, James D. Ford, et al. 2021. "Equity in Human Adaptation-Related Responses: A Systematic Global Review." *One Earth* 4 (10):1454–67. https://doi.org/10.1016/j.oneear.2021.09.001.

Asuncion, Ruben Carlo, and Minsoo Lee. 2017. "Impacts of Sea Level Rise on Economic Growth in Developing Asia." ADB Economics Working Paper Series. 0 ed. ADB Economics Working Paper Series. Manila, Philippines: Asian Development Bank. https://doi.org/10.22617/WPS178618-2.

Bank Negara Malaysia (BNM). 2021. "Climate Change and Principle-Based Taxonomy." https://www.bnm.gov.my/documents/20124/938039/Climate+Change+and+Principle-based+Taxonomy.pdf.

Chan, Ngai Weng. 1997. "Institutional Arrangements for Flood Hazards in Malaysia: An Evaluation Using the Criteria Approach." *Disasters* 21 (3):206–22. https://doi.org/10.1111/1467-7717.00057.

———. 2012. "Impacts of Disasters and Disaster Risk Management in Malaysia: The Case of Floods." In *Resilience and Recovery in Asian Disasters*, edited by Daniel P. Aldrich, Sothea Oum, and Yasuyuki Sawada, 239–65. Tokyo: Springer Japan. https://doi.org/10.1007/978-4-431-55022-8_12.

Climate Council. 2022. "Everything You Need to Know about Floods and Climate Change | Explainer." March 2, 2022. https://www.climatecouncil.org.au/resources/climate-change-floods/.

CoastAdapt, National Climate Change Adaptation Research Facility, and Department of Environment and Energy, Australia. n.d. "'What Is a 100-Year Flood?'" https://coastadapt.com.au/sites/default/files/infographics/What_is_a_100-year_flood.pdf.

Davies, Richard. 2015. "Malaysia Floods – Kelantan Flooding Worst Recorded as Costs Rise to RM1 Billion." *FloodList*, January 5, 2015. https://floodlist.com/asia/malaysia-floods-kelantan-worst-recorded-costs.

Department of Irrigation and Drainage. 2019. "National Flood Forecasting and Warning Programme." https://publicinfobanjir.water.gov.my/mengenai-kami/prab/?lang=en.

Donald, Rachel. 2021. "They Safeguarded Nature, but Now Malaysia's Mah Meri Face Eviction for an Eco-Resort." *Mongabay Environmental News*, August 2021. https://news.mongabay.com/2021/08/they-safeguarded-nature-but-now-malaysias-mah-meri-face-eviction-for-an-eco-resort/.

Dovers, Stephen R., and Adnan A. Hezri. 2010. "Institutions and Policy Processes: The Means to the Ends of Adaptation." *WIREs Climate Change* 1 (2):212–31. https://doi.org/10.1002/wcc.29.

Dryzek, John S., Richard B. Norgaard, and David Schlosberg. 2013. *Climate-Challenged Society*. Oxford University Press. https://doi.org/10.1093/oso/9780199660100.001.0001.

Economic Planning Unit. 2010. *Tenth Malaysia Plan 2011-2015*. Putrajaya: Prime Minister's Department.

European Union Disaster Risk Management Centre. 2021. "INFORM Risk Country Risk Profile." https://drmkc.jrc.ec.europa.eu/Inform-Index/Portals/0/InfoRM/CountryProfiles/MYS.pdf.

Global Business Reports. 2023. Global Business Reports: Southeast Asia Chemicals 2023. https://projects.gbreports.com/southeast-asia-chemicals-2023/port-klang-authority-pka-interview.

Government of the Netherlands. 2023. "2024 Delta Programme." Netherlands: Ministry of Infrastructure and Water Management Netherlands. https://english.deltaprogramma.nl/binaries/delta-commissioner/documenten/publications/2023/09/19/delta-programme-2024-english/DP2024+ENG.pdf.

Green Sarawak. n.d. "Sibu, a Sinking Town in Sarawak," n.d. https://greensarawak.com/sibu-a-sinking-town-in-sarawak/.

Hartman, Marco, Neeltje Kielen, Bastien van Deen, Petra Dankers, and Michelle Rudolph. 2022. "DRR Mission Team Report: Towards Long Term Flood Risk Management." The Netherlands: Netherlands Enterprise Agency.

Haziq Sarhan Rosmadi, Minhaz Farid Ahmed, Mazlin Bin Mokhtar, and Chen Kim Lim. 2023. "Reviewing Challenges of Flood Risk Management in Malaysia." *Water* 15 (13):2390. https://doi.org/10.3390/w15132390.

Hiew, Kim Loi. 1994. "Coastal Zone Management in Malaysia: The Need for an Integrated Approach." Department of Irrigation and Drainage. https://www.water.gov.my/jps/resources/auto%20download%20images/5844e2dee0094.pdf.

IPCC. 2022. "Summary for Policymakers." In *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, by H.-O. Pörtner, S. Langsdorf, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, et al., edited by H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Craig, et al., 3–33. Cambridge, UK: Cambridge University Press. 10.1017/9781009325844.001.

Jane Moh. 2024. "Projects to Address Collapsed Drain, Sinking Roads at Sibu's Jalan Merdeka 13 Completed." *The Borneo Post*, May 17, 2024. https://smc.gov.my/web/subpage/news_view/1141.

Kaijser, Anna, and Annica Kronsell. 2014. "Climate Change through the Lens of Intersectionality." *Environmental Politics* 23 (3):417–33. https://doi.org/10.1080/09644016.2013.835203.

Kasinathan, Shathana. 2022. "Selangor Govt Considering Climate Emergency Declaration." *The Star*, September 13, 2022. https://www.thestar.com.my/metro/metro-news/2022/09/13/selangor-govt-considering-climate-emergency-declaration.

Lee, LC. 2007. "Johor Floods: Once in 100 Years, Twice in Three Weeks?" *Malaysiakini*, January 16, 2007. https://www.malaysiakini.com/letters/62176.

Malaysiakini. 2022. "RM392 Billion Needed to Mitigate Floods Due to Climate Change." *Malaysiakini*, September 6, 2022. https://www.malaysiakini.com/news/634693#google_vignette.

Matsuo, Akane, Nagisa Shiiba, Naoyuki Okano, and Kei Kurushima. 2023. "Status of Adaptation Planning in the Asia-Pacific." Institute for Global Environmental Strategies. https://www.iges.or.jp/en/pub/adaptation-planning-asiapacific/en.

Ministry of Economy. 2023. "Mid-Term Review Twelfth Malaysia Plan 2021 - 2025 - Malaysia Madani: Sustainable, Prosperous, High Income." https://rmke12.ekonomi.gov.my/ksp/storage/fileUpload/2023/09/2023091116_1_overview.pdf#page=6.14.

Ministry of Environment and Water, Economic Planning Unit, and Akademi Sains Malaysia. 2020. "The Water Sector Transformation 2040." https://wst2040.my/.

Ministry of Finance. 2023. "Fiscal Outlook 2024: Federal Government Expenditure." Ministry of Finance of Malaysia. https://belanjawan.mof.gov.my/pdf/belanjawan2024/revenue/section3.pdf.

Ministry of Natural Resources and Environment. 2009. "National Policy on Climate Change." Putrajaya: Ministry of Natural Resources and Environment.

———. 2018. "Intended Nationally Determined Contribution Of The Government Of Malaysia." https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Malaysia/1/INDC%20 Malaysia%20Final%2027%20November%202015%20Revised%20Final%20UNFCCC.pdf.

Ministry of Natural Resources and Environmental Sustainability. 2024. "Malaysia's Fourth National Communication under the United Nations Framework Convention on Climate Change." Ministry of Natural Resources and Environmental Sustainability. https://unfccc.int/sites/default/files/resource/NRES_NC4_To%20UNFCCC_2024%20v1.0.pdf.

Ministry of Natural Resources, Environment and Climate Change. 2022. "Malaysia's Fourth Biennial Update Report under the United Nations Framework Convention on Climate Change." Ministry of Natural Resources, Environment and Climate Change. https://unfccc.int/sites/default/files/resource/MY%20BUR4_2022.pdf.

NAP Central. 2024. "Submitted NAPs from Developing Country Parties." UNFCCC. https://napcentral.org/submitted-naps.

NAP Global Network. 2017. "Financing National Adaptation Plan (NAP) Process: Contributing to the Achievement of Nationally Determined Contribution (NDC) Adaptation Goals." 2017. https://www4.unfccc.int/sites/NAPC/Documents/Supplements/napgn-en-2017-financing-nap-processes.pdf.

National Hydraulic Research Institute of Malaysia (NAHRIM). 2019. "Impact of Climate Change: Sea Level Rise Projections for Malaysia (2017)."

Notre Dame Global Adaptation Initiative. 2024. "ND-GAIN Country Index." University of Notre Dame. https://gain.nd.edu/our-work/country-index/.

OCHA Regional Office for Asia Pacific. 2007. "Floods Malaysia, 2006-2007." 2007. https://www.unocha.org/publications/map/malaysia/floods-malaysia-december-2006-and-january-2007.

Pereira, Joy Jacqueline, Mohd Khairul Zain, and Rajib Shaw, eds. 2022. *Climate Change Adaptation in Southeast Asia*. Disaster Risk Reduction. Singapore: Springer Singapore. https://doi.org/10.1007/978-981-16-6088-7.

Pielke, Roger A. 1998. "Rethinking the Role of Adaptation in Climate Policy." *Global Environmental Change* 8 (2):159–70. https://doi.org/10.1016/S0959-3780(98)00011-9.

———. 2005. "Misdefining 'Climate Change': Consequences for Science and Action." *Environmental Science & Policy* 8 (6):548–61. https://doi.org/10.1016/j.envsci.2005.06.013.

PlanMalaysia. n.d. "Persisiran Pantai: Aset Negara." https://www.planmalaysia.gov.my/kompendium/pantai/PLANINFO85-95_Persisiran_Pantai_Aset_Negara.pdf.

Roy, Christopher. 2022. "Climate Finance in Asia: Assessing the State of Climate Finance in One of the World's Most Climate Vulnerable Regions." Oxfam International. https://doi.org/10.21201/2022.9837.

Sarkar, Sujahangir Kabir, Rawshan Ara Begum, Joy Jacqueline Pereira, Abdul Hamid Jaafar, and M Yusof Saari. 2014. "Impacts of and Adaptations to Sea Level Rise in Malaysia." *Asian Journal of Water, Environment and Pollution* 11 (2):29–36.

Socio-Economic Research Centre. n.d. "SERC- Carey Islands Port Is a Need or Want." https://www.acccimserc.com/images/researchpdf/2018/20180901%20Part%203%20-%20Carey%20Islands%20port%20is%20a%20Need%20or%20Want.pdf.

Sofia Ehsan, Rawshan Ara Begum, Nor Ghani Md Nor, and Khairul Nizam Abdul Maulud. 2019. "Current and Potential Impacts of Sea Level Rise in the Coastal Areas of Malaysia." *IOP Conference Series: Earth and Environmental Science* 228 (February):012023. https://doi.org/10.1088/1755-1315/228/1/012023.

Syed Azhar. 2014. "Kelantan Floods Worst in a Decade, Say Authorities." The Star. December 20, 2014. https://www.thestar.com.my/news/nation/2014/12/20/kelantan-floods-worst-in-a-decade.

Tan, Yvonne. 2022. "Asia's Sinking Cities: Malaysia." *Climate Tracker Asia*, January 2022.

UNFCCC. 2020. "Introduction to Adaptation and Resilience / Loss and Damage." UNFCCC: Adaptation and Resilience. 2020. https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/introduction.

———. 2023. "Views on the Elements for the Consideration of Outputs Component of the First Global Stocktake: Synthesis Report by the Secretariat." UNFCCC. https://unfccc.int/sites/default/files/resource/SYR_Views%20on%20%20Elements%20for%20CoO.pdf.

United Nations Environment Programme. 2023. *Adaptation Gap Report 2023: Underfinanced. Underprepared. Inadequate Investment and Planning on Climate Adaptation Leaves World Exposed*. United Nations Environment Programme. https://doi.org/10.59117/20.500.11822/43796.

World Bank. 2021. "Natural Hazard Statistics: Malaysia." Climate Change Knowledge Portal. 2021. https://climateknowledgeportal.worldbank.org/country/malaysia/vulnerability.

World Bank and Bank Negara Malaysia (BNM). 2024. "Managing Flood Risks: Leveraging Finance for Business Resilience in Malaysia." Washington, D.C.

World Meteorological Organisation (WMO). 2024. "WMO Confirms That 2023 Smashes Global Temperature Record," January 12, 2024. https://wmo.int/media/news/wmo-confirms-2023-smashes-global-temperature-record.

CHAPTER

05

CHAPTER 5

CLIMATE EQUITY

5.1 Introduction

Development under the constraints of climate change presents great challenges for developing countries. Not only are they confronted with mounting climate impacts, but they also lack the financial and technological capabilities needed to adapt to them. These nations further grapple with the potential economic and social costs associated with implementing climate solutions. On the other hand, developed countries, historically the largest contributors to global warming, have underdelivered their promises of financial and technological transfer despite their greater capabilities.

