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ABBREVIATIONS

ADS	Accelerated Decarbonization Scenario
ASEAN	Association of Southeast Asian Nations
ASI	Avoid-Shift-Improve
BAU	Business-As-Usual
CBAM	Carbon Border Adjustment Mechanism
CCDR	Country Climate and Development Report
CCGT	Combined-Cycle Gas Turbine
CGE	Computable General Equilibrium
CMP-CB	Combined Mitigation Policies Scenario + Co-Benefits
CO_2	Carbon dioxide
COP26	UN Climate Change Conference (2021)
CPAT	Carbon Pricing Assessment Tool
CSA	Climate-Smart Agriculture
°C	Degrees Celsius
EAP	East Asia and the Pacific
EPT	Environmental Protection Tax
ESVD	Ecosystem Services Valuation Database
ET	Effective Temperature
ETS	Emissions Trading System
EU	European Union
EV	Electric Vehicle
EVN	Viet Nam Electricity
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIC	Growth Incidence Curves
GJ	Gigajoule
GVA	Gross Value Added
GW	Gigawatt
Ha	Hectare
IEA	International Energy Agency
JICA	Japan International Cooperation Agency
Km^2	Square kilometer
LCOE	Levelized Cost of Electricity
LMIC	Lower Middle-Income Country
LNG	Liquefied Natural Gas
LULUCF	Land Use, Land-use Change and Forestry

MANAGE	Mitigation, Adaptation and New Technologies Applied General Equilibrium
MARD	Ministry of Agriculture and Rural Development
MNC	Multinational corporation
MOIT	Ministry of Industry and Trade
MONRE	Ministry of Natural Resources and Environment
MPI	Ministry of Planning and Investment
MRV	Monitoring, Reporting, and Verification
MSP	Marine Spatial Planning
MW	Megawatt
MWh	Megawatt-hour
Mt	Metric ton
$MtCO_2$	Metric tons of carbon dioxide equivalent
NAP	National Adaptation Plan
NDC	Nationally Determined Contribution
NGO	Non-Governmental Organization
NSCC	National Strategy on Climate Change
NTMs	Non-tariff measures
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
OWP	Offshore Wind Power
PDP8	Eighth Power Sector Development Plan 2021–30 with a vision to 2045
PPP	Purchasing Power Parity
PVS	Photovoltaic connected solar system
RCP	Representative Concentration Pathway
RoK	Republic of Korea
SME	Small and Medium Enterprise
TDR	Triple Dividends of Resilience
TJ	Terajoule
TOE	Tons of Oil Equivalent
2Ws	Two-wheelers
UMIC	Upper Middle-Income Country
UNDP	United Nations Development Programme
VASI	Viet Nam Agency of Seas and Islands
VAT	Value-Added Tax
VHLSS	Viet Nam Household Living Standards Survey
VND	Viet Nam Dong
VNEEP3	Viet Nam (third) National Energy Efficiency Plan

ACKNOWLEDGMENTS

This study was prepared as part of the Viet Nam 2045 engagement with the Government of Viet Nam.

The team included Dorsati Madani, Muthukumara S. Mani, Thu-Ha Thi Nguyen, Martin Aaroee Christensen, Sacha Dray, Katherine Stapleton, Hector Pollitt, Stephen John Stretton, Ira Irina Dorband, Laura Rodriguez Takeuchi, Matthew Wai-Poi, Ketut Ariadi Kusuma, Paul Andres Corral Rodas, Thu Thi Le Nguyen, Hanh Minh Duong, Hang Minh Dang, Victor Frebault, Steven Louis Rubinyi, Chiara Odetta Rogate, Guo Li, Vinh Quang Dang, Shigeyuki Sakaki, Phuong Thi Minh Tran, Halla Maher Qaddumi, Anil Markandya, Diego Castillo, Brent Boehlert, Ken Strzepek, Leonardo Garrido, Dung Viet Do, Quyen Hoang Vu, Phuong Anh Nguyen, Viet Anh Nguyen, Quang Hong Doan, Nga Thi Nguyen, Duong T. Tran, Anh Thi Quynh Le, Khanh-Linh Thi Le, and Hoa Thi Thanh Nguyen.

The team is grateful to the peer reviewers as well as the broader Viet Nam 2045 team for comments and collaboration, including Aaditya Mattoo, Habib Rab, Margaret Triyana, Stefanie Onder, Duong Trung Le, Andrea Coppola, James Anderson, Dirk Heine, and Lulit Mitik Beyene. The team is also grateful for the feedback provided by participants at the technical meetings with VIDS, now absorbed into the National Institute of Economics and Finance, and the round table hosted by the Ho Chi Minh National Academy of Politics.

This study was prepared under the overall guidance of Carolyn Turk (former Country Director for Viet Nam), Mariam Sherman (Division Director for Viet Nam, Cambodia and Lao PDR), Lalita Moorty (Regional Director, Prosperity, EAP), Sebastian Eckardt (Practice Manager, Economic Policy, EAP) and Africa Eshogba Olojoba (Practice Manager, Environment, EAP). Financial support from the Australian Aid is gratefully acknowledged.

OVERVIEW

Viet Nam has bold ambitions—to become a high-income economy by 2045, build climate resilience, and achieve net zero emissions by 2050. The country's development and climate challenges are deeply intertwined. With more than 3,260 kilometers of coastline, low-lying river deltas, and a tropical climate, Viet Nam is on the front lines of climate risk. Heat waves, floods, storms, and rising sea levels are not just environmental challenges—they threaten the farms that feed communities, the factories and cities that drive growth, and the infrastructure that connects people and markets. The economic cost is real. Projections show that without action, climate impacts could take a serious toll on gross domestic product (GDP) over the coming decades, threatening Viet Nam's ability to reach high income levels by mid-century. And as Typhoon Yagi recently demonstrated, these are not threats in the distant future, they are already becoming a reality today.

At the same time, Viet Nam's development story is still heavily tied to carbon emissions. With coal making up around one-third of the energy mix and energy efficiency lagging, especially in manufacturing, the country emits 45 percent more carbon per unit of output than the average middle-income economy. To achieve its net zero emission goal, Viet Nam must find ways to reduce emissions while ensuring energy remains affordable and industries stay competitive.

This report is not about choosing between prosperity and sustainability — it is about making them work together. Integrating climate adaptation and mitigation strategies into Viet Nam's economic planning ensures that growth is resilient, reducing vulnerability and promoting long-term prosperity. Conversely, as incomes rise, the capacity of households and communities to prepare for, respond to, and recover from climate-related impact improves. Therefore, advancing economic development is integral to strengthening climate resilience, and vice versa.

The good news is Viet Nam can act today to help climate-proof its economy, while reconciling economic development and emissions reductions. With effective policies and well-targeted investments, the country can continue on its development path in step with making progress on climate resilience and reducing carbon intensity.

While the transition to greener and more resilient development will pose challenges, it will also unlock new drivers of growth and job creation. With its strong manufacturing sector and abundant natural assets, including a rich marine ecosystem with immense economic potential, Viet Nam is well-positioned to take advantage of these opportunities. Already today, Viet Nam has about 1.7 million 'green jobs'. And as government, firms, and households

scale up climate action, the demand for green jobs is expected to rise, creating new opportunities in renewables, resilient infrastructure, climate-smart agriculture, and the blue economy.[1]

The authorities have already begun laying the groundwork for a greener, more resilient future. On adaptation, the government established the Mekong Delta Region Coordinating Council, bringing together government, local communities and the private sector to align investments and actions to tackle climate risks across the entire delta. The government also adopted a Master Plan for the Sustainable Use of Coastal Resources to transform coastal regions into thriving centers of culture, economic opportunity, and sustainability. On mitigation, Viet Nam has accelerated its energy transition. Between 2019 and 2023, the country's installed solar power capacity surged from 4.5GW to more than 17GW, driven by policy incentives and private investment. Building on this momentum, the revised Eighth National Power Sector Development Plan (PDP8) now targets 73GW of solar power by 2030 — a more than five-fold increase from the earlier 12.8GW goal, while wind power ambitions nearly doubled from 21GW to 38GW. Concurrently, Viet Nam is advancing preparations for an Emissions Trading System (ETS), with pilot programs slated to launch in 2025 and full implementation expected by 2028.