Pursuing global sustainable development under the shadow of climate change is inherently an uneven playing field. It is precisely under this condition that fairness needs to be upheld.

Equity is a key principle of climate policymaking. Climate equity—or climate justice—stresses the fairness of climate action in both outcomes and processes. It entails a fair redistribution of costs and benefits associated with climate policies and meaningful participation in decision-making for climate governance and redress[304].

The UNFCCC articulates that the protection of the climate system should be undertaken “on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities” (Article 3.1). The objective of “stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system” should simultaneously “enable economic development to proceed in a sustainable manner.” (Article 2).

For developing countries, addressing climate change means more than indiscriminately taking on mitigation; it means balancing developmental priorities with climate goals. Developing countries are not a homogeneous bloc; many remain inadequate in attaining key developmental goals, some fall behind in achieving decent living standards due to a lack of access to necessities such as energy, utilities and water. They face deeper challenges as climate change brings on physical impacts that disrupt the delivery of these services.

On the other hand, the pressure of climate destabilisation also constrains developing countries’ ability to pursue similar development pathways that benefited advanced, industrialised countries in the past[305]. Governments of developing countries are now compelled to search for alternative development pathways, albeit without adequate support.

[304] Newell et al. (2021)
[305] Lebdioui (2024)

Climate-resilient development, as defined by the IPCC, involves putting into action "mitigation and adaptation options to support sustainable development for all."[306] It entails a delicate balancing act that aims to reduce the negative impacts of climate change and climate solutions while also harnessing opportunities for sustainable development. Sustainable development amid climate constraints necessitates low-carbon transition, i.e., transforming energy, land, urban, infrastructure and production systems to low-emission, climate-resilient ones[307]. However, transition comes with significant costs and carries inherent risks.

These factors make transition especially difficult for developing countries, which often have fewer technological resources and financial reserves to devote to such efforts.

5.1.1. A case of climate equity for Malaysia

As a developing nation with a small, open economy, Malaysia faces a complex challenge in balancing socioeconomic development with environmental sustainability. Its historical reliance on fossil fuels and openness to trade for growth[308] create vulnerabilities during the transition to a low-emissions future.

Climate change can exacerbate existing social inequalities. The adverse effects of climate change unequally impact different social groups. As discussed in chapter 3 and 4, existing social gaps only amplify these risks. If not carefully designed with distributional effects in mind, transition initiatives can also disproportionately burden and benefit disparate groups, leading to inequitable outcomes.

Therefore, a careful balancing act is necessary. Malaysia must address climate change impacts while also mitigating the potential for increased inequality. This balancing act requires Malaysia to address both domestic and international concerns. Domestically, the country must navigate the trade-off between socioeconomic progress and minimising inequities caused by climate change policies. Internationally, it must weigh its contribution to global climate goals against the actions of other countries.

This paper explores (1) the equity implications of climate burden sharing, (2) the equity risks imposed by climate mitigation as implied in the low-carbon transition and (3) enabling conditions as implied in domestic climate legislation.

Along with fair burden sharing, we also seek to understand the risks of low-carbon transition faced by countries with respect to just transition. Second, we outline the low-carbon transition risks facing countries along two dimensions: (1) macroeconomic risk and (2) distributional risk. Third, we compare the national climate change laws of six countries, i.e., the United Kingdom, Australia, South Korea, Mexico, Pakistan and the Philippines. We analyse the legal provisions in terms of the national circumstances, scope and utility of the law in light of the capabilities and responsibilities of the country.

[306] IPCC (2022)
[307] IPCC (2018); Schipper et al. (2022)
[308] Lee (2019); Devadason (2019)

5.2 A Fair Share of Burden

The Paris Agreement pronounced the global objective of climate stabilisation as:

> *Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels[309].*

Following this global goal, the IPCC defined the "carbon budget", the "net amount of GHG humans can still emit without exceeding a chosen global warming limit"[310]. IPCC (2018) pointed out that for a 50% chance of holding temperature rise 1.5°C above pre-industrial levels, global cumulative emissions should not exceed 500GtCO_2e from 2019[311]. However, emissions have continued to grow rather than tapering off, leaving a remaining budget of around 275 Gt CO_2e in 2023[312]. Thus, the world has seven years before using up all of the budget, assuming the same emissions level in 2023 continues (see Chapter 3).

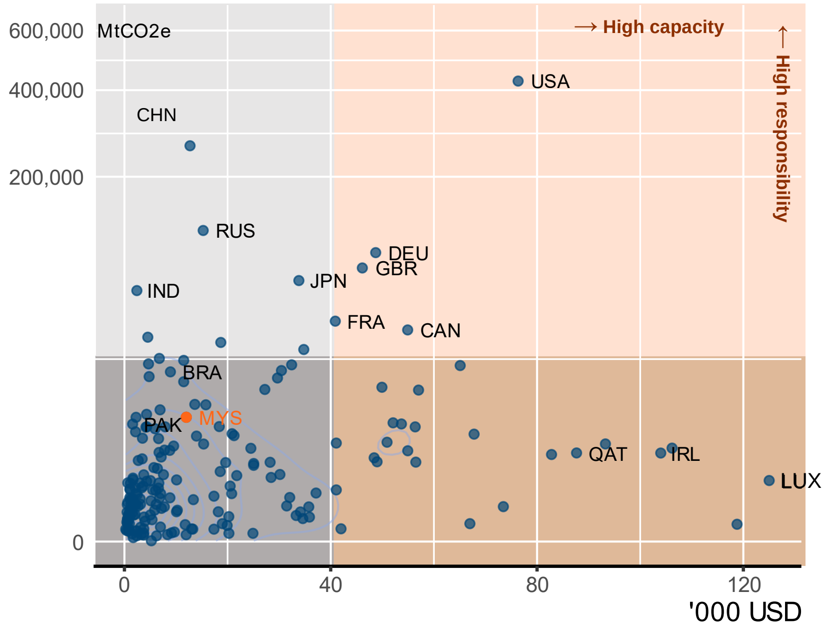
The climate effects of 1.5°C warming above pre-industrial levels will lead to "unavoidable increases in multiple climate hazards and present multiple risks to ecosystems and humans"[313]. In order to prevent disastrous climate effects, all countries should cooperate to limit their collective emissions within the carbon budget; however, this issue is complicated by the fact that climate change's adverse impacts will be more detrimental to developing nations, which have higher vulnerability and lower historical responsibility. Meanwhile, the problem is disproportionately caused by historical emissions of a handful of countries that often have greater capabilities to address it (Figure 5.1). For the global climate effort to be equitable, the distribution of effort among countries **should not** be equal.

Burden-sharing frameworks inform the distribution of climate obligations among countries and other global actors. The idea is simple: each country is allocated a burden based on its differentiated responsibilities and capabilities. There are different ways of operationalising this. Some frameworks employ the "emissions right" concept, assigning each person an equal emission allowance and subtracting them as debt in the case of over-emitting. Others allocate a mitigation obligation to each country based on past emissions and current capability.

In either case, some form of compensation needs to be transferred for burden-sharing schemes to be fair. To illustrate the present inequity, we compare the fair shares of burden that developed and developing countries.

[309] UNFCCC (2015)
[310] Lamboll et al. (2023)
[311] IPCC (2018)
[312] Friedlingstein et al. (2023)
[313] IPCC (2022)

Figure 5.1: Cumulative emissions and GDP per capita by country in 2022



Source: Friedlingstein et al. (2023); Author's visualisation

Operationalising CBDR-RC

The concept of Common but Differentiated Responsibilities and Respective Capabilities (CBDR-RC) can be operationalised in various ways. At its core, the principle focuses on differentiation among actors. A metric that allows assessment and differentiation of responsibilities and capabilities among various actors is needed. Historical emissions, measured in tCO_2e, are commonly used to indicate an actor's contribution to the problem (see Chapter 3). Meanwhile, the commonly used measure for capability is GDP per capita, which proxies the average income of a country's population. GDP per capita correlates with many human development indicators that reflect a country's socioeconomic well-being and living standards[314].

We use the Climate Equity Reference Calculator (CERc) to obtain the fair shares of Indonesia (IDN), Thailand (THA), the United States of America (US) and Malaysia (MYS). Developed by Stockholm Environment Institute and EcoEquity, CERc is based on the CERP framework of burden sharing[315]. The framework allocates climate burden as a share of the global mitigation requirement to meet the 1.5°C-consistent pathway. The framework assigns burdens based on a responsibility capability index (RCI), a combined measure of responsibility in terms of emissions and capability in terms of income.

[314] However, GDP per capita obscures the within-country differentiation between the rich and the poor. It assumes all citizens are equally responsible and capable and thus must expend the same amount in addressing climate change. This assumption is flawed as the rich's consumption is often emission-heavy and has more capacity in mitigation and adaptation, while poorer groups are lower in emissions as they are in capacity.
[315] Holz et al. (2019)

5.2.1. Findings and implications

Tables 5.3 and 5.4 compare the countries' fair share to their pledged NDC targets.

Table 5.1: National mitigation fair share, incl. LULUCF

Country	RCI	Baseline emission	mitigation fair share			emission allowance	
			as tonnes below baseline	as tonnes per capita below baseline	as percent below baseline	as tonnes	as tonnes per capita
IDN	0.72%	2,584 $MtCO_2e$	202 $MtCO_2e$	0.7 tCO2e	7.8%	2,382 $MtCO_2e$	8.0 tCO_2e
THA	0.43%	458 $MtCO_2e$	120 $MtCO_2e$	1.7 tCO2e	26%	337 $MtCO_2e$	4.8 tCO_2e
USA	27.9%	6,363 $MtCO_2e$	7,785 $MtCO_2e$	22.1 tCO2e	122 %	-1,422 $MtCO_2e$	-4.0 tCO_2e
MYS	0.47%	313 $MtCO_2e$	131 $MtCO_2e$	3.6 tCO2e	42%	182 $MtCO_2e$	5.0 tCO_2e

Table 5.2: National mitigation fair share, excl. LULUCF

Country	RCI	Baseline emission	mitigation fair share			emission allowance	
			as tonnes below baseline	as tonnes per capita below baseline	as per cent below baseline	as tonnes	as tonnes per capita
IDN	0.48%	1,102 $MtCO_2e$	130 $MtCO_2e$	0.4 tCO2e	12%	972 $MtCO_2e$	3.2 tCO_2e
THA	0.38%	450 $MtCO_2e$	103 $MtCO_2e$	1.5 tCO2e	23%	348 $MtCO_2e$	4.9 tCO_2e
USA	29.4%	7,174 $MtCO_2e$	7,912 $MtCO_2e$	22.4 tCO2e	117%	-1,193 $MtCO_2e$	-3.4 tCO_2e
MYS	0.47%	390 $MtCO_2e$	127 $MtCO_2e$	3.5 tCO2e	33%	263 $MtCO_2e$	7.3 tCO_2e

Note: Responsibility-Capability Indicator (RCI) is shown as a percentage of the global total.

Table 5.3: National fair share compared to NDCs, incl. LULUCF ($MtCO_2e$)

Country	NDC emission reduction		NDC emission level		Fair share	
	Unconditional	Conditional	Unconditional	Conditional	Reduction	Allowance
IDN	915	**1,240**	1954.1	1629.6	**201.7**	2,382
THA	166.5	**222**	388.5	333	**120.5**	337
USA	**3,317.5 – 3,450.2**		3317.5 – 3184.8		**7,784.8**	-1,422
MYS		**217.32**		85.6	**131**	182

Note: Based on 5(e) of the MYS NDC, we include LULUCF removals data from BUR4 into the quantification of NDC.

Table 5.4: National fair share compared to NDCs, excl. LULUCF ($MtCO_2e$)

Country	NDC emission reduction		NDC emission level		Fair share	
	Unconditional	Conditional	Unconditional	Conditional	Reduction	Allowance
IDN	915	**1,240**	1954.1	1629.6	**130.4**	972
THA	166.5	**222**	388.5	333	**103**	348
USA		**3,317.5 – 3,450.2**		3317.5 – 3184.8	**7,912.1**	-1,193
MYS		**126.37**		403.9	**127.1**	263

Note:

1. The BAU baseline for IDN and THA in this table refers to the updated NDCs submitted by respective countries, which are different from the CERF baseline derived from the CERF method. Indonesia's projected BAU in 2030 is est. 2.87GtCO_2e (Indonesian Enhanced NDC, 2022); Thailand's projected BAU in 2030 is est. 555MtCO_2e (Thailand 2nd updated NDC, 2021). The US baseline (net emissions in 2005) is reported at 6635MtCO_2e, referred to updated NDC (US updated NDC, 2021).
2. MYS NDC is quantified in emission intensity following the reference indicator reported in BUR4.
3. Shaded cells denote NDCs without conditionality. MYS updated NDC in 2021 has removed conditionality, which expanded the 35% unconditional and 10% conditional targets to a target of an unconditional reduction of 45% of economy-wide emissions intensity (MtCO_2e/GDP) relative to 2005 levels.

Indonesia and Thailand's conditional and unconditional NDC targets are above their fair share of emission reduction. This means that these countries are, at least by pledged ambitions, contributing more than a fair amount to solve global warming.