Against such a backdrop, this report provides new evidence and policy options to help Viet Nam reduce both transition and physical climate risks, while seizing emerging green growth opportunities.[2] In doing so, it seeks to answer three critical questions: what can Viet Nam do to adapt to climate change, how to engender growth-friendly emissions reduction, and how to unlock the potential of the marine economy? Each of these questions is essential for building a sustainable and resilient future for Viet Nam.

Adapting to climate impacts

Viet Nam is one of the world's most vulnerable countries to climate change. According to Germanwatch, it ranked 13th globally in terms of climate risk in 2019. Since 1960, mean annual temperatures have increased by 0.5°C–0.7°C, with the most rapid warming occurring in southern Viet Nam and the Central Highlands. With numerous transboundary river basins and an extensive low-lying coastline, the country faces significant exposure to rising sea levels. The climate crisis is already impacting major sectors of the economy, such as agriculture and transport, as well as urban and industrial hubs.

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[1] Abla Safir, et, al. 2024. *Green jobs – upskilling and reskilling – Viet Nam's workforce for a greener economy*. World Bank. Using a task-based approach, 39 out of 441 occupations in Viet Nam's Labor Force Survey 2021 are "green". Green tasks are activities essential to producing the output for which the job was created. Green tasks are performed in a position that involves developing or using green technologies. The Green Task Intensity (GTI) index is calculated as the proportion of green tasks to the total number of tasks in an occupation.

[2] This report updates, complements, and expands on the *2022 Viet Nam Country Climate and Development Report (CCDR)*. See Box 1 for more details.

In rural areas, Viet Nam's agriculture sector is profoundly impacted by rising temperatures, variability in rainfall and storms. During 1990–2019, a 1 percent increase in temperature resulted in an estimated 3 percent long-term fall in the agricultural production index.[3] The variability of rainfall has multi-spectrum impacts on regional production, with increased droughts in the Central Highlands significantly reducing coffee yields, while excessive rainfall in the Red River Delta has heightened flood risks, damaging rice and vegetable crops, as evidenced by the extensive flood damage left in the wake of super Typhoon Yagi in September 2024. Looking ahead, projections suggest that a sea level rise of 75–100 centimeters could flood 47.3 percent of the Mekong Delta by mid-century, threatening its economic viability and worsening salinity challenges.[4]

Viet Nam's cities, industrial and export centers are also exposed to climate risks, such as heat stress, storm-related high winds, heavy rains and flooding. Seventy percent of Viet Nam's population lives in densely populated urban and coastal areas that are also home to a majority of its 433 industrial zones,[5] a source of more than 90 percent of the country's manufacturing exports. Urban areas also face rising temperatures, heat stress and exposure to more violent storms. Dense cities like Ho Chi Minh City suffer from "heat island" effects, pushing peak daytime temperatures several degrees higher than surrounding rural zones.[6] Firms and factories are exposed as well. According to a 2024 World Bank study,[7] 71 percent of apparel and 74 percent of electronics firms operate in areas at significant risk of heat stress, leaving more than 1.3 million employees vulnerable – 70 percent of whom are female. More frequent natural disasters may cause physical damage while disrupting supply chains and factory operations. For instance, the city of Haiphong, a critical industrial and export center and home to one of the main national ports, sustained an estimated US$955 million in damage due to Typhoon Yagi alone,[8] with supply chain disruptions due to loss of power and communication.

Finally, climate change leaves Viet Nam's transport infrastructure and connectivity at risk with severe impacts on the economy. Geospatial analyses reveal that road failures due to river flooding are expected to increase by at least 40 percent by 2030. For example, in the current climate, 188km of the national highway network is already exposed to extreme flash flooding, which primarily affects mountainous terrain. Moreover, under high-emission scenarios, "1,000-year" flood events may occur as frequently as every five years. In some regions, annual rainfall could increase by more than 20 percent, with the frequency of extreme five-day rainfall events rising up to 70 percent. Hazards are generally most severe in coastal areas, the northern mountains, and Mekong Delta, where the convergence of high exposure and concentrated economic activity amplifies vulnerability. As early as 2015, excess heat was blamed for causing road subsidence, especially where asphalt had melted.[9] Outdated design

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[3] Dao le Trang Anh, et. Al. 2022. *Climate change and its impacts on Viet Nam agriculture: A macroeconomic perspective.* Researchgate.net

[4] MONRE. 2022. *Viet Nam's Climate Change Scenario Updated Version in 2020.*

[5] Delco. 2025. 433 operational industrial parks as of early 2025, mostly clustered in the north-west and around Ho Chi Minh City.

[6] Rentschler, J, de Vries Robbé, S, Braese, J, Huy Nguyen, D, van Ledden, M, and Pozueta Mayo, B. 2020. *Resilient shores: Viet Nam's coastal development between opportunity and disaster risk.* Washington, DC. World Bank. Pgs. 37-39.

[7] World Bank. 2024. *Advancing competitiveness of Vietnamese industries through green and resilient transition.*

[8] Ministry of Finance, September 2024.

[9] *Viet Nam Investment Review,* June 10, 2015.

standards and insufficient maintenance increase the vulnerability of road transport infrastructure. The interconnected nature of the transport system means that disruptions in one mode or corridor can cascade throughout the entire network. For instance, major maritime ports – such as those in the Ho Chi Minh City seaport complex and Haiphong – are projected to become nearly five times more prone to flooding, potentially disrupting 68,000 to 106,000 tons of cargo flows per day. A vulnerability assessment suggests that some corridor disruptions could result in daily economic losses of up to US$89 million (0.02 percent of GDP) in Viet Nam coastal provinces.[10]

Addressing climate change, therefore, is a critical issue for the economy. Climate change effects will ripple through every part of the economy, directly and indirectly. Rising temperatures, extreme weather, and changing rainfall patterns will impact land, labor, and capital—the essential building blocks of growth. As temperatures rise and disasters become more frequent and severe, productivity may decline, output could shrink, and prices could rise, including for food. And the impacts do not stop there. Disruptions in one sector can spill over into others, affecting supply chains, trade, and investment flows. The government will face tough choices as tax revenues fall, while demand for public support rises.

Simulations from macroeconomic modelling suggest that climate impacts could reduce Viet Nam's output by at least 12.5 percent relative to the baseline by 2050, potentially hindering the country's ability to achieve high-income status by 2045. While there are numerous potential climate shocks, the simulations capture three key and quantifiable impact channels: loss of labor productivity due to heat stress, capital losses in infrastructure, and impacts on agriculture. In the most likely scenario (RCP4.5)[11], the macroeconomic cost of these climate impacts alone is projected to reduce real GDP growth by an average of half a percentage point annually during the 2020s, decelerating to a 0.25 percentage point by the 2040s. These impacts are expected to intensify, with total output losses reaching 9.1 percent by 2035 and 12.5 percent by 2050, compared to the baseline scenario (Figure 0.1).

The increased frequency and intensity of weather events could exacerbate damage. Extreme events – such as flooding, storm surges and typhoons – could reduce real GDP level by an average 1 percent (deviation relative to baseline) under the most likely scenario (RCP4.5). This damage could escalate to up to 2.5 percent of real GDP level (deviation relative to baseline) if such events occurred more frequently or were more powerful, destroying infrastructure capital such roads, housing, and buildings.[12]

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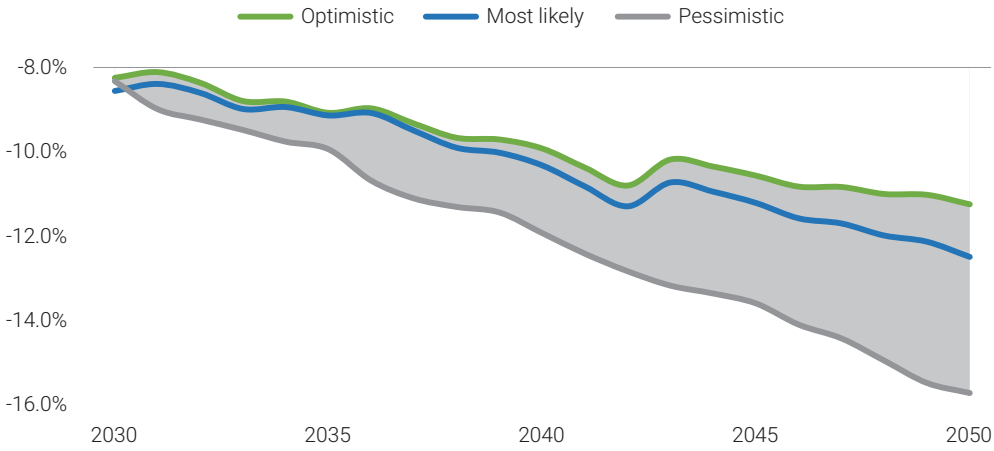
[10] Rentschler, J, de Vries Robbé, S, Braese, J, Huy Nguyen, D, van Ledden, M, and Pozueta Mayo, B. 2020. *Resilient shores: Viet Nam's coastal development between opportunity and disaster risk.* Washington, DC. World Bank. Page 79

[11] RCP 4.5 is described by the Intergovernmental Panel on Climate Change (IPCC) as a moderate scenario in which emissions peak around 2040 and then decline.

[12] These damages only consider capital or asset losses and reconstruction costs crowding out investment elsewhere in the economy.

Figure 0.1. Impact of climate change on real GDP levels relative to baseline

(% deviation from baseline levels)



Source: World Bank staff simulations using MANAGE model.

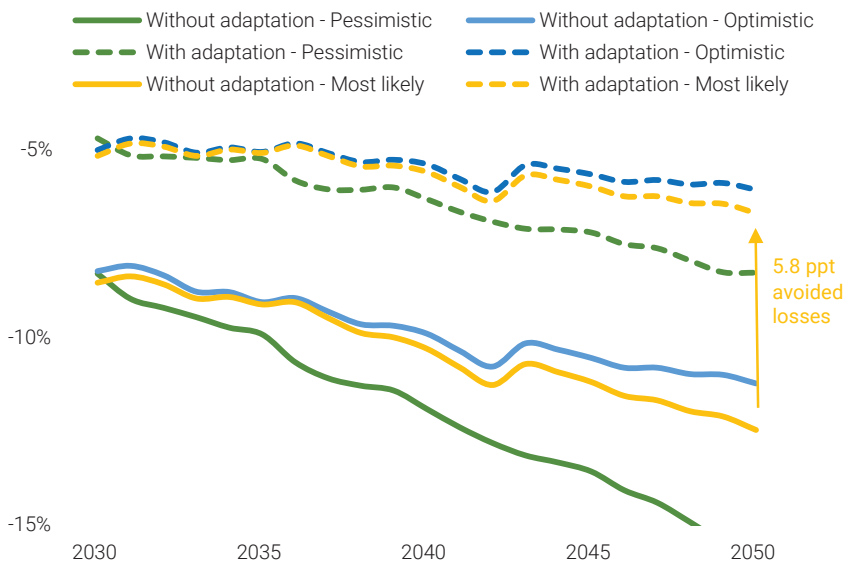
Climate change is expected to slow Viet Nam's progress in reducing poverty. While the number of people living in extreme poverty is projected to continue declining, without adaptation climate impacts could leave between 100,000 and 1.1 million people trapped in poverty by 2050, compared to the baseline scenario. The lower estimate (100,000) assumes that climate change will not worsen inequality, while the higher estimate (1.1 million) reflects a scenario where inequality increases 15 percent by 2050 due to climate impacts as low-income and low-skill workers are more exposed to climate risks, while low-income households often lack the resources and capacity to protect themselves from adverse climate change impacts. Additionally, climate change poses significant threats to regional livelihoods and poverty reduction. For instance, in the Mekong Delta, saline intrusion and sea level rises could have substantial and persistent income losses, especially under the most likely scenario. Simulations suggest these income losses could stall poverty reduction efforts in Viet Nam's rice basket, potentially keeping the share of population living below the poverty line (defined as the 25th percentile of per capita income in 2024) above baseline levels.

Investing in adaptive measures, while costly, can significantly reduce these economic losses and social impacts. The additional investments required for adaptation in agriculture, infrastructure, and to protect human capital between 2025–50 are estimated at US$233 billion, or an annual average of 0.75 percent of GDP. These investments are primarily needed to address the impacts of increased heat stress, including cooling measures. Simulation results indicate that such measures could substantially reduce climate change impacts on GDP.[13] Under the most likely scenario (RCP4.5), investing in adaptation could help prevent a 5.8 percentage point loss in GDP, reducing the projected loss from 12.5 to 6.7 percent (Figure 0.2).

[13] World Bank. 2021. While adaptation investments are often viewed as non-productive and reliant on public resources, their primary role is to reduce damage rather than enhance productive capital stock.

Figure 0.2. Impacts of adaptation measures on real GDP levels relative to baseline

(with and without adaptation, %)



Source: World Bank staff simulations using MANAGE model.

Beyond macroeconomic benefits, adaptation investments often yield multiple dividends at the micro level. When considering not only avoided losses but also co-benefits such as increased productivity, environmental sustainability, and social resilience, the cost-benefit ratio of these investments improves significantly. For instance, an ex-post reassessment of the World Bank's Mekong Delta Integrated Climate Resilience and Sustainable Livelihoods project found that when all three dividends were integrated, the project-wide benefit-cost ratio rose to 14.67, compared to 1.27 when only the first dividend was considered.

While the government plays a pivotal role, approximately two-thirds of adaptation investments are expected to be undertaken by the private sector and households. Encouragingly, there is growing evidence of individuals and firms in Viet Nam proactively responding to climate risks. In the Mekong Delta, some farmers are implementing sustainable rice cultivation techniques such as alternate wetting and drying (AWD) irrigation and using drones for precise fertilizer application.[14] These practices not only enhance resilience and reduce methane emissions, but also lower production costs and open access to premium organic markets. In urban areas, there is evidence that manufacturing firms in Ho Chi Minh City, often SMEs, have installed portable high-capacity pumps to rapidly remove floodwaters and elevate critical machinery and electrical panels above historical high-water marks, enabling operations to resume within hours of inundation and significantly reducing downtime and asset damage.[15]

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[14] World Bank. Viet Nam Sustainable Agriculture Transformation Project (VnSAT), 2015-22.

[15] R. Leitold, M. Garschagen, V. Tran & J. Revilla Diez. 2021. *Flood risk reduction and climate change adaptation of manufacturing firms: Global knowledge gaps and lessons from Ho Chi Minh City*. International Journal of Disaster Risk Reduction, vol. 61, p. 102351.

However, several barriers limit the adaptation responses of firms and households, including incomplete information about the impacts of climate change and credit constraints. To facilitate a broader adaptation response, government policies must create an enabling environment. Certain public goods and infrastructure investments, such as urban flood protection, necessitate direct government action. While some measures, like the expanded use of air conditioning by households, can be adopted independently by the private sector, others may require government support to encourage private sector adoption. Even when adaptation measures such as flood protection and rainwater harvesting systems are cost-effective over time, the initial capital outlay may deter adoption. This is especially acute among small enterprises and low-income households that lack sufficient collateral or cash flow to finance adaptation investments. Government incentives or financial support may, therefore, be needed. Providing accessible, localized climate information to inform decision-making is also crucial to businesses and communities to implement effective adaptation strategies.

The following table proposes a select set of cross-cutting and sectoral recommendations for the upcoming five-year policy cycle (2026–30), that require public and private sector uptake. The sector-level measures respond to the three main impact channels identified (heat stress affecting labor productivity, agriculture, and infrastructure). The focus is on the design and implementation of government policies, but these are intended to create an environment that enables, and in some cases encourages adaptation actions and investments by firms and households. This implies ensuring private sector actors have both the incentives and information they need to manage risks. The table indicates which actions are expected to generate economic co-benefits above and beyond reducing climate risks, such as jobs creation and growth, and which will simultaneously contribute to climate change mitigation.