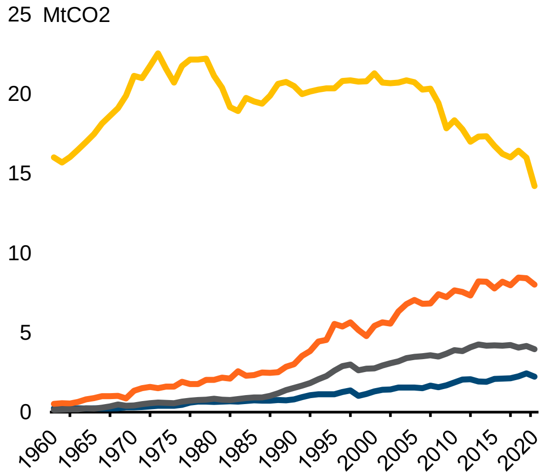
Malaysia's NDC target exceeds its fair share of emission reduction by almost 165% when considering LULUCF removals, but falls 1% below its fair share when excluding LULUCF removals. This is assuming that Malaysia's GDP continues to rise at a CAGR of 4.5%, as the country's pledge is in terms of carbon intensity[316]. This means that economic performance can significantly influence Malaysia's attainment of its climate goal. Nonetheless, this should be viewed against developed countries' pledges and performance rather than on its own.

The US's NDC targets, both the upper and lower bounds, deviate from their fair share by more than 4GtCO_2e in both scenarios. The country's NDC target range—aiming for 50–52% lower emissions compared to 2005 levels—falls short of more than 40% of the country's fair share of required emission reduction. CERc suggests that, in fairness, the US should achieve net-negative emissions before 2030. In contrast, developing countries like Malaysia, Indonesia and Thailand are pledging more mitigation than what would be considered their fair share.

To put things into perspective, the combined historical emissions of Indonesia, Malaysia and Thailand make up a little less than 30GtCO_2e, merely 6.6% of what the US emits throughout history. Economic development and emissions in all three Southeast Asian countries, in our comparison, only started to grow recently. It was towards the end of the 1980s that the per capita emissions of Indonesia, Malaysia and Thailand truly picked up and diverged (Figure 5.2). However, the income levels of all four have yet to equalise, much less converge with the level of developed countries. GDP per capita in all three countries remains significantly lower compared with the US (Figure 5.3).

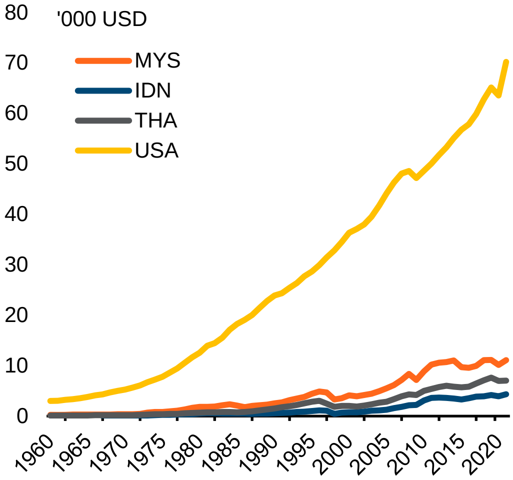
[316] See Khoo (2023) for methodological notes,

Figure 5.2: Historical CO_2 emissions per capita in selected countries, 1960 – 2021



Source: Friedlingstein et al. (2022)

Figure 5.3: GDP per capita in selected countries, 1960 – 2021



Source: World Bank (n.d.)

Assuming the US can achieve its NDC by 2030, the reduced emissions would be nearly double the emissions reduced of the other three countries combined. More importantly, the US's fair share of emissions reduction is already twice what the country has pledged to achieve. This illustrates the core challenge of global climate burden sharing: countries with greater responsibility and capability to move the needle are effectively pledging or doing less than their fair share.

Such arguments, however, are less tenable in a world where the distinction between developed and developing economies blurs at the margin—rapidly industrialising countries like China and India have seen their cumulative emissions outstripping many developed countries in recent years, accompanied by mass improvements in living standards. Nonetheless, per capita cumulative emissions in China and India remain lower than in the US[317].

China sits in the same per capita GDP range as Malaysia (upper-middle income) but possesses much higher technological and industrial capacity. Institutionally, the country also benefits from a highly centralised polity for long-term planning and coordination. These characteristics create meaningful differentiation within developing country groups that GDP per capita-based capability measures cannot capture. Consequently, developing a fair burden-sharing scheme will remain challenging in international negotiations.

[317] 85% and 95% lower than the US, based on per capita cumulative emissions since 1950 (Friedlingstein et al, 2023; KRI's calculation).

Box 5.1: Limits of emissions reduction pledges as a benchmark

The CERc framework allocates burdens as a share of the required emissions reduction to meet the Paris Agreement global temperature target, the framework subjects all countries to mitigation obligations. This approach is not without issues.

Notably, the fixation on mitigation obscures the different roles and responsibilities of developed and developing countries as provisioned under climate treaties. Under the Paris Agreement, developed countries are obligated to take the lead in pursuing economy-wide emissions reduction and providing technological and financial resources and support in capacity building to developing countries. Developing countries are encouraged to develop adaptation plans and, over time, take on emissions reduction.

Besides, accounting for responsibility with territorial cumulative emissions also discounts the colonial history and history of emissions outsourcing[318] (see Chapter 3). Simply assigning all countries with mitigation role can be reductive. Developing countries have critical needs to achieve equally important development goals such as raising income and welfare and more importantly, the need to defend them by improving resilience against climate impacts.

Different approaches to burden sharing can lead to varying levels of burden allocation. These approaches are distinguished by their underlying ethical assumptions. The carbon debt framework developed in Khor (2020) and Fanning and Hickel (2023) is one example of a different approach of burden sharing[319].

The carbon debt approach argues that the historically disproportionate appropriation of atmospheric resource by a minority group of individuals towards their own prosperity impinged on others' right to an equal share of the atmospheric resource. This approach emphasises equal individual access to atmospheric resource. It requires those who historically expend more resource to "pay for the carbon debt" by undertaking mitigation, while exempting those who underutilised their fair share of atmospheric resource from mitigation obligations.

The various approaches underscore the continued debates in determining a fair global collective climate action, and the struggle for an equitable international climate governance.

[318] Evans and Viisainen (2023)
[319] Fanning and Hickel (2023)

The foundation of any fair system for sharing global burdens lies in two key acknowledgements: the historical disadvantages faced by developing countries and the ongoing inequities they experience. With this recognition, the world can work towards solutions that address these disparities and ultimately achieve climate-resilient sustainable development.

As highlighted by the IPCC's recent report, there is no room for delay in mitigation and adaptation[320]. Developing nations must make significant changes to avoid unpredictable future damage, even though their impact on total emissions is limited. In this context, it would be unfair to expect these developing countries to sacrifice their development prospects for a potentially lower chance of climate success. This is especially true when highly capable and historically responsible nations have yet to set a strong example. **For global sustainable development to be fair, developed countries ought to provide meaningful, new and additional finance, as well as enhanced and unconditional support through technology transfer and capacity building.**

Malaysia's NDC commits the country to economy-wide carbon intensity reduction, which presents two challenges. First, the country must continuously improve its GDP-to-emissions ratio. Carbon intensity ties GDP growth to emission efficiency, requiring GDP to grow at a higher rate than emissions. This requirement puts a bigger pressure on Malaysia to transition away from inefficient carbon-intensive energy consumption, facilitated by low-emission energy sources like renewable energy. Second, conserving and expanding available carbon sinks are crucial for reaching emission target. In the case of higher emission intensity (lower GDP with higher emissions), emission offsets become the primary source of abatement. Both of these needs are costly and unjust if Malaysia is to pursue without support.

Malaysia decided in 2020 to raise its ambition by removing conditionalities in its NDC. The lack of conditionality may limit the country's ability to secure international resources. To secure the necessary resources and technological transfers needed for pursuing sustainable development, voluntary partnerships or bilateral agreements can be helpful, provided the negotiated terms are fair. NDCs are revised every five years. The next round of ratcheting, due in 2025[321,322] provides an opportunity for Malaysia to define fairer terms in its NDC.

5.3 A Just Transition

Climate-resilient sustainable development hinges on the transition to a greener economy. This entails transforming critical infrastructures, energy systems and socioeconomic activities into more sustainable ones[323]. Transformations must achieve two goals: (1) reducing emissions and (2) adapting to the physical impacts of climate change. However, transition presents a significant distributional challenge. Transition requires substantial upfront costs, the costs and benefits will likely be unequally distributed across countries and social groups. It is key that policies consider potential inequitable outcomes of transition. The design of climate policies should, if not correct for present inequities, avoid creating new inequities.

---

[320] IPCC (2023)
[321] Fransen et al. (2023)
[322] Paris Agreement Article 4.9.
[323] Schipper et al. (2022)

In developing countries, transition can entrench prevalent social gaps. Ordinary and vulnerable people can be impacted by inflation, income loss and energy insecurities as a consequence of unmanaged and unjust transition, in addition to the adverse physical climate impacts, which entail similar socioeconomic effects. Developing countries also face challenges in climbing the economic growth ladder. Climate change and transition can disrupt their traditional growth prospects by limiting previously viable industrial development pathways. Furthermore, the emerging technological regime that underpins green or low-carbon value chains can be particularly difficult for developing countries to reorient their developmental strategies around. This is due to varying institutional capacities and resource constraints they must navigate[324].

Governments of developing countries must operate under mounting constraints to capture economic prosperity and promote living standards in respective societies. Below, we explore the risks of inequities implicated by an unmanaged transition, we look at both (1) macroeconomic risks impacting national economies and (2) distributional risks focusing on households.

5.3.1. Macroeconomic risks

Economic output

Scientists use computational models to simulate how development might progress under limitations imposed by climate change. These models aim to identify pathways to keep global warming below the 1.5°C threshold. The IPCC reports the results of these simulations in the form of modelled mitigation pathways, which represent the potential future development trajectories under different emission scenarios.

Research by Kanitkar, Mythri and Jayaraman (2022) suggested that these modelled pathways reveal deeply unfair economic consequences for developing countries[325]. Modelled pathways that followed a 1.5°C-aligned emission trajectory supported an overall global economic growth, but not equally across countries. The models assume global economic growth patterns that do not promote convergence[326]. In other words, the modelled pathways for a global transition to a low-carbon world place an unfair burden on developing countries, leading to unequal development outcomes.

Inequality can arise from complex shifts in production and trade patterns, as well as cascading effects across value chains during the transition.

One key assumption is that global transition tends to drive down fossil fuel demand while raising demand for low-carbon technology and critical minerals. An accelerated transition can result in market imbalances, leading to unpredictable price changes in primary commodities, energy and final goods. This is partly due to the incongruities of national policies and interdependencies of global energy trade, as exemplified by the recent Russo-Ukrainian war and the resulting energy crisis in Europe, which has disrupted progress on energy transition made in the name of energy security[327].

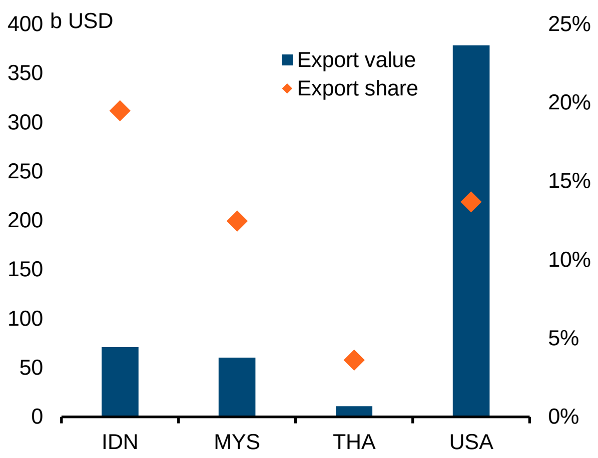
Espange and colleagues (2023) argued that the midway of the global transition will likely be characterised by the parallel development of low-carbon technologies and the persistence of fossil-

[324] Herman (2023); Lebdioui (2024)
[325] Kanitkar, Mythri, and Jayaraman (2022)
[326] Ibid.
[327] Harvey (2022)

based infrastructures[328]. The uneven levels of lock-in, factor endowments and capabilities across countries can lead to unequal economic risks from global transition.

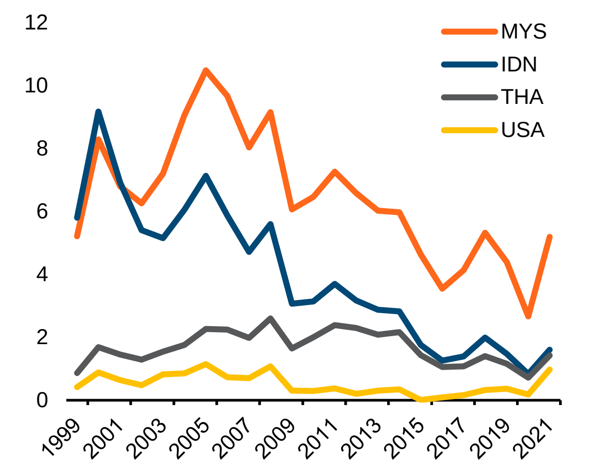
Global transition drives the phaseout of fossil-based energy production and the growth in demand for low-carbon technology. This shift causes imbalances in the global energy trade. Contracted fossil fuel demand will primarily accrue to low-cost producers, while high-cost producers will likely bear the brunt of this imbalance[329].