Recommendations for 2026–30

Cross-cutting		Economic Co-Benefits	Mitigation Co-Benefits
Leverage innovative financing tools	• Create financial products that blend public, private, and donor resources for investment in climate-resilient infrastructure and adaptive investments.	Medium	Low
Develop the insurance market and adopt new risk-sharing mechanisms	• Roll-out parametric insurance to encourage rapid payouts when triggers (like rainfall or heat thresholds, or wind speeds) are exceeded, accelerating the recovery process. • Launch rapid contingency financing to ensure that critical infrastructure remains operational during large-scale disruptions and facilitate immediate repairs when needed. • Facilitate development of private insurance products that incentivize adoption of climate-smart technology and investment in resilient housing and production practices.	Medium	Low

Develop a public investment program adapted to climate change risks	• Integrate climate risk considerations into existing and upcoming infrastructure projects. Identify and prioritize infrastructure vulnerable to climate shocks (such as transport, water supply, urban, agriculture). • Ensure effective cross-governmental coordination to align public investment planning across ministries and provinces, ensuring that infrastructure, climate adaptation, and economic development projects are synchronized to avoid duplication and maximize efficiency.[16]	High	Low
Ensure effective disaster risk management	• Ensure that disaster risk management and recovery plans as well as early warning systems are regularly updated in a participatory process at the national and regional levels and well-funded • Roll-out a rapid contingency financing instrument to support businesses and an adaptive social safety net to support households in the event of climate-driven disasters.	Medium	Low
Provide information and data to enable risk management by firms and households	• Provide comprehensive and detailed information on climate risks and weather data to support households and private sector actors in making risk-based decisions about their coping strategies, including investment decisions.[17]	Medium	Low
Resilient cities		**Economic Co-Benefits**	**Mitigation Co-Benefits**
Align fiscal incentives to enhance land use and urbanization patterns	• Adjust land or property taxes to discourage settlement in high-risk areas and reward resilience investments (such as property tax rebates for upgrading building standards). • Ensure adjustments are paired with sufficient resources and training for implementation of the new taxes and building codes.	Medium	Low
Strengthen building resilience	• Revise building codes and standards so that residential, commercial, and public buildings meet expected higher temperatures and stricter storm-resilience criteria.	High	Medium

[16] World Bank. 2025. *Viet Nam 2045 – Breaking Through – Institutions for a High-Income Future.* (forthcoming).

[17] A 2025 World Bank report found that with knowledge about extreme temperatures on agricultural output, farmers in Peru adjusted the area and mix of crops. In Tanzania, firms exposed to climate risk primarily through their supply chains hold larger inventories and build larger supplier networks. Because information is a public good, there is a role for government to support its production and dissemination. Forhad J. Shilpi et. al. 2025. *Rethinking resilience: how to help people to pre-pare, recover, and adapt.* Washington, DC: World Bank (forthcoming).

Build adaptive urban infrastructure	• Incentivize adaptative private investments that reduce urban heat and increase energy efficiency of buildings, such as green roofs.[18] • Invest in flood-resilient urban drainage combining gray infrastructure (pumps, sluice gates) with green infrastructure (wetlands, bioswales) to reduce peak flood flows, control stormwater runoff, and enhance groundwater recharge. • Undertake proactive public maintenance of existing urban infrastructure at risk of weather events.	Medium	Medium
Resilient transport		**Economic Co-Benefits**	**Mitigation Co-Benefits**
Establish robust adaptation planning	• Establish a unified risk database that consolidates climate, hydrological, and infrastructure condition data to enable more precise vulnerability assessments and asset management decisions.	Low	Low
Develop technical standards and protocols for maintenance of existing assets	• Develop technical standards commensurate with risk levels, and technical specifications and norms for both routine and emergency maintenance that include climate vulnerability zoning to complement targeted adaptation investments. • Establish clear protocols for maintenance prioritization using geospatial data to help ensure that limited resources are directed to the most vulnerable and critical segments.	Low	Low
Resilient agriculture		**Economic Co-Benefits**	**Mitigation Co-Benefits**
Diversify crops and livelihoods	• Support farmers to diversify to climate-resilient crops through subsidies, technical assistance, and access to markets. Alternative products include drought-resistant and low-emission rice and saline-tolerant maize, vegetables, corn, banana, mulberry and shrimp farming.	High	High
Mitigate the impacts of irregular rainfall and droughts	• Use of Alternate Wetting and Drying (AWD) can reduce water use, while maintaining yields and lowering methane emissions. • Efficient irrigation systems, including drip irrigation (or solar-powered drip irrigation) and rainwater harvesting, improve water conservation in drought-prone regions.	High	High

[18] US EPA. https://www.epa.gov/heatislands/using-green-roofs-reduce-heat-islands

Reconciling economic growth and emissions reductions

While Viet Nam has made progress in scaling-up renewable energy, its economy remains relatively carbon intensive. Viet Nam's total emissions are relatively small, accounting for a modest share of 0.99 percent of global GHG emissions in 2023. Similarly, its per capita emissions are relatively low at 5.2 tCO_2e/capita, slightly below the average of middle-income economies (5.6 tCO_2e/capita) (Figure 0.3). However, reflecting its reliance on coal for energy production and energy-intensive industrial sectors, Viet Nam's carbon intensity—measured as GHG emissions per unit of GDP—exceeds the middle-income country average by 45.6 percent. What is more, GHG emissions in Viet Nam continue to grow rapidly, increasing at an annual rate of 6.2 percent over the last decade. The main sources of emissions in Viet Nam are the power sector (30.4 percent), agriculture, industrial process emissions (38.3 percent), and transport (7.6 percent) (Figure 0.4).

Figure 0.3. Viet Nam's development has been carbon intensive

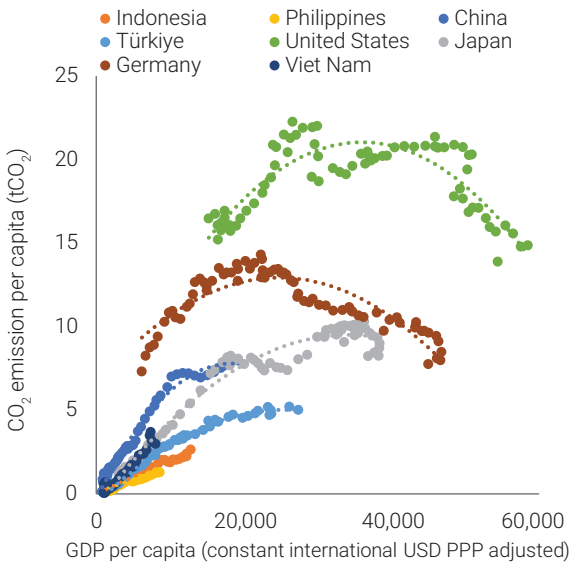
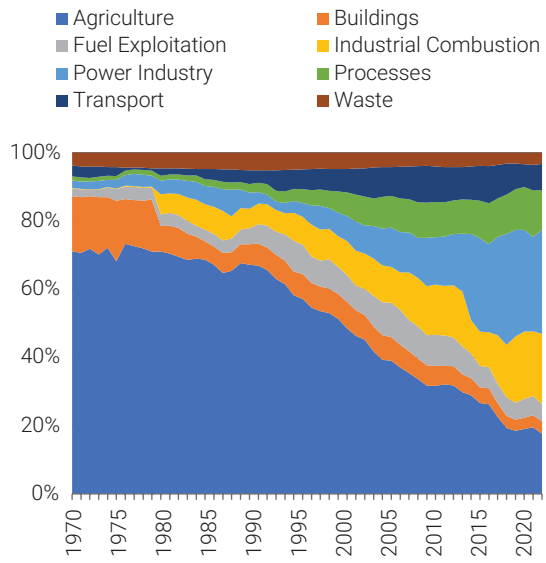