Figure 5.4: Value of fossil fuel export and export share, 2021



Source: UN Comtrade (n.d.)
Note: Fossil fuel exports include commodities under the category HS 27.

Figure 5.5: Total natural resource rent, 1999 – 2021 (% of GDP)



Source: Word Bank (n.d.)
Note: Total natural resources rents are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents and forest rents.

Figure 5.4 shows that Indonesia ranks highest in fossil fuels as a share of total exports, followed by the US and Malaysia. As shown in Figure 5.5, Malaysia ranks the highest among the compared countries in terms of natural resource rent as a share of GDP, including fossil fuel rent. Diversification away from this high dependence on fossil production will be particularly critical for Malaysia and Indonesia as global transition forges ahead.

The growing valence of low-carbon technology also shifts demand for critical minerals and related end-products. However, the extent to which developing countries can benefit from this shift varies. Commodity-dependent developing countries face higher structural barriers to enter high-value-added segments of the green value chain. In comparison, developed countries with more resources for technological capabilities development are poised to extract higher gains (Figure 5.1).

Without transforming the foundational conditions, global development under changing circumstances will likely entrench the current patterns that suppress development for some while disproportionately enriching others.

For middle-to-low-income countries, substituting dirty capital and labour for new green ones may be costlier compared to developed countries. The social opportunity cost of investing in green sectors is

[328] Espagne et al. (2023)
[329] Ibid.

often higher for these nations. This is due to more pronounced competition for limited resources by other equally important sectors, where the same investments could be directed towards vital social goals like poverty alleviation and ensuring basic food security.

The rush to rapidly phase out carbon-inefficient equipment can create stranded assets—capital equipment and physical assets that will be retired before the end of their economic life. For the transition to be economically viable, the returns from new investments in the economy must be able to offset the costs of stranded assets. Besides the environmental benefit from lowered emissions, the investment multiplier should be sufficiently significant to make sense. This is a tall order for many developing countries still grappling with constraints of lower institutional capacities, not to mention many are burdened with debt distress[330].

Fiscal sustainability

Transition is costly. It requires large upfront investment on risky projects that do not guarantee the same returns that one might expect from other similar-scale investments. Financing transition can also be more costly in developing countries with lower sovereign credit ratings[331]. Low-income developing countries with debt distress rely on concessional finance or grants to foot their climate bill. These are often adaptation finance, which pales in comparison to the size of mitigation finance, made up of predominantly market-rate debts[332, 333].

For middle-income countries with transitional economies, access to concessional rates or grants can be limited. Private finance and domestic public resources become crucial in driving transition. Higher risk ratings lead to higher capital costs for climate projects in developing countries, making them less viable for private finance[334]. Public finance is crucial for projects that involve little to no direct financial returns, which is often the case for adaptation initiatives and critical public infrastructure projects.

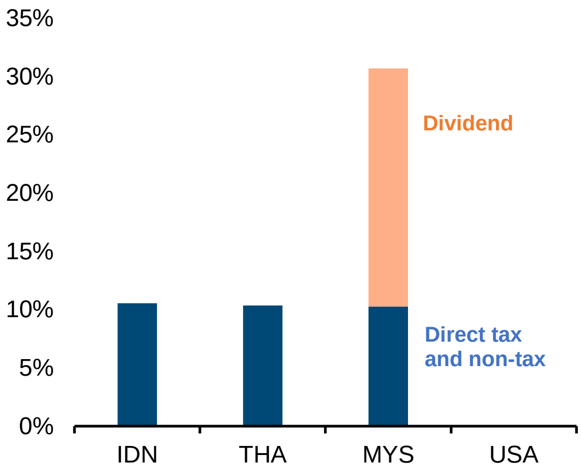
Developing countries with limited public revenue sources often rely on income from natural resources such as fossil fuels. This dependency directly exposes some nations to the impacts of the transition. For example, in 2019, fossil fuel income—including tax and non-tax revenue—accounted for around 10% of the total government income in Indonesia, Malaysia and Thailand. If we consider windfall dividends from national oil companies, Malaysia's income from fossil fuel stood at 30.5% of total government revenue (Figure 5.6). This figure fluctuated about a quarter of government revenue from 2019 to 2022. Global transition poses risks to fiscal resources relying on fossil fuel income, while the need for bigger outlays during transition can push governments into further fiscal deficit.

Developing countries also spend a significant amount on energy subsidies. Figure 5.8 shows that Indonesia and Thailand spend the most on energy subsidies, with the bulk subsidising natural gas and petroleum. In contrast, developed countries like the US spend more on clean energy than affordable measures (Figure 5.9).

---

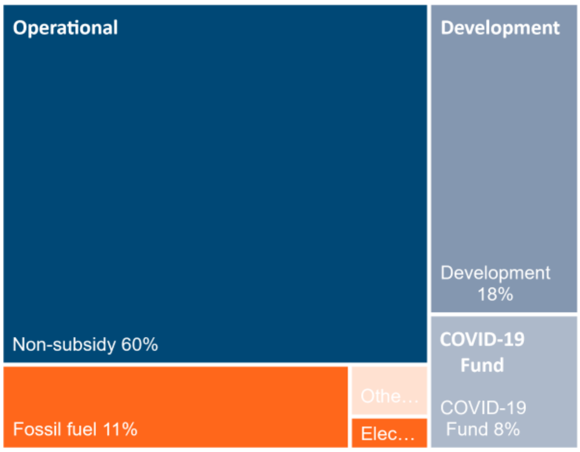
[330] Wade (2023)
[331] Avantika Goswami and Ananya Anoop Rao (2023)
[332] UNFCCC Standing Committee on Finance (2022)
[333] Mitigation composes 57% of the total climate-specific financial support through bilateral, regional and other channels in 2019 – 2020 (UNFCCC Secretariat, 2023). Concessional finance, e.g., grants and low-cost project debt made up 15% of the total 2019 – 2020 average (Naran et al., 2022)
[334] Avantika Goswami and Ananya Anoop Rao (2023)

Figure 5.6: Fossil fuel as a share of government revenue, 2019 (per cent)



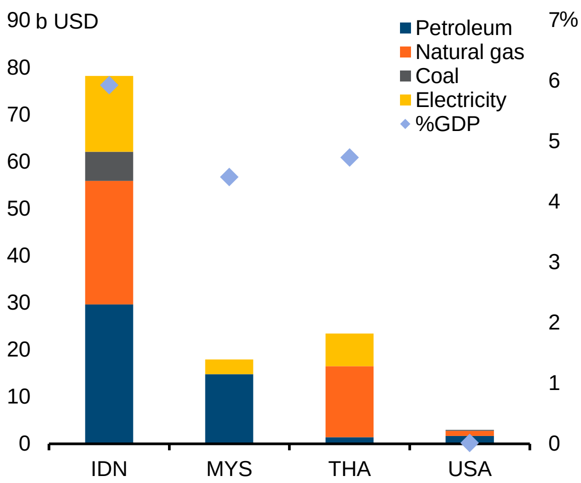
Source: IMF (n.d.); BNM (2021); MOF (2021); CEIC (n.d.)
Note: Data in local currency normalised by KRI. Fossil fuel source of government revenue inclusive of direct income tax for petroleum and natural gas, mining (IDN) and non-tax revenue. Non-tax revenue other than royalties are not included, e.g., inclusive of PETRONAS dividend pay-out, MYS O&G share will bump up to 30.5%.

Figure 5.7: Total government expenditure by use-type in Malaysia, 2022



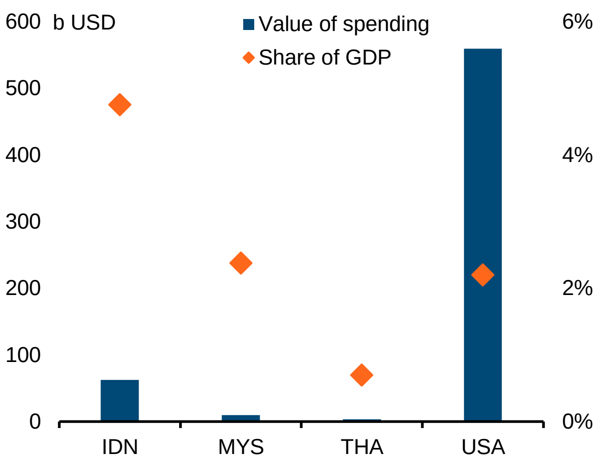
Source: National Audit Department Malaysia (2023); Author's visualisation

Figure 5.8: Explicit energy subsidies spending in selected countries, 2022 (USD billion)



Source: IMF (2023)

Figure 5.9: Government energy spending (USD billion) and as a share of GDP (% of GDP)



Source: IEA (2023)
Note: IEA Government Energy Spending Tracker measures two types of energy spending: clean energy investment support and consumer energy affordability measures.

Developing countries need to ensure energy security and manage energy affordability. Household energy burden, which measures household energy expenditure as a share of income, can be improved by raising the denominator. Development goals like raising the average household's income and reducing economic inequality intersect with low-carbon transition, supporting or impeding a just transition. However, middle-income developing countries facing stagnating growth[335] also face challenges in achieving these goals.

5.3.2. Distributional risks

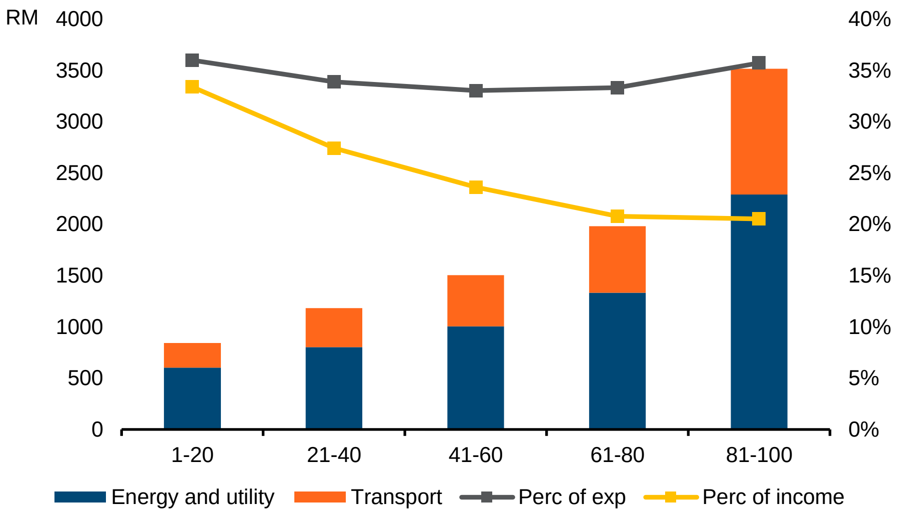
Use-side effects

Low-income households face challenges in weathering the inflationary pressures caused by energy transition. Transition can drive structural inflation in three ways: (1) price pressures created by supply-demand imbalances of fossil fuel and critical minerals in the absence of sufficient green energy replacements[336], (2) higher government demand and public debt financing for green projects[337], and (3) intermediate cost pass-throughs of carbon pricing.

The inflationary pressures from energy price hikes have significant distributional implications, as households vary both in their exposure to these price increases and in their capacity to respond to them. We discuss two ways in which transition policies can entail distributional impacts.

First, the implementation of price-based policies such as carbon pricing instruments and subsidy removals can cause inflation in princes of energy and essential goods, disproportionately affecting poorer households. Because energy is used in all types of production, a price on carbon can inflate the input cost for all types of products, which can be reflected in price. The extent to which costs can be passed on to consumers will depend on the price elasticity of the goods and services. Often, demand of essential goods, including energy, is inelastic. Because expenditure on energy as a share of income tends to be regressive (Figure 5.10 yellow line), the cost increase burdens low-income groups more than high-income groups.

Figure 5.10: Monthly energy expenditure by household income quintiles in Malaysia, 2022



Source: DOS (2022), Author's visualisation

In Malaysia, for example, the monthly expenditure on energy products, including transport, takes up 33% of the monthly income of the poorest households (Figure 5.10). This is 12% more than the wealthiest households. In the transition process, inflated energy costs can significantly reduce a

[335] Kaldewei, Gu, and Dong (2023)
[336] van der Watt (2022)
[337] Romero and Marín (2017); Ibid.

household's disposable income if income growth does not catch up with inflation, which will further impoverish poor households and cause irreversible losses that undermine their prospects of escaping poverty[338].

Second, constrained by lower income levels, poorer households face difficulties financing energy-efficient equipment and changing to low-emission energy use. The options for private transition such as electric passenger vehicles and residential rooftop solar generation, remain largely accessible only to well-off groups.

Poorer households' ability to transition their remaining energy-use depends on the transition of public utilities. Owing to rapid improvements in variable renewable energy (VRE) technologies, generation cost of VRE like solar power have become cheaper. However, the complete transition of the entire power system remains costly. This is in part attributable to the need to expand the power system capacity itself to meet higher demands from higher electrification, as well as the balancing reserves, storage capacities and grid reinforcements required by the higher variability of renewable energy sources. The high grid investment costs needed for renewable integration, if done without proper burden-sharing schemes with power producers, can entail upward price pressures on electricity tariffs.

This does not mean that a policy's worth is solely determined by its affordability; rather, its distributional impacts must be carefully considered. Market-based instruments that aim to correct price fail to directly address the problem of high energy cost relative to household income, which subjects households to already high energy burdens. Government subsidies have long been the stopgap measure to address affordability. Abrupt removal is akin to pulling the rug from under marginalised economic groups, further the squeeze on household expenditure. Targeted, staggered subsidy removal can partially ease direct inflationary effects, but it should nevertheless be implemented alongside efforts to improve household income.

Source-side effects

Job loss has been frequently cited as a stumbling block to just transition. As the history of coal phaseouts demonstrated, workers affected by phaseouts left without support can be particularly hard-hit by loss of livelihood.

Transition involves replacing fossil-based technology with green, low-emission technology. This technological shift fundamentally changes how humans derive energy. The impact extends beyond physical infrastructure but to human labour embedded throughout the energy system—from extraction and transformation to generation. Alongside job displacements from fossil fuel and energy production phaseouts, techno-optimists argued that new jobs will also be created elsewhere in the low-carbon value chain as demand for low-carbon technology grows.

This process can lead to "frictional technological unemployment"—a situation where new jobs created do not seamlessly match the skills of existing workers in the labour market[339]. Transition entails a reallocation of capital and employment across sectors, differentiated by their skill

[338] Yemtsov and Moubarak (2018)
[339] Susskind et al. (2020)

requirements, productivity levels and bargaining powers. International labour flows and trade further complicate domestic reallocation.

Theoretically, job creation in clean energy, building and green transportation sectors can offset losses in traditional sectors, leading to net employment gains[340]. However, these aggregate figures do not reflect the qualitative differences between lost and gained jobs. Low-value or low-quality jobs may dominate the new sectors, offering little improvement for displaced workers.

Studies suggest that job losses in fossil fuel producer countries are often not fully compensated by new jobs, while importer countries may see a net gain[341]. This is because high-value segments of the low-carbon value chain tend to be concentrated in a handful of economies. Without adequate technology transfer, developing nations risk being trapped in the role of primary commodity exporters, with limited opportunities for higher-value green industrial development.

Transition can also exacerbate income inequality through "functional distributional effects." These effects arise from compositional shifts in the economy during the transition, often disproportionately burdening workers compared to capital owners[342]. For example, emissions regulations and energy taxes without accompanying support measures can lower wages for workers in traditional sectors while profits remain relatively unaffected for companies in those sectors[343].

Green sectors are often capital-intensive, meaning they rely heavily on investment. Investors are typically unwilling to accept lower returns for the risks involved in these new industries[344]. This translates to a higher share of profits going towards capital owners than labour. Additionally, young sectors with a high proportion of unorganised labour often see lower wages due to weaker bargaining power. Increased job substitution in these sectors further widens the income gap[345]. Even when net employment gains occur, they may be driven by investment in low-productivity, labour-intensive jobs. Examples include solar panel manufacturing and building weatherisation[346]. While these sectors contribute to overall employment growth, wages tend to be lower than traditional sectors like electricity and Oil & Gas, which have higher labour productivity[347].

5.3.3. LT-LEDS

Following Muttitt and Kartha (2020), an equitable managed transition must take into account the developmental needs and fair burden-sharing of the transition process[348]. The authors argued that addressing the distributional question requires countries to assume differentiated roles in an equitable global phaseout of fossil fuel extraction. They propose two key normative principles: (1) phaseout should happen the fastest where the social cost of doing so is the least and (2) the largest burden should be borne by those with the greatest ability to pay.

[340] Chateau, Bibas, and Lanzi (2018); IRENA and ILO (2021)
[341] Mercure et al. (2021)
[342] Vona (2021)
[343] Ibid.
[344] IEA (2023)
[345] Luciani (2020)
[346] Jobs involving weatherproofing and modifying buildings to withstand climate variations and optimize energy efficiency such as housing insulation.
[347] Luciani (2020)
[348] Muttitt and Kartha (2020)

The Paris Agreement invites all parties to "strive to formulate and communicate long-term low greenhouse gas emission development strategies (LT-LEDS)" [349]. LT-LEDS informs national long-term indicative planning towards achieving climate objectives.

Because LT-LEDS has primarily been focused on mitigation, it has progressively become "a proxy for countries' vision on how to reach net zero emissions" [350]. Almost all LT-LEDS involve energy system surveys that inform domestic energy transition, mainly in power production[351]. We compared the LT-LEDS of developed and developing countries to assess their transition commitments against their fair share[352].

Figure 5.11: Timeline of NDCs and LT-LEDS target (2025 – 2065)

	2025	2030	2050	2060	2065
IDN		**LCCP** Emissions peak at 1.27GtCO_2e **Uncon. NDC 31.89% below BAU** **Con. NDC 43.2% below BAU**	**LCCP** 540MtCO_2e **TRNS** Emissions peak	**LCCP** Net-Zero GHG	
THA	**Carbon Neutrality** CO_2 emissions peak **Net-zero GHG** Emissions peak at 388MtCO_2e	**Uncon. NDC 30% below BAU** **Con. NDC 40% below BAU**	**Carbon Neutrality** Net-zero CO_2		**Net-zero GHG**
USA		**NDC 50 – 52% below 2005 levels**	NDC Net-zero GHG		

Source: KRI compilation
Notes: Uncon. NDC (Unconditional NDC); Con. NDC (Conditional NDC), BAU (Business-as-usual scenario)

All countries' LT-LEDS in our comparison have taken on net zero as an aspirational goal, differing primarily in the scope of covered gases and the target landing years.

LT-LEDS often uses scenario pathways, which represent trajectories by sector under pre-defined emissions constraints. Governments set an emissions target, then project the required economic-wide emissions reduction to meet that target. This is often done by simulating changes in each economic sector[353]. As it is a back-casting exercise, the contribution of each sector to emissions reduction reflects a reasoned economic decision by the policy maker. For example, Thailand's emissions reduction strategy focuses primarily on the power sector, while Indonesia has assigned the AFOLU sector the main mitigation task due to its high emissions[354]. Both Thailand's and Indonesia's LT-LEDS employ at least three scenario pathways for potential emissions-development trajectories, ordered by ambition from lower to upper bounds.

A tall order for developing countries is to ensure economic prosperity and uplift their population while simultaneously reducing GHG emissions. This challenge is particularly acute for two types of economies: resource-dependent economies, where scaling back high-emitting sectors is socially

[349] Article 4.19
[350] Waisman et al. (2021)
[351] IEA (2023)
[352] Khoo (2023)
[353] Because the total emissions under a pathway is constrained by a geophysical carbon budget, decisions in one sector affect the efforts required from others.
[354] AFOLU sector contributed to 50.13% of the total annual emissions in Indonesia as of 2019

costly due to large population dependency, and industrial economies with growing demand for cheap energy.

Indonesia exemplifies the resource-dependent case, with its regional coal industries creating a deep fossil fuel lock-in within the economy [355]. The Indonesian LTS-LCCR (Long-Term Strategy for Low Carbon and Climate Resilience) aims for the power system to transition to a 43% renewable energy mix by 2050, while coal will still provide nearly 38%. Under the upper bound pathway, fossil fuels are projected to remain the primary energy source until 2050, based on a larger aggregate supply. The power sector's emissions abatement is expected to depend heavily on CCS. This measured ambition reflects Indonesia's attempt to negotiate a balance between economic loss and climate outcomes[356].

Thailand's LT-LEDS illustrates the challenges faced by newly industrialised economies. The energy sector is expected to deliver a major share of total emissions reduction by 2050, with renewable energy targeted to reach 74% of total generation. Thailand's growing industrial base is expected to drive energy demand up to 122.6 – 248Mtoe by 2050. The power sector must ensure a secure and affordable supply to meet this growing demand, of which electricity comprises nearly 30%.

Over the past decade, Thailand has grown increasingly reliant on petroleum and natural gas for electricity generation. Natural gas price instability and limited energy source diversity have underpinned Thailand's need to transition to renewables. Nonetheless, its success is contingent upon the cost of VRE systems and their integration, which can often be high[357]. The transition is already projected to result in a welfare loss of 3.7% of GDP and a macroeconomic loss of 1.3%, provided lower consumption and higher investment costs.

The US's LT-LEDS outlines a pathway to achieve net zero GHG latest by 2050. This goal will be reached through energy system transformation and enhanced CDR utilising both land-based carbon removals and CCUS. The energy system is expected to contribute to 70% of the emissions reduction, equivalent to 4.5GtCO_2 per year by 2050. Contrasted with its own NDC, the US's LT-LEDS projected emissions to decline to 26 – 28% by 2025, and drop sharply to 50 – 52% within the next five years. As discussed in section 5.1, the US's pledged targets are lower than its fair share. Under the principle of CBDR-RC, the US ought to take on the burden of reducing not only national emissions but also assist the transition of other developing countries.

Malaysia is positioned as an upper middle-income country among the developing countries. The country now boasts a growth pattern that has since diversified from the resource-based economy of the colonial period. However, the country still depends on fossil fuel resources for national income and government revenue (see *Fiscal Sustainability*).

Moreover, subnational disparities in economic development and energy access persist. Some states experience higher poverty rates and energy insecurity than others. This disparity challenges efforts to ensure the resilience of the entire country to both climate impacts and transition risks. In developing a long-term low-emissions development strategy, the country would have to balance the

[355] Bulmer et al. (2021); World Bank (2023)
[356] The LTS-LCCR modelled cumulative production loss of USD218b in the coal sector (p. 67). This prompt the need for regional economies to diversify away from extractive industries and prepare the workforce to transition, all of which constitute risk to development.
[357] IEA (2018) analysis on the Thailand Power Development Plan's RE target showed that VRE systems are attractive only when compared to gas-fired plants, while being outcompeted by coal. IRENA (2017) estimated the required annual investments until 2036 is 2.6b USD/year.

distribution of socioeconomic costs across geographies and groups while ensuring economic growth at lower emissions. This involves improving the economy's carbon intensity at the source while accommodating growing energy and resource demand.

Along with economic growth, Malaysia's energy demand is expected to grow over the mid-term. The recently introduced National Energy Transition Roadmap (NETR) projected total final energy demand will rise above 100Mtoe by 2050[358] from 57Mtoe in 2021.

As a mid-term plan for the energy sector, the NETR envisions a target of net zero emissions in the energy sector by 2050. The energy sector is expected to deliver 32% of GHG emission reductions relative to the 2019 baseline by 2050. The plan projected that the primary energy supply will remain delivered mainly by natural gas (57Mtoe, 56%), followed by RE (23Mtoe, 22.5%). The plan relies significantly on removals through carbon sink to meet the net zero target, with uncertainties surrounding both achievement and potential sink degradation (see Chapter 3)[359]. Additionally, a persisting reliance on natural gas can expose the country to stranded assets and price shocks potentially exacerbated by carbon pricing policies.

Equitable transition strategies are crucial to mitigate these risks. The country should address potential labour market disruptions by fostering reskilling programmes while mitigating brain drain. Additionally, bolstering labour income and considering long-term capital share implications are essential[360]. Policy interventions should also aim to cushion the impact of rising energy costs, particularly on lower-income groups, through targeted electricity market reforms. Diversifying fiscal revenue streams from reliance on fossil fuel income is equally vital. The recent subsidy rationalisation is a welcoming start to address fiscal sustainability. Still, the structural issue of weak and unequal household income growth underlies the resilience of the general population to climate impacts and energy security.

Scenario modelling can provide valuable insights into these cross-sectoral interactions, complementing the current energy-focused plan. Ultimately, an equitable energy transition requires identifying and mitigating potential distributional inequities. A clear and just climate target, aligned with Malaysia's development needs and capabilities, is key to securing international support and achieving its climate goals.

[358] KRI's calculation based on the 2% annual compounded growth rate projected by NETR (p. 9) upon final energy demand in 2021 reported final energy demand by Energy Commission (Around 103.7Mtoe).
[359] NETR projected the remaining 215 $MtCO_2e$ reduction to reach Net-zero emissions to be sequestered by LULUCF sinks, which assumed a stable size of forest sink from now until 2050 (Ministry of Economy, 2023).
[360] Nithiyananthan Muthusamy, Jarud Romadan Khalidi, and Mohd Amirul Rafiq Abu Rahim (2023)

5.4 An Equitable Institution

Climate institutions are essential in supporting climate-resilient development[361]. Institutions define the "set of rules, processes or practices that prescribe behavioural roles for actors, constrain activity and shape expectations."[362]. As climate change is a problem of global collective action, international climate institutions coordinate global actors towards a common good of lower anthropogenic emissions. The UNFCCC is the main international framework and platform for countries to negotiate and agree upon collective action to address climate change.

Given the long-standing stagnation in international negotiations prior to the Paris Agreement, institutions at this scale have shown inconsistent performance in reaching effective global collective action. Scholars have argued that "scaling down" climate action to national and subnational levels are equally important[363]. National and local institutions have an advantage over international institutions in their proximity to polluting activities and contextual knowledge of climate vulnerabilities, theoretically allowing more effective implementation.