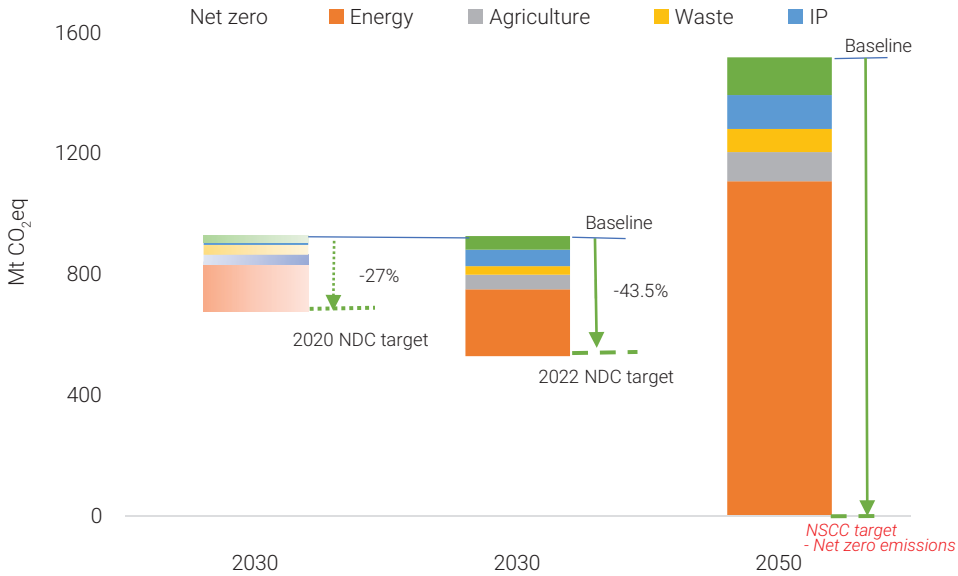
Figure 0.4. Viet Nam's emissions profile



Source: Maddison Project (2023), Global Carbon Budget (2024) – processed by Our World in Data, and World Bank staff calculations.

Viet Nam has made an ambitious pledge to reduce carbon emissions (Figure 0.5). The 2022 National Strategy on Climate Change (NSCC) includes a net zero emissions commitment with an intermediate 2030 target equal to that year's Nationally Determined Contribution (NDC). The NSCC's mitigation goal requires a nationwide 43.5 percent GHG reduction compared to the baseline by 2030, with carbon emissions to peak in 2035 and fall sharply thereafter to achieve net zero by 2050. These targets imply that Viet Nam will need to decouple economic growth and emissions at a faster pace, and at a lower per capita GDP and lower per capita emissions than almost any other major economy (Figure 0.6).

Figure 0.5. Mitigation goals of Viet Nam (2030 and 2050)

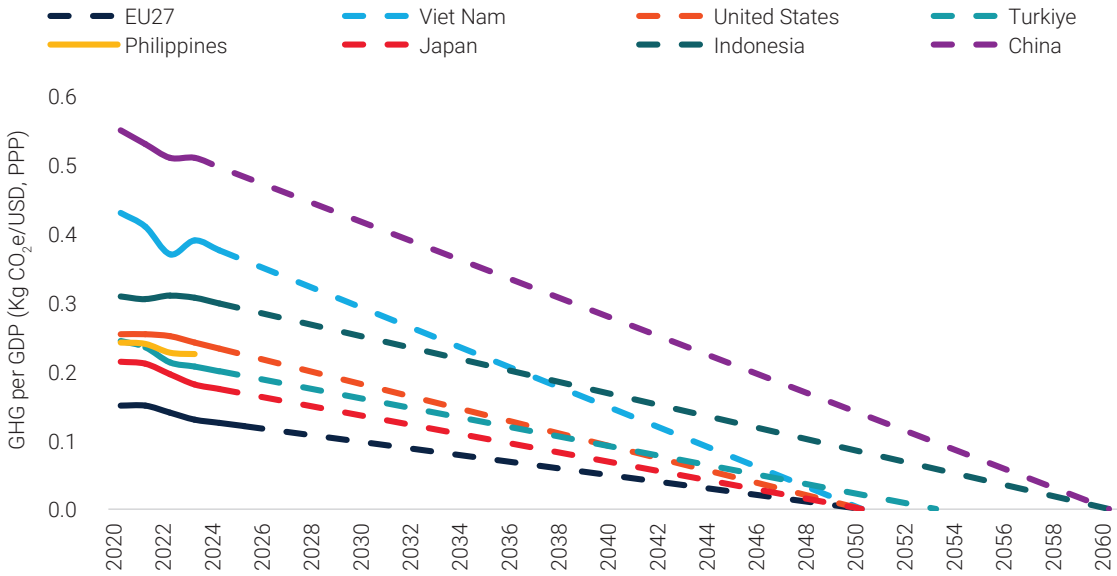


Source: World Bank staff calculations, based on NDC and NSCC declarations.

The government has adopted an ambitious set of cross-sectoral and sector specific policies to curb carbon emissions and help transform Viet Nam's economy. The energy transition will be the most important component of Viet Nam's net zero transition as the sector accounts for two-thirds of national GHG emissions, with 60 percent from the power sector alone due to the rapid rise in coal-based power supply. The 2023 Eighth Power Sector Development Plan 2021–30 (PDP8) presents an ambitious shift for Viet Nam's generation mix away from coal towards renewables. The revised PDP8 outlines a bold expansion of renewable energy, targeting 73GW of solar power by 2030 — a more than five-fold increase from its earlier 12.8GW goal — while nearly doubling wind power ambitions from 21GW to 38GW. To stabilize this renewable surge, Viet Nam is prioritizing grid modernization and flexible storage solutions, including 18 planned pumped-storage hydropower projects. Meanwhile, the transport sector — which accounted for 7 percent of total GHG emissions in 2021, is undergoing decarbonization via an action plan focused on electrification and promoting public transit. In agriculture, which contributes 15 percent of emissions, Viet Nam has pledged to cut methane emissions by 30 percent by 2030 compared to 2020 levels, aligning with its COP26 commitments. And Viet Nam is developing an emissions trading system (ETS) as a carbon pricing tool, with an ETS pilot set to be launched in 2025 for three main sectors: power, cement, and steel. Meanwhile, Viet Nam's third National Energy Efficiency Plan (VNEEP3) outlines energy consumption reduction targets of 8–10 percent by 2030 relative to a baseline scenario.[19]

[19] https://vneec.gov.vn/gioi-thieu/c15/introduction.html

Figure 0.6 Achieving net zero requires a steep decline in carbon intensity



Source: World Bank Indicators.

If current government mitigation policies are implemented, Viet Nam could achieve its NDC target by 2030 – but would still fall short of its 2050 net zero target. The key policy areas underpinning the NDC encompass measures to decarbonize the energy, transport and agriculture sectors which together account of 80 percent of Viet Nam's total emissions, complemented by steps to boost energy efficiency and carbon pricing. Simulations results show that under current policies, emissions would decline by 37 percent in 2030 compared to the baseline, contributing 85 percent to the NDC target of a 43.5 percent reduction in 2030. Also, without additional major technological changes,[20] current mitigation policies would contribute 55 percent of the emissions reduction necessary to reach the ambitious net zero target by 2050 (Figure 0.7), but fall short of the target. Implementing the 2023 PDP8 energy transition plan (Eighth Power Sector Development Plan 2021–30 with a vision to 2045) will make a major contribution towards the net zero goal, with a 4.7 percent reduction in emissions by 2030 and 15.3 percent by 2050 compared to the baseline.