However, there are limits to climate institutions at this scale. Gupta (2007) pointed out that local climate action is limited by its territorial scale. The total global emissions cannot be abated individually when its effects are cross-border[364]. Local institutions are diverse in size and their resource and capacity are limited to solving local, community-scale issues. On the other hand, achieving emissions abatement at production levels, such as within the power sector or MNCs, requires national and international interventions.

Second, subnational actors can be poorly incentivised to pursue climate-resilient pathways. In developing countries, socioeconomic priorities often overshadow environmental priorities. Local governments are often charged with local socioeconomic development mandates. Transition may not immediately prove viable when socioeconomic interests misalign with climate solutions. For example, local authorities in competition over economic investments may undercut each other in lowering environmental protection standards or conservation, leading to a race-to-the-bottom situation that contravenes environmental goals. Institutions should be able to coordinate interests and incentives towards balanced outcomes.

Equity should be the guiding principle underpinning climate institutions. Climate institutions at any given scale should be designed to reflect fairness. The UNFCCC recognises equity through the CBDR-RC principle, assigning different roles to parties with different responsibilities. Similarly, domestic climate institutions can be designed to effectively mediate conflicting interests, social and climate objectives.

[361] Schipper et al. (2022)
[362] Keohane (1988) in Willems and Baumert (2003)
[363] Gupta (2007)
[364] Ibid.

Box 5.2: Equity in the International Climate Legal Regime

Despite clear provisions of equity in international climate treaties, absent an adequate global enforcement mechanism, combined with the voluntary nature of NDCs, a just burden-sharing remains difficult. The Paris Agreement's voluntary pledge system has allowed countries with higher historical responsibility to commit below their fair share of emissions reductions. International negotiations have been marked by political tension between developing countries asserting their right to atmospheric resources and developed countries attempting to equalise the distribution of climate burden.

As some have pointed out, the current climate crisis has obviated room for delayed action in both developed and developing world. Such delays can push the climate system over the tipping point, leading to irreversible environmental damage and adverse climate extremes. Developing countries, however rightful, cannot anymore develop under the exact conditions that enabled carbon-intensive industrial development in the past. This suggests that the key to equitable collective action in a climate constrained world lies in fairly sharing resources to achieve sustainable development. Fairness in development also underscores the need for sustainable development pathways to generate economic prosperity equivalent to that promised by carbon-intensive industrialisation, so that individuals in developing countries would achieve similar levels of economic well-being.

The Paris Agreement has built in mechanisms that allows collaboration and resource transfer. Articles 9, 10 and 11 obligated transfers of financial resources, technological support and capacity building from developed countries to developing countries. The Agreement also provided for carbon trading among countries under Article 6. However, previous international carbon trading mechanisms, such as the Clean Development Mechanism, are widely regarded as failures. Carbon markets are vulnerable to creating perverse incentives and do not necessarily contribute to raising climate action, nor sustainable development.

Aside from mitigation, there are obligations provisioned in the international climate treaties for developed countries to support developing countries through climate impacts. These include promotion of international cooperation of adaptation efforts under Article 7 (7.6 and 7.7) a loss-and-damage fund under Article 8. These legal provisions were the result of a long and arduous negotiation that represents a compromise between conflicting priorities.

This suggests that achieving distributive justice at the international level requires diplomatic means.

5.4.1. National climate laws

At the national level, institutions can perform a dual role of (1) effectuating globally agreed goals at the national level and (2) ensuring equitable processes and outcomes in climate policies.

National climate legislation has become central in constituting global climate action, particularly under the Paris Agreement, where national governments are accountable for their own NDC. Climate legislations are legislative and regulatory instruments that address climate change established by state-sponsored legal means[365]. National climate legislation plays three key roles: establishing (1) institutional and governance structures that include accountability mechanisms, (2) embedding or mainstreaming climate change into administrative structures and acting as (3) a source of authority and credibility[366].

KRI's comparison of six country's framework climate laws, or National Climate Change Acts (NCCAs), analysed qualitative trends across climate legislations in developed and developing countries. The finding shows significant diversity in terms of the scope, utility and relevance of national climate framework laws.

Common elements among all countries include the use of NCCAs to establish (1) institutional frameworks for climate governance and (2) government obligations for climate change planning. However, countries differ in their approaches to both elements owing to varying legal conventions and contextual differences.

For institutional frameworks, establishing a dedicated governing agency (or statutory body) is the most common approach, as observed in the UK, Australia, Mexico, Pakistan and the Philippines. Some countries, including South Korea, Mexico, Pakistan and the Philippines, have implemented cross-governmental coordination architectures, typically through high-level councils that hold periodic meetings.

The establishment of monitoring, reporting and verification (MRV) systems is the least common element among NCCAs, observed only in the UK and South Korea. The UK's MRV system is particularly explicit and complex, being tied to the goal management of five-year carbon budgets—a periodically reviewed emissions cap of which performance is monitored by the central agency Climate Change Committee set under the same law.

The study also identified parting lines between developed and developing countries. The key divergence is in the (1) adoption of legally binding climate targets and (2) the use of NCCA to institute market-based policy tools. Annex I countries like the UK and Australia have formally legislated legally binding emission reduction targets. Among non-annexed countries, Mexico has included a transitory article in the 2018 General Law on Climate Change amendment, with conditional clauses that aim to secure foreign support. The South Korean emissions reduction target is set through an enforcement decree[367]. This provision is absent in developing or non-Annexed countries where mitigation is less of a priority (e.g., Pakistan and the Philippines) or where flexibility is needed (e.g., Mexico).

---

[365] Merner et al. (2024)
[366] Scotford and Minas (2019); Higham et al. (2021); Brunner, Flachsland, and Marschinski (2012)
[367] Enforcement decrees are statutory instruments enacted by administrative power, i.e., the President, of which legal status is equivalent to executive orders (see KLRI, n.d.).

As developed countries are more responsible for causing climate change, it stands to reason that they face more pressure in passing laws consistent with not just international commitments but global objectives of climate stabilisation. For example, the Australian Climate Change Act 2022 directly references the Patis Agreement, which obligates the national target to be consistent with international treaty objectives. This reinforcement of NDC through law could be an internal commitment device for strengthening credibility, which helps signal to international actors a government's devotion to protecting the global public good. However, it may also incur trade-offs in responsiveness in achieving other goals[368].

Another key feature of developed countries' NCCAs is the establishment of carbon markets or emissions trading systems (ETS). These are known as "market-based" policies. Legislation is instrumental in instituting these policies, as formal constraints are needed to establish usage rights for atmospheric resource. This can be achieved through either (1) limiting total permissible emissions and/or (2) imposing a tax on emissions.

The UK implemented an emissions cap through carbon budgets on covered economic sectors, while the South Korea established sectoral emission reduction targets agreed upon by the covered industries under the Target Management System. Both laws grant authority to allocate tradable emission allowances and set up emissions trading scheme[369]. Under this approach, the ability to trade emissions allowances or pollution rights among firms is considered crucial to induce efficient emissions reduction through effective pricing[370].

Carbon taxation offers another means of pricing emissions. Both Australia and Mexico impose carbon taxes on emissions in covered sectors. Mexico has also initiated a pilot cap-and-trade ETS program, though it has not yet entered its operational phase.

NCCAs in climate-vulnerable developing countries, such as Pakistan and the Philippines, include provisions focused on establishing institutional structures that facilitate adaptation. The Philippines mandates the integration of disaster risk reduction (DRR) into development plans and programmes while also establishing a funding mechanism for climate change programs through fiscal transfers to local governments[371]. Pakistan, meanwhile, has designated a Climate Change Fund that appropriates finances for mitigation and adaptation projects under the direction of the Climate Change Authority, set up under the same piece of legislation.

Legislation constitutes only a facet of climate institutions, enacting a law does not guarantee the translation into effective action on the ground[372]. The enforceability of legislation is contingent upon institutional capacity in terms of the buy-in of stakeholders, bureaucratic efficiency and government capacity to perform and implement legislated measures. The effectiveness of legislation also relies on the processes it confers to public scrutiny, redress and MRV.

---

[368] Brunner, Flachsland, and Marschinski (2012); Hovi, Sprinz, and Underdal (2009)
[369] UK ETS was set up in 2021 through The Greenhouse Gas Emissions Trading Scheme Order 2020; KETS followed in the earlier phase of Target Management System (TMS) that covered emissions reduction goals in specified sectors.
[370] Stern (2007)
[371] Through Local Government Code 1991, the Philippines enforces Internal Revenue Allotment to allocate an amount of budget for climate change uses in Local Government Units.
[372] Scotford and Minas (2019)

Table 5.5: Comparison of National Climate Law provisions in six countries

	UK	AUS	KOR	MEX	PAK	PHI
Legally binding mitigation targets	Exist	Exist	Provisional/Adjunct	Provisional/Adjunct		
Adaptation measures	Provisional/Adjunct		Provisional/Adjunct	Exist	Provisional/Adjunct	Provisional/Adjunct
Goal management system	Exist	Provisional/Adjunct	Provisional/Adjunct			
Market						
Carbon tax	Provisional/Adjunct	Repealed		Provisional/Adjunct		
ETS	Exist	Provisional/Adjunct	Exist	Exist		
Non-market						
Planning tool	Exist	Exist	Exist	Exist	Exist	Exist
CAC provisions	Exist	Provisional/Adjunct	Exist	Provisional/Adjunct		Provisional/Adjunct
Active industrial support			Exist	Provisional/Adjunct		Provisional/Adjunct
Financial measures	Exist		Exist	Exist	Exist	Exist

● Exist ● Provisional/Adjunct ● Repealed

Source: Author's compilation

Nonetheless, climate action in the national context does not necessarily require legislation. Observers pointed out the potential underside of legislative capture, which risks delays and increased uncertainty through statutory processes and electoral cycles[373]. The codification of climate mandates needs a clear rationale. From an equity perspective, it is perfectly reasonable to hold developed countries with deep culpabilities to mandates of addressing climate change. This has proven challenging through the international legal regime. Developed countries like the UK have moved to enact NCCA that holds government climate actions accountable[374]. However, to hold countries with fewer responsibilities and higher developmental needs to the same standards may be fundamentally unfair. Governments of developing countries need more flexibility and support to achieve sustainable development goals.

Legislation plays a crucial role in mediating distributional and procedural justice to ensure equity in climate policies. Distributional justice emphasises equitable outcomes of climate action. Distributional risks involve not only the distribution of climate action costs but also the disproportionate burden these costs place on vulnerable communities. Climate-related measures, from large-scale VRE projects to carbon pricing, create significant distributional impacts, particularly in developing countries. Procedural justice requires fair, democratic participation in decision-making that affects community welfare[375]. Environmental organisations have highlighted the risks that carbon offset projects pose to Indigenous customary rights, including procedural violations such as the disregard for Free, Prior and Informed Consent (FPIC)[376].

[373] Hovi, Sprinz, and Underdal (2009); Scotford and Minas (2019)
[374] Horton (2024)
[375] Newell et al. (2021)
[376] Chávez (2024)

Public institutional frameworks can be designed with the objective of safeguarding and promoting equity. As a straightforward example, setting up carbon taxation through law should be complemented by redistributive programmes and social safety nets to cushion its impacts on vulnerable groups. Commonly referred to as "revenue recycling", this is often built into successful carbon pricing models. Needless to say, there are challenges in practice where public services can fall short of theoretical efficiency. Such challenges are even more pressing when implementing mitigation and adaptation together when holistic developmental planning entails sectoral and jurisdictional overlaps.

Institutional challenges in addressing environmental problems are not foreign to Malaysia. The country's Environmental Protection Act, enacted to address pollution, controls only a limited set of pollutants. Traditional institutions, bounded by strict jurisdictions, find it particularly challenging to address the cross-sectoral nature of climate problems[377]. The cross-sectoral nature of the climate problem makes it trickier for traditional institutions bounded by strict jurisdictions. GHG pollution represents just one aspect of the challenge. Mitigation efforts can impact various social priorities, while climate change impacts create additional challenges for physical planning and disaster risk management policies.

In building an equitable climate institution, we suggest a few considerations:

1. **Acknowledge national circumstances.** Malaysia is not a major historical polluter nor a highly developed nation. Climate law should reflect this by considering both managed energy transition and conservation efforts. A flexible goal management system allows for adjustments based on social and climate objectives;
2. **Mobilise international resources.** Climate institutions can secure international support for technology transfer and financing through dedicated institutions.
3. **Mitigate distributional risks.** The law should avoid burdening vulnerable groups or hindering small businesses during the transition. Social protection and industrial support can be funded through strengthened fiscal sources;
4. **Preparing for impacts.** Even with mitigation efforts, some climate change impacts are inevitable. Information on emissions helps us anticipate these changes and prepare for them. This could involve building seawalls to protect against rising sea levels or developing heat-resistant crops; and
5. **Balance development and climate action.** Ensure economic stability for growth while transitioning to a low-carbon economy and adapting to climate impacts. This requires a whole-of-government approach and international cooperation.