Dramatic declines in the costs of clean technologies, particularly in the energy sector, are expected to help facilitate the transition. Global innovation and the decreasing costs of alternative technologies for electricity generation are set to fundamentally reshape the energy sector's fuel demand. According to estimates from Bloomberg NEF, solar power paired with battery storage systems (or photovoltaic-

[20] New technologies include: (i) battery storage systems, by integrating large-scale battery storage to manage the intermittency of solar and wind energy, ensuring grid stability, (ii) green hydrogen can be used for hard-to-abate sectors like heavy industry and transport, offering a zero-emission alternative, (iii) carbon capture, utilization, and storage (CCUS) can reduce emissions from existing fossil fuel infrastructure, enabling a smoother transition to renewable energy, (iv) smart grid technology that facilitates efficient energy distribution, better integrates renewable energy, and allows for demand-response mechanisms and (v) advanced energy efficiency technologies, which reaches beyond basic efficiency measures, adopting advanced technologies like smart meters, building automation systems, and high-efficiency industrial processes.

connected solar systems - PVS) is expected to become cost-competitive with new coal and gas plants in Viet Nam by the end of this decade. Additionally, shifts in regulations, standards, energy use practices, and price incentives outlined in Vietnamese national policies, including the 2023 PDP8, will shift the energy mix towards a higher share of renewable energy.

The emissions reduction path is expected to vary by sector. The power sector—the largest emitter—leads the way, with emissions set to decline rapidly over the next two decades. Coal use will be steadily phased down, replaced by least-cost domestic solar and wind. This will be supported by expanded battery and pumped storage to meet rising power demand, including from electrification in downstream sectors, such as industry and transport. Power market reforms will be essential to building a competitive, nationally integrated power system capable of efficiently managing a high share of variable renewable energy. Industrial emissions can be reduced in the near term through efficiency gains and electrification. In transport, decarbonization will require not just expanded public transit and rail networks, but also advancements in low-carbon fuels for hard-to-electrify modes. Buildings will see emissions drop through electrification, clean district heating, and energy efficiency improvements. Finally, nature-based solutions – including reforestation and ecosystem restoration – will play a key role in offsetting residual emissions from hard-to-abate sectors, helping Viet Nam move towards carbon neutrality. These measures, grounded in the assumptions and results of the World Bank's MANAGE model (Mitigation, Adaptation and New Technologies Applied General Equilibrium), collectively form a comprehensive strategy for achieving sustainable emissions reductions.

Macroeconomic estimates suggest that the economic costs of a net zero transition are manageable. Estimates based on a macroeconomic model suggest that GDP could be 0.02 percent lower than the baseline in 2030 primarily due to the impacts of rising energy prices resulting from changes in the energy mix, carbon pricing, and reduced household income and consumption. This economic loss could increase over time, reaching 2.76 percent in 2050, although such long-term impacts are subject to considerable uncertainty including future development of carbon-neutral technologies.

When factoring in additional benefits of mitigation policies—such as improved air quality—the economic impacts could even turn positive. If local co-benefits – from reduced local air pollution and improved productivity and competitiveness – are considered, the model suggests that GDP could increase by 1.8 percent compared to the baseline scenario in 2030, and by 1.4 percent in 2050. These co-benefits underscore the potential for a green transition to generate long-term economic gains, even in the face of short-term challenges (Figure 0.8).

Taking additional steps to decarbonize the industrial sector, stimulate reforestation and increase carbon sinks could significantly contribute to reaching the net zero objective. To illustrate the impacts of increased ambition, we model an Accelerated Decarbonization Scenario, with ADS including co-benefits and achieving a 74 percent reduction in GHG emissions by 2050 relative to the baseline scenario, closer to net zero objectives (Figure 0.7). In turn, these efficiency gains and lower energy services costs will contribute to real GDP level increases of 2.3 percent by 2030 and 4.4 percent by 2050 (Figure 0.8) compared to the baseline.

Figure 0.7. GHG emission reductions

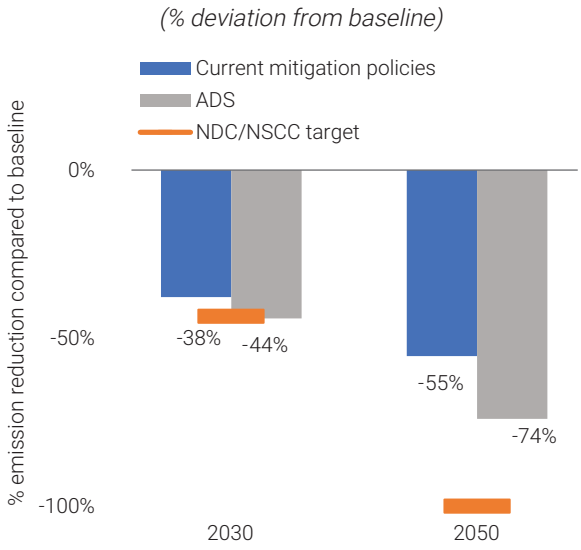
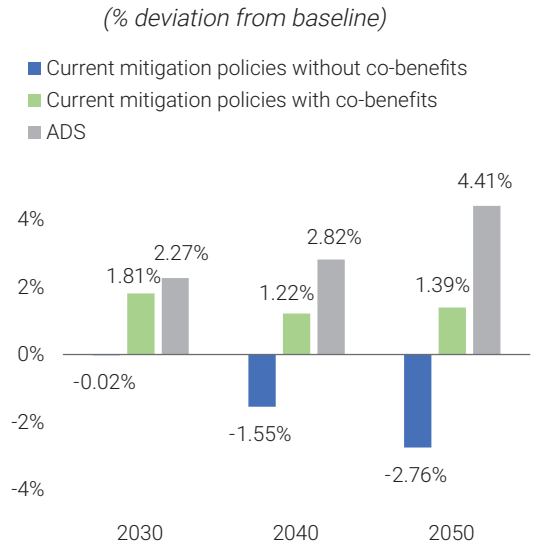
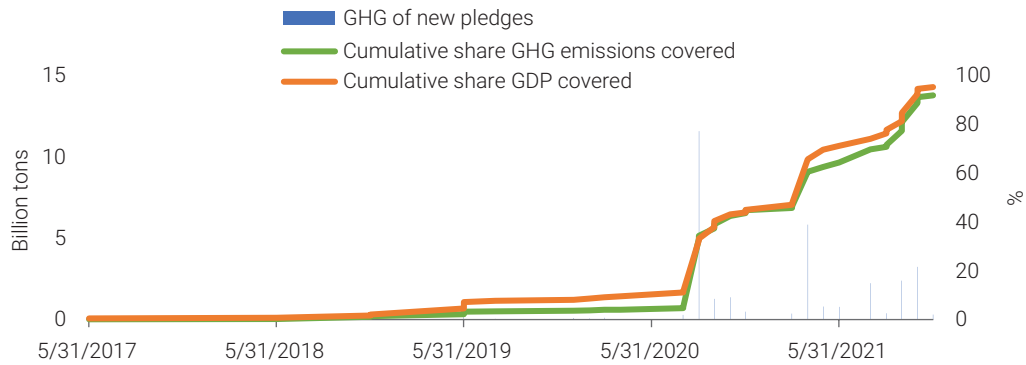


Figure 0.8. Impact of current mitigation and accelerated decarbonization policies on real GDP levels



Source: World Bank staff simulations using MANAGE model.

Figure 0.9. Share of global GDP and emissions covered by net zero pledges



Source: Net Zero Tracker (https://zerotracker.net/) and WDI, and World Bank staff calculation.

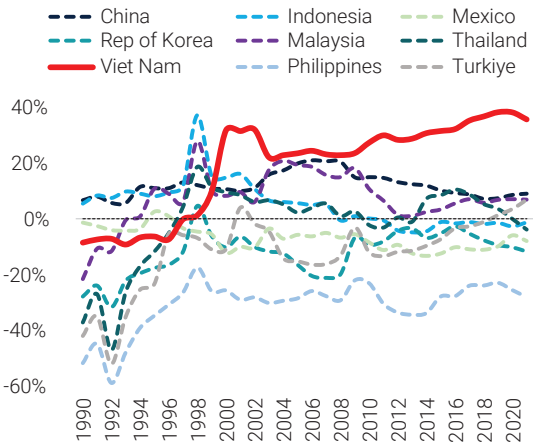
But, Viet Nam's climate commitments are not the only reason to reduce carbon emissions. The drive to lower emissions is reinforced by shifting global demand. Today, more than 90 percent of global GDP is generated in countries that have committed to achieving net zero emissions in coming decades (Figure 0.9). This global drive to net zero will boost demand for green products and technologies, while industries with large carbon footprints may face barriers to international markets, especially with the introduction of Carbon Border Adjustment Mechanisms (CBAM) in key export markets, such as the European Union. While current products subject to CBAM are relatively limited, Viet Nam's exposure is larger than in regional peers and is expected to increase as CBAM is rolled out to other products.