[377] Ainul Jaria Bt. Maidin (2005)

Key takeaways

1. **NDC targets present a double-bind to Malaysia's economy and emissions.** Malaysia's NDC target exceeds its fair share of emissions reduction. Moreover, NDC is defined in terms of economy-wide carbon intensity, which puts pressure on the continuous improvement of the GDP-to-emissions ratio. This means that transitioning away from carbon-inefficient energy and conserving existing carbon sinks is crucial in achieving NDC.
2. **Global transition affects Malaysia's economy and domestic public resources.** Malaysia's reliance on fossil fuel resources for fiscal revenue limits public spending capacity, requiring strengthening of fiscal sources and improved household income. The government can implement targeted subsidies to mitigate the impact of inflation on energy products and a wide range of goods and services.
3. **Potential inequities of transition pose challenges to sustainable development and inequitably affect vulnerable groups.** Malaysia's position within the low-carbon value chain determines the types of jobs created, which risks generating more low-productivity, labor-intensive and low-wage jobs. Malaysia is also vulnerable to the physical impacts of climate change, necessitating a balanced approach to planning and investment. The economic opportunities of transition should be strategically captured, with the displacement of high-skill, high-productivity jobs counterbalanced by equivalent job gains in the new sector.
4. **Build fair institutions based on Malaysia's national priorities.** Climate legislation should serve the purpose of mediation of distributional impact and effective implementation of climate actions and policies.

5.5 References

Ainul Jaria Bt. Maidin. 2005. "Challenges in Implementing and Enforcing Environmental Protection Measures in Malaysia." In . Bar Council Malaysia. https://www.malaysianbar.org.my/article/news/legal-and-general-news/legal-news/challenges-in-implementing-and-enforcing-environmental-protection-measures-in-malaysia-by-ainul-jaria-bt-maidin.

Avantika Goswami and Ananya Anoop Rao. 2023. *Beyond Climate Finance: Climate Ambition in the Global South Requires Financial System Reforms*. New Delhi: Centre for Science and Environment. https://www.cseindia.org/beyond-climate-finance-climate-ambition-in-the-global-south-requires-financial-system-reforms-11753.

Bank Negara Malaysia (BNM). 2021. "Economic and Monetary Review 2021." Kuala Lumpur: Bank Negara Malaysia.

Brunner, Steffen, Christian Flachsland, and Robert Marschinski. 2012. "Credible Commitment in Carbon Policy." *Climate Policy* 12 (2). Taylor & Francis:255–71. https://doi.org/10.1080/14693062.2011.582327.

Bulmer, Elizabeth Ruppert, Kevwe Pela, Andreas Eberhard-Ruiz, and Jimena Montoya. 2021. "Global Perspective on Coal Jobs and Managing Labor Transition out of Coal: Key Issues and Policy Responses." Washington, DC: World Bank. http://hdl.handle.net/10986/37118.

CEIC. n.d. "CEIC Database."

Chateau, Jean, Ruben Bibas, and Elisa Lanzi. 2018. "Impacts of Green Growth Policies on Labour Markets and Wage Income Distribution: A General Equilibrium Application to Climate and Energy Policies." Paris: OECD. https://doi.org/10.1787/ea3696f4-en.

Chávez, Luciana Téllez. 2024. "Carbon Offsetting's Casualties: Violations of Chong Indigenous People's Rights in Cambodia's Southern Cardamom REDD+ Project." Human Rights Watch. https://www.hrw.org/report/2024/02/28/carbon-offsettings-casualties/violations-chong-indigenous-peoples-rights.

Climate Policy Initiative. 2021. "Global Landscape of Climate Finance: A Decade of Data." Climate Policy Initiative. https://www.climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-a-decade-of-data/.

Coady, David P, Moataz El Said, Robert Gillingham, Kangni Kpodar, Paulo A Medas, and David Locke Newhouse. 2006. "The Magnitude and Distribution of Fuel Subsidies: Evidence from Bolivia, Ghana, Jordan, Mali, and Sri Lanka." IMF Working Paper 06/247. International Monetary Fund.

Department of Statistics Malaysia. 2023. "Household Income and Expenditure Survey Report 2022". Department of Statistics Malaysia. Putrajaya, Malaysia.

Devadason, Evelyn S. 2019. "Malaysia: Trade, Foreign Direct Investment and Regional Integration." In *Southeast Asia and the ASEAN Economic Community*, edited by Roderick Macdonald, 187–220. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-19722-3_5.

Espagne, Etienne, William Oman, Jean-François Mercure, Romain Svartzman, Ulrich Volz, Hector Pollitt, Gregor Semieniuk, and Emanuele Campiglio. 2023. "Cross-Border Risks of a Global Economy in Mid-Transition." IMF Working Paper 2023/184. International Monetary Fund.

Evans, Simon, and Verner Viisainen. 2023. "Revealed: How Colonial Rule Radically Shifts Historical Responsibility for Climate Change - Carbon Brief." *Carbon Brief*, November 26, 2023. https://www.carbonbrief.org/revealed-how-colonial-rule-radically-shifts-historical-responsibility-for-climate-change/.

Fanning, Andrew L., and Jason Hickel. 2023. "Compensation for Atmospheric Appropriation." *Nature Sustainability*, June. Nature Publishing Group, 1–10. https://doi.org/10.1038/s41893-023-01130-8.

Fransen, Taryn, Ryan O'Connor, Natalia Alayza, Courtnae Bailey, Molly Caldwell, Christopher Henderson, Bradley Kratzer, Ashna Siddhi, and Ginette Walls. 2023. "9 Things to Know About National Climate Plans (NDCs)," July. https://www.wri.org/insights/assessing-progress-ndcs.

Friedlingstein, Pierre, Michael O'Sullivan, Matthew W. Jones, Robbie M. Andrew, Dorothee C. E. Bakker, Judith Hauck, Peter Landschützer, et al. 2023. "Global Carbon Budget 2023." *Earth System Science Data* 15 (12). Copernicus GmbH:5301–69. https://doi.org/10.5194/essd-15-5301-2023.

Gupta, Joyeeta. 2007. "The Multi-Level Governance Challenge of Climate Change." *Environmental Sciences* 4 (3):131–37. https://doi.org/10.1080/15693430701742669.

Harvey, Fiona. 2022. "UN Climate Talks End in Stalemate and 'Hypocrisy' Allegation." *The Guardian*, June 17, 2022, sec. Environment. https://www.theguardian.com/environment/2022/jun/17/un-climate-talks-stalemate-hypocrisy-allegation-european.

Herman, Kyle S. 2023. "Green Growth and Innovation in the Global South: A Systematic Literature Review." *Innovation and Development* 13 (1):43–69. https://doi.org/10.1080/2157930X.2021.1909821.

Higham, Catherine, Alina Averchenkova, Joana Setzer, and Arnaud Koehl. 2021. "Accountability Mechanisms in Climate Change Framework Laws." London: Grantham Research Institute on Climate Change and the Environment and Centre for Climate Change Economics and Policy, London School of Economics and Political Science.

Holz, Ceecee, Eric Kemp-Benedict, Tom Athanasiou, and Sivan Kartha. 2019. "The Climate Equity Reference Calculator." *Journal of Open Source Software* 4 (35):1273. https://doi.org/10.21105/joss.01273.

Horton, Helena. 2024. "Britain's Climate Action Plan Unlawful, High Court Rules." *The Guardian*, May 3, 2024, sec. Environment. https://www.theguardian.com/environment/article/2024/may/03/britain-climate-action-plan-unlawful-high-court.

Hovi, Jon, Detlef F. Sprinz, and Arild Underdal. 2009. "Implementing Long-Term Climate Policy: Time Inconsistency, Domestic Politics, International Anarchy." *Global Environmental Politics* 9 (3):20–39. https://doi.org/10.1162/glep.2009.9.3.20.

IEA. 2023. "Scaling Up Private Finance for Clean Energy in Emerging and Developing Economies." International Energy Agency. https://www.iea.org/reports/scaling-up-private-finance-for-clean-energy-in-emerging-and-developing-economies/key-findings.

———. 2023. "Government Energy Spending Tracker – Analysis." Global Energy Transition Stocktake. Paris. https://www.iea.org/reports/government-energy-spending-tracker.

———. 2018. "Thailand Renewable Grid Integration Assessment." Partner Country Series. International Energy Agency. https://www.iea.org/reports/partner-country-series-thailand-renewable-grid-integration-assessment.

IMF. n.d. "Government Finance Statistics". IMF Data. International Monetary Fund. https://data.imf.org/?sk=89418059-d5c0-4330-8c41-dbc2d8f90f46&sid=1437430552197.

IPCC. 2018. *Global Warming of 1.5°C: IPCC Special Report on Impacts of Global Warming of 1.5°C above Pre-Industrial Levels in Context of Strengthening Response to Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*. 1st ed. Cambridge University Press. https://doi.org/10.1017/9781009157940.

———. 2022. "Summary for Policymakers." In *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, by H.-O. Pörtner, S. Langsdorf, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, et al., edited by H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Craig, et al., 3–33. Cambridge, UK: Cambridge University Press. 10.1017/9781009325844.001.

IPCC, Christopher Jones, Frank Jotzo, Thelma Krug, Rodel Lasco, Yune-Yi Lee, Valérie Masson-Delmotte, et al. 2023. "IPCC, 2023: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (Eds.)]. IPCC, Geneva, Switzerland." First. Intergovernmental Panel on Climate Change (IPCC). https://doi.org/10.59327/IPCC/AR6-9789291691647.

IRENA. 2019. "Global Energy Transformation: A Roadmap to 2050." Abu Dhabi: International Renewable Energy Agency. https://www.irena.org/publications/2019/Apr/Global-energy-transformation-A-roadmap-to-2050-2019Edition.

IRENA and ILO. 2021. "Renewable Energy and Jobs – Annual Review 2021." Report. Abu Dhabi: International Renewable Energy Agency. http://www.ilo.org/global/publications/books/WCMS_823807/lang--en/index.htm.

IRENA and Thailand Ministry of Energy. 2017. Renewable Energy Outlook: Thailand. Abu Dhabi: International Renewable Energy Agency. https://www.irena.org/-/media/files/irena/agency/publication/2017/nov/irena_outlook_thailand_2017.pdf.

Kaldewei, Cornelia, Benda Gu, and Yixiu Dong. 2023. "Accelerating Middle-Income Countries' Progress towards Sustainable Development." UN DESA Policy Brief No. 155. United Nations Department of Economic and Social Affairs. https://www.un.org/development/desa/dpad/publication/un-desa-policy-brief-no-155-accelerating-middle-income-countries-progress-towards-sustainable-development/.

Kanitkar, Tejal, Akhil Mythri, and T. Jayaraman. 2022. "Equity Assessment of Global Mitigation Pathways in the IPCC Sixth Assessment Report." OSF Preprints. https://doi.org/10.31219/osf.io/p46ty.

Keohane, Robert O. 1988. "International Institutions: Two Approaches." *International Studies Quarterly* 32 (4). [International Studies Association, Wiley]:379–96. https://doi.org/10.2307/2600589.

Khoo, Wei Yang. 2023. *Climate Policy: An Equitable Approach*. Kuala Lumpur: Khazanah Research Institute.

Lamboll, Robin D., Zebedee R. J. Nicholls, Christopher J. Smith, Jarmo S. Kikstra, Edward Byers, and Joeri Rogelj. 2023. "Assessing the Size and Uncertainty of Remaining Carbon Budgets." *Nature Climate Change* 13 (12). Nature Publishing Group:1360–67. https://doi.org/10.1038/s41558-023-01848-5.

Lebdioui, Amir. 2024. *Survival of the Greenest: Economic Transformation in a Climate-Conscious World*. 1st ed. Cambridge University Press. https://doi.org/10.1017/9781009339414.

Lee, Cassey. 2019. "Agglomeration, Human Capital and Foreign Labour: The Case of Malaysia." Economics Working Paper 8. Singapore: ISEAS Yusof Ishak Institute. https://www.iseas.edu.sg/wp-content/uploads/pdfs/ISEAS_EWP_2019_8_Lee.pdf.

Lockwood, Matthew. 2015. "Fossil Fuel Subsidy Reform, Rent Management and Political Fragmentation in Developing Countries." *New Political Economy* 20 (4). Routledge:475–94. https://doi.org/10.1080/13563467.2014.923826.

Luciani, Giacomo. 2020. "The Impacts of the Energy Transition on Growth and Income Distribution." In *The Geopolitics of the Global Energy Transition*, edited by Manfred Hafner and Simone Tagliapietra, 305–18. Lecture Notes in Energy. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-39066-2_13.

Mercure, J.-F., P. Salas, P. Vercoulen, G. Semieniuk, A. Lam, H. Pollitt, P. B. Holden, et al. 2021. "Reframing Incentives for Climate Policy Action." *Nature Energy* 6 (12). Nature Publishing Group:1133–43. https://doi.org/10.1038/s41560-021-00934-2.

Merner, L. Delta, Lisa Benjamin, William Ercole, Isabela Keuschnigg, Julian Kunik, Karla Martínez Toral, Laura Peterson, et al. 2024. "Comparative Analysis of Legal Mechanisms to Net-Zero: Lessons from Germany, the United States, Brazil, and China." *Carbon Management* 15 (1). Taylor & Francis:2288592. https://doi.org/10.1080/17583004.2023.2288592.

Ministry of Economy Malaysia. 2023. "National Energy Transition Roadmap." Putrajaya, Malaysia: Ministry of Economy Malaysia.

Muttitt, Greg, and Sivan Kartha. 2020. "Equity, Climate Justice and Fossil Fuel Extraction: Principles for a Managed Phase Out." *Climate Policy* 20 (8). Taylor & Francis:1024–42. https://doi.org/10.1080/14693062.2020.1763900.

National Audit Department Malaysia. 2023. "Auditor General's Report 2022." Putrajaya, Malaysia: National Audit Department Malaysia.

Newell, Peter, Shilpi Srivastava, Lars Otto Naess, Gerardo A. Torres Contreras, and Roz Price. 2021. "Toward Transformative Climate Justice: An Emerging Research Agenda." *WIREs Climate Change* 12 (6):e733. https://doi.org/10.1002/wcc.733.

Nithiyananthan Muthusamy, Jarud Romadan Khalidi, and Mohd Amirul Rafiq Abu Rahim. 2023. "The Returns to Malaysian Labour – Part I: Wage Growth and Inequality from 1995 to 2019." Kuala Lumpur: Khazanah Research Institute. https://www.krinstitute.org/Working_Paper-@-The_Returns_to_Malaysian_Labour_%E2%80%93_Part_I-;_Wage_growth_and_inequality_from_1995_to_2019.aspx.

Romero, José Pablo Barquero, and Kerry Loaiza Marín. 2017. "Inflation and Public Debt." *Monetaria* 5 (1). Centro de Estudios Monetarios Latinoamericanos, CEMLA:39–94.

Schipper, E.L.F., A. Revi, B.L. Preston, E.R. Carr, S.H. Eriksen, R. Mukerji, L.R. Fernandez-Carril, et al. 2022. "Climate Resilient Development Pathways." In *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by H.-O. Pörtner, K. Mintenbeck, D.C. Roberts, M. Tignor, E.S. Poloczanska, A. Alegría, M. Craig, et al., 2655–2807. Cambridge, UK: Cambridge University Press. 10.1017/9781009325844.027.

Scotford, Eloise, and Stephen Minas. 2019. "Probing the Hidden Depths of Climate Law: Analysing National Climate Change Legislation." *Review of European, Comparative & International Environmental Law* 28 (1):67–81. https://doi.org/10.1111/reel.12259.

Stern, Nicholas Herbert. 2007. *The Economics of Climate Change: The Stern Review*. Cambridge University Press.

Susskind, Lawrence, Jungwoo Chun, Selmah Goldberg, Jessica A. Gordon, Griffin Smith, and Yasmin Zaerpoor. 2020. "Breaking Out of Carbon Lock-In: Malaysia's Path to Decarbonization." *Frontiers in Built Environment* 6. https://www.frontiersin.org/articles/10.3389/fbuil.2020.00021.

UN Comtrade. n.d. "UN Comtrade Database." United Nations Statistics Division. https://comtradeplus.un.org/.

UNFCCC. 2015. "Paris Agreement." UNFCCC. https://treaties.un.org/pages/viewdetails.aspx?src=treaty&mtdsg_no=xxvii-7-d&chapter=27

UNFCCC Standing Committee on Finance. 2022. "Fifth Biennial Assessment and Overview of Climate Finance Flows." Bonn, Germany: UNFCCC. https://unfccc.int/sites/default/files/resource/J0156_UNFCCC%20BA5_2022_Report_v4%5B52%5D.pdf.

Vona, Francesco. 2021. "Managing the Distributional Effects of Environmental and Climate Policies: The Narrow Path for a Triple Dividend." Environment Working Paper No. 188. OECD.

Wade, Robert H. 2023. "The World Development Report 2022: Finance for an Equitable Recovery in the Context of the International Debt Crisis." *Development and Change* 54 (5):1354–73. https://doi.org/10.1111/dech.12796.

Waisman, Henri, Marta Torres Gunfaus, David Levaï, Lola Vallejo, and Alexandra Deprez. 2021. "A Country-Driven Perspective on Long-Term Low-Emission Development Strategies (LT-LEDS) - Implications for a COP26 Decision Text or Outcome." Study N°07/21. IDDRI. https://www.iddri.org/en/publications-and-events/study/country-driven-perspective-long-term-low-emission-development.

Watt, Diana van der. 2022. "Economic Insights - The Green Transition: Inflation That We Cannot Afford Not to Bear." Swiss Re Institute. https://www.swissre.com/dam/jcr:cea109c9-aa4f-436e-9798-b7daaad28616/EI-11-2022-green-transition-inflation.pdf.

Willems, Stéphane, and Kevin Baumert. 2003. "Institutional Capacity and Climate Actions." OECD and IEA information papers for the Annex I Expert Group COM/ENV/EPOC/IEA/SLT(2003)5. OECD and IEA.

World Bank. 2023. "Indonesia Country Climate and Development Report." Washington, D.C.: World Bank Group. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099042823064019635/P177245025ebd20a40ad3f0d89409039679.

———. n.d. "World Development Indicators." World Bank. https://databank.worldbank.org/reports.aspx?source=world-development-indicators.

Yemtsov, Ruslan G, and Amr S Moubarak. 2018. "Assessing the Readiness of Social Safety Nets to Mitigate the Impact of Reform: Households." Energy Subsidy Reform Assessment Framework (ESRAF) Good Practice Note No. 5. Washington, D.C.: World Bank Group.

CHAPTER

06

CHAPTER 6

POLICY RECOMMENDATIONS

6.1 Overview of the Report

The report has so far explored the developmental challenges Malaysia faces resulting from climate change. The physical impacts and economic threats of climate change are all the more pressing as the world hurls toward a future warming above the 1.5°C threshold. Developing countries need to brace for a potentially steeper path to development, marked by Big Power conflicts along geo-economic fault lines on critical technologies, climate-related resource transfer stalled by negotiations and pressures upon traditional growth pathways from both emission constraints and physical hazards. The report explored issues concerning (1) the strategic positioning of national climate policies, (2) approaches to understanding climate data, (3) institutional challenges in driving adaptation and (4) equity issues in global climate burden-sharing and just transition.

6.2 Policy Recommendations

The report recommends several ways forwards under four thrusts:

6.2.1. Bolster national climate strategy

National climate strategy must reflect core national interests

1. Climate strategy should be consistent with Malaysia's ambition to graduate from middle-income status and keep on rising. The high costs of climate transition, which run into the trillions, make managing debt with dynamic growth an imperative.
2. It must take account of multiple scenarios ranging from successfully achieving 1.5°C warming and various degrees of failure to do. A mitigation-heavy policy approach focused on 1.5°C will not cover all of Malaysia's security and development needs in the event of failure. Climate adaptation, debt sustainability and industrial policy must play balanced and complementary roles.

Safeguard forests, safeguard strategic state-owned firms

1. Explore the establishment of financial stewardship arrangements between strategic state-owned firms (including national oil companies) and forests. This would allow Malaysian – and only Malaysian – firms, strategic ones at that, to balance their remaining emissions *after mitigation measures* against removals by forests and other ecosystems. It should also allow forest conservation efforts to access sustainable financing at terms better than available from international programmes.

Invest in climate diplomacy to prevent an unjust transition

1. Malaysia will require weight of numbers and consensus on its climate concerns so that global outcomes are favourable to national interest. Great power cooperation will produce the lowest threat climate scenario while great power conflict will lead to higher risk scenarios. Malaysia's climate agenda should be advanced via greater Track One and Tract Two diplomatic efforts. In effect, a climate foreign policy led by a National Climate Envoy.

Malaysian policy development needs to be cautious about the Western ESG hype cycle

1. Malaysia needs to articulate positively what environmental, social and governance concerns matter for its own society and firms so as not to be caught out by Western double standards or cooling support for ESG amongst investors and oil companies. If Malaysia's regulatory and operational environment for firms is overly geared towards foreign needs domestic demands may suffer.
2. Recognise that what matters in "environment" is context-dependent and contested. Western investors are concerned about greenhouse gas emissions, but Malaysians are concerned about local toxins and pollutants as well as climate adaptation. Yet, Europe exports its plastic waste to Malaysia. Malaysian environmental concerns should not be trumped by Western concerns. Hydrocarbon waste imports should be blocked.
3. With regards to the E in ESG, local priorities such as better pollution standards and climate adaptation to reduce physical risks need to be backed both by high-level policy support and a pro-active narrative that articulates a Malaysian climate view as opposed to a Western-centric one.

Trade protectionist measures such as CBAM and EUDR should be challenged on both environmental and economic grounds

1. Malaysia should actively track and study regulatory and policy developments in countries with high trade or financial significance that practice regulatory imperialism.
2. Regulatory imperialism by the EU and other developed countries should be resisted when it is unjust. If left unchecked, other developed countries may move ahead with their plans to impose *de facto* tariffs and undermine the trade gains Malaysia has made in the past 30 years.[378]
3. Malaysia has already challenged the EU Deforestation Regulation at the WTO and via bilateral dialogue. The first simple step with the EU Carbon Border Adjustment Mechanism would be to signal concern by joining the meetings of the WTO Committee on Market Access or the Council for Trade in Goods. Coordinated action by affected countries can emerge from there.

Recognise that industrial policy offers more powerful tools than carbon pricing

1. Carbon taxes and markets are demand-side interventions. Carbon pricing on its own weighs down competitiveness, breeding an unhealthy demand for perverse subsidies in the case of Europe. Effective industrial policies address not only demand-side and supply-side measures, but also "profit-side" measures to ensure that new industries are dynamic and profitable, therefore investible. The profitability of clean technologies and adaptation solutions needs to outcompete the profitability of fossil fuels.
2. In economies such as China and to some extent the US, well-researched, catalytic subsidies and appropriate policy incentives have helped improve the profitability and investability of clean technology industries without any significant role being played by carbon pricing. Malaysia should look beyond the narrow selection of carbon pricing policies normally offered to climate advocates and instead use the most powerful economic tools available.

[378] Such measures can conflict with common but differentiated responsibilities under the UNFCCC and do not honestly reflect past and ongoing environmental harm caused by developed countries. They are often a cover for disguised subsidies for developed country firms and thus have negligible climate impacts. They demonstrate a lack of international leadership due to the desire to compensate domestic reforms with punishment of developing country trade partners.

6.2.2. Strengthen the current policy framework for climate adaptation

Improve interagency coordination

1. To address the challenge of fragmented governance, clear roles and responsibilities across government agencies must be established. Utilising existing platforms to coordinate climate policy integration across sectors and alignment with national, state and local priorities.
2. Embed cross-sectoral integration mechanisms, ensuring inclusivity and participation from all levels of government in the MyNAP development process.

Empower states and local governments

1. Increase engagement and provide states and local governments with knowledge, authority, resources and technical support.
2. Integrate adaptation with state development plans to ensure that strategies are locally driven.
3. The provision of financial and technical support would further encourage states to develop their adaptation plans.

Foster private sector and community participation

1. Identify scalable adaptation projects through collaboration with the private sector to build adaptive capacity.
2. Encourage the involvement of civil society and non-government organisations to drive participation and community agency.

6.2.3. Address long-term impacts of climate change today

Develop comprehensive coastal management plans

1. There is an urgent need to include coastal management and address the long-term risk of sea level rise. Prioritise integration for land-use planning, coastal defence infrastructure and nature-based solutions starting with vulnerable coastal areas such as Port Klang, Batu Pahat and the Kedah coast.

Shift to risk-based adaptation planning

1. Shift from sectoral vulnerability assessments to risk-based planning to increase readiness for future climate shocks. Start with a comprehensive assessment which also integrates risks from increasing temperature like heatwaves, prolonged dry spells and droughts.

Leverage cost-effective solutions

1. Integrating viable cost-effective strategies like nature-based solutions and soft infrastructure like urban planning, risk maps and data sharing platforms into flood and coastal management.

6.2.4. Pursue an equity-informed climate policy

Balance the distributional risks of low-carbon transition

1. Climate change impacts and climate-related initiatives such as low-carbon transition involve distributional risks that may lead to inequitable outcomes. These inequities can manifest internationally as unfair burdens among countries and domestically as unfair outcomes across communities. Balancing the trade-offs of benefits and burdens of transition is crucial.
2. Distributional impact assessments can be undertaken to identify the distributional risks of transition-related measures and groups at risk. Scenario modelling is helpful. The government can design clear mechanisms to redistribute income generated through sources like carbon tax and windfall tax, as well as social programs that support low-carbon transition of vulnerable communities.

Avoid an institutional design that risks entrenching inequities

1. The design of climate institutions, such as national climate change framework laws, should align with national circumstances. As a developing nation with limited capacity and significant climate risks, legislation can emphasise resource coordination for adaptation that leads to just outcomes for vulnerable communities.
2. Market-based instruments such as carbon pricing policies can lead to inequitable outcomes across different socioeconomic classes. It is recommended that distributional effects of market-based instruments implementation should be thoroughly assessed before being institutionalised through law.

KHAZANAH
RESEARCH
INSTITUTE

Level 17 Mercu UEM
Jalan Stesen Sentral 5
Kuala Lumpur Sentral
50470 Kuala Lumpur
MALAYSIA

Tel: +603 2034 0000

www.KRInstitute.org