In addition, commitments by multinational companies (MNCs), such as the RE100 initiative to have 100 percent of firm-level energy consumption from renewable sources by 2030, could make access to clean energy a clear competitive advantage. As a result, Viet Nam's industries could face reduced market access and lower demand if they fail to transition to greener practices, making it crucial to align domestic decarbonization efforts with global market trends to safeguard export opportunities and maintain growth.

Simulation results suggest that loss of market share could have potentially sizable impacts. In 2024, more than half of all Vietnamese exports—US$225 billion—went to key Organisation for Economic Co-operation and Development (OECD) markets, where new country-level climate-trade policies and the climate commitments of firms are changing import demand. In a hypothetical 30 percent fall in exports to OECD countries, Viet Nam's GDP would be around 6 percent lower than in a no-impact reference scenario by 2030. With around 70 percent of Viet Nam's exports to MNCs and two-thirds to OECD MNCs with stringent climate commitments, this scenario is not implausible – but does reflect a likely worst-case outcome, as Viet Nam has committed to decarbonization objectives and plans that require prompt implementation and ancillary policies and regulations to succeed.

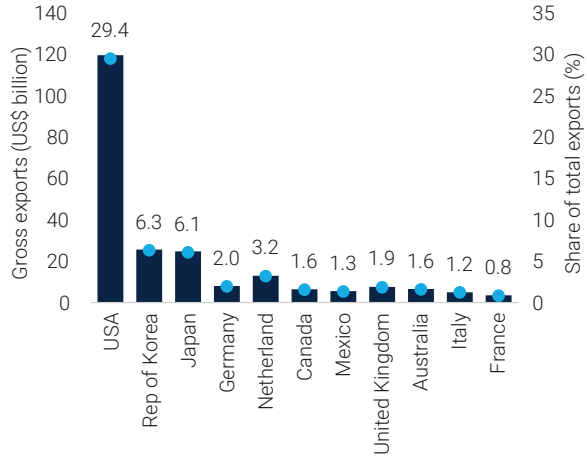
Figure 0.10. Viet Nam growth model's reliance on carbon-intensive exports to OECD countries

a) Net export-related CO_2 emissions as % of production



Source: World Bank staff calculations.

b) Exports to key OECD countries in 2024



Source: OECD.
Note: Trade values in US$ billion expressed as a share of Viet Nam's total exports.

On the other hand, Viet Nam is well-positioned to capitalize on the global surge in demand for green technologies, goods, and services. One of the country's key advantages is unparalleled technical potential for wind and solar energy in Southeast Asia, estimated at 1,000GW per year, with the majority driven by its high wind energy potential. This gives Viet Nam a unique competitive edge, presenting an

invaluable opportunity to attract global and regional companies seeking green production and service facilities, including RE100 manufacturers. The successful implementation of its energy transition plan, currently laid out in PDP8, will be a critical step in unlocking Viet Nam's full economic potential in this space. Viet Nam has rapidly increased exports of electric vehicles, wind, and solar products during 2010–22, although some of these exports face some challenges in export markets, including scrutiny of solar panels exports to the United States, its main market, by the American authorities, with a preliminary anti-subsidy finding against Viet Nam in October 2024.

The private sector is central to Viet Nam's efforts to reduce emissions and transition to a low-carbon economy. Mobilizing private capital is essential to meet investment needs, particularly in sectors where private entities can effectively drive innovation and efficiency. According to the World Bank's Country Climate and Development Report (CCDR), with appropriate policy reforms, the private sector could provide a majority of financing across multiple sectors, including energy and industry. Private investments have already significantly contributed to the country's renewable energy capacity, with Viet Nam's solar energy sector having expanded from nearly zero in 2017 to 17GW today, largely due to private sector involvement. Beyond renewable energy, the private sector is also instrumental in driving energy efficiency and emissions reductions across various industries. Industrial decarbonization, particularly in sectors like cement and steel, will require substantial private investment in low-carbon technologies and processes. This includes adopting energy-efficient practices, transitioning to cleaner fuels, and investing in carbon capture and storage solutions.

Given the net zero transition commitments both domestically and abroad, Viet Nam should adopt a comprehensive approach that integrates nation-wide policies with incentives, regulations, and standards in key emitting sectors, such as energy and transport. Current policies have relied more heavily on planning mechanisms such as renewable energy targets in the Power System Development Plans. Shifting the policy mix towards a more market-driven approach could enhance efficiency and reduce the cost of emission abatement by leveraging the power of market forces and incentives. Market instruments, by imposing a cost on carbon emissions, shift relative prices, and these price signals can accelerate the adoption of low-carbon technologies by making them more competitive. These instruments include the launch of the pilot ETS[21] planned for 2025, with full implementation expected by 2028. Viet Nam is also participating in voluntary carbon markets, along with transactions under Article 6 of the 2015 Paris Agreement that defines the certification and trading of carbon credits. Additionally, the introduction of a carbon tax to complement the ETS would further bolster Viet Nam's ambitious goal of achieving net zero emissions by 2050. Also, enhancing access to green finance and reducing regulatory barriers will enable businesses to undertake necessary investments in clean technologies and infrastructure. The following table provides a set of cross-cutting and sectoral recommendations for the upcoming five-year policy cycle (2026–30). Potential economic and adaptation co-benefits are highlighted.

[21] Decree No.06/2022/ND-CP provides a roadmap for development of a domestic carbon market, with Viet Nam set to launch an ETS pilot by 2028, for three main sectors (power, cement, steel).

Recommendations for 2026–30

Cross-cutting		Economic Co-Benefits	Adaptation co-benefits
Implement carbon pricing: ***Emission Trading System (ETS) and a complementary carbon tax to accelerate the transition to low-carbon technologies***	• Pilot the planned ETS for three main sectors (power, steel and cement) by its 2025 deadline. • Introduce a moderate carbon tax (US$7.5–15/ton) to complement ETS coverage, avoiding double taxation: - Reform the EPT fuel excise tax to reflect carbon content, starting with coal. - Complement with a feebate system to incentivize cleaner technology adoption in polluting industries like power.	High	Low
Introduce green subsidies to support the transition to cleaner technologies	• Provide tax rebates, VAT reductions, or investment write-offs for green products, such as energy-efficient machinery, to stimulate demand and private sector investments.	Medium	Low
Leverage voluntary carbon markets to attract private sector climate investments	• In parallel with the development of the official ETS, support the realization of a private carbon trading market underpinned by clear MRV standards, engage with global carbon markets and partner with international stakeholders, including Article 6 projects, to mobilize private sector funding for renewable energy and sustainable development projects.	High	Low
Implement energy efficiency standards and behavioral change programs	• Launch technical standards and sector-specific initiatives, such as consumer awareness campaigns, to improve energy efficiency in industrial, commercial, and residential sectors. • In the industrial sector, strengthen energy efficiency standards to align with international benchmarks.	Medium	Low
Facilitate accessibility of green financing to firms	• Issue clear guidelines and a framework that defines green projects (e.g. green taxonomy). • Build technical capacity and verification systems in Vietnamese financial institutions to address skills gaps in evaluating and managing green bond projects.	Medium	Medium

Empower the private sector to invest in mitigation	• Facilitate the availability of climate policy information related to firms' key export markets, MNCs' requirements, support for implementing adaptation measures and investing in mitigation technology, and the cost-benefit analysis of these investments. • Strengthen green certification standard systems for major export products and help firms adopt international certifications.	Medium	Low
Sustainable Energy		**Economic Co-Benefits**	**Adaptation co-benefits**
Implement the revised PDP8	• Streamline project approvals for PDP8 implementation: reduce delays by establishing time-bound regulatory approval processes, digital platforms for tracking, and clear institutional roles for PDP8 energy transition projects.	Medium	Low
Adopt least-cost planning and clarify procurement rules for PDP8	• Ensure dynamic, least-cost planning to optimize energy security and affordability. Streamline procurement methods across laws and establish clear investor selection criteria.	Low	Low
Strengthen Energy Service Companies (ESCOs) for efficient implementation	• Enhance the capacity of ESCOs by improving access to financing mechanisms, technical training, and enabling regulations to scale-up energy efficiency projects.	Low	Low
Sustainable Transport		**Economic Co-Benefits**	**Adaptation co-benefits**
Accelerate green urban mobility	• Expand bus rapid transit systems and metros. • Promote low emission zones to improve air quality.	Medium	Low
Support the transition to low emission vehicles and electric vehicles	• Put in place better vehicle fuel economy standards for new internal combustion engine vehicles (cars and motorcycles). • Implement incentives and standards for low emission vehicles. • Invest in public charging stations and electric bus pilots.	Medium	Low

Leveraging the marine economy for sustainable and resilient growth

While Viet Nam's geography – with more than 3,260 kilometers of coastline and rich marine ecosystems – presents unique climate vulnerabilities, it also provides opportunities to transition to a greener and resilient economy. Nearly 30 percent of Viet Nam's population lives in coastal zones, which also account for a substantial portion of the nation's economic activity. Viet Nam's ocean, its diverse marine and coastal ecosystems—such as forests and mangroves—are an important source of livelihoods and provide crucial ecological services that sustain economic development. Coastal ecosystems protect around 7 percent of the population (seven million people) from flooding, shielding more than 1 percent of the country's total land area (0.3 million hectares), including some of the most fertile land, and defend economic assets valued at US$6.5 billion[22] (1.6 percent of GDP), such as infrastructure, property, and agricultural land. Key sectors – such as aquaculture, fisheries, shipping tourism and potentially offshore wind power generation – rely on marine natural assets for production and livelihoods. Moreover, these ecosystems store 84 million metric tons of CO_2, directly contributing to climate mitigation efforts.

Government policies have recognized the importance of the marine economy. The 12th Party Congress, through Resolution 36-NQ/TW (October 22, 2018), set forth an ambitious vision for the sustainable development of Viet Nam's marine economy, with a clear target for 2030 and a long-term outlook toward 2045. The resolution aims to establish Viet Nam as a strong, prosperous maritime nation, while safeguarding the security and integrity of its marine economy. By 2030, marine sectors are expected to contribute 10 percent of GDP, driven by significant growth and investment in fisheries, shipping, and marine tourism. Furthermore, the economies of 28 coastal provinces and cities are projected to generate 65–70 percent of national GDP, underscoring the crucial role these regions play in Viet Nam's economic future (Figure 0.11).

While relatively small, the marine sector's direct contribution to GDP is growing fast. Marine and coastal economic activities are estimated to now contribute 3–5 percent of GDP, based on OECD methodology. Analyzing data on Gross Value Added (GVA) and employment across five economic sectors, from 2010 to 2020, reveals that the marine sector's contributions appear modest compared to results from other studies. During the last decade, the marine sector grew at an annual rate of nearly 9 percent, at least as fast as the economy as a whole.

In addition to these direct economic benefits, marine ecosystems also generate a range of positive externalities and ecosystem services that remain unpriced. In addition to market activities, marine ecosystems provide a wide range of services for Viet Nam, estimated by this study at 0.6 percent of GDP.[23] Notably, 94 percent of this total value is from mangroves, with coral reefs, coastal systems, and open ocean systems contributing the remainder.

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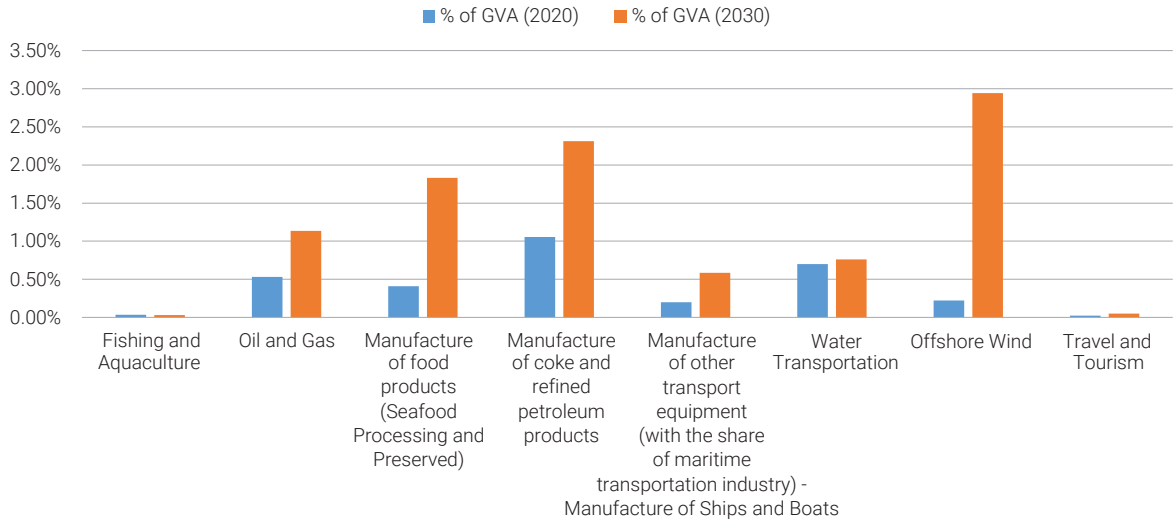
[22] The relatively low economic asset value of US$6.5 billion (1.6 percent of GDP) reflects only direct, quantifiable economic assets, such as infrastructure, property, and agricultural land, that are protected by these ecosystems. However, this figure does not capture the full extent of their economic and ecological contributions. A more comprehensive assessment would likely reveal a significantly higher economic value, underscoring the importance of preserving and restoring these ecosystems as a strategic priority for Viet Nam's development and climate adaptation efforts.

[23] Please see results from the calculations in Table 3.5.

Figure 0.11. Comparing 2030 projections with 2020 (as % of GDP by sectors)



Source: World Bank staff calculations, 2024.

Prospects for future growth are promising, with the marine economy growing in tandem with the rest of the economy. Projections for 2030 were developed by assessing expected increases in physical outputs from 2020 to 2030, while assuming stable unit prices. As illustrated in Figure 0.11, the projected value in 2030 is expected to be 4.6 times higher in real terms than in 2020.

However, unsustainable practices threaten the very assets that drive this growth. Overfishing, pollution, and the accelerating impacts of climate change, including ocean acidification, are undermining the long-term viability of these sectors. Viet Nam was recently estimated as among the top five ocean polluters in the world, with 0.28–0.73 million metric tons of marine plastic debris annually leaking into the ocean. Poorly planned and rapid infrastructure development with a focus on short-term gains, weak regulatory enforcement and a lack of regional and sectoral coordination have impaired natural assets along the coast. A significant portion of Viet Nam's protective mangrove forests has been lost over the decades, with a dramatic decline of 72 percent between 1950 and 1999, equivalent to the destruction of 180,000 hectares. While the rate of mangrove loss slowed between 1999 and 2015, the net reduction continued, albeit at a diminished pace. More recent data indicates that between 2000 and 2020, Viet Nam lost an additional approximately 13,000 hectares of mangrove forests, bringing the total loss over the last 25 years to around 15–20 percent of the remaining mangrove cover. This ongoing decline highlights the persistent pressures from aquaculture expansion, urbanization, and unsustainable coastal development. By 2020, Viet Nam's mangrove coverage was estimated at around 150,000 hectares, down from approximately 250,000 hectares in 1990. These losses not only undermine the country's coastal resilience, but also jeopardize critical ecosystem services – such as flood protection, carbon sequestration, and biodiversity conservation – underscoring the urgent need for stronger conservation and restoration efforts. Climate change is further intensifying these pressures. Viet Nam is highly exposed to typhoons, with a particularly high rate of landfall along its northern, north central and central coasts. Climate-induced sea level rises will heighten risks associated with storm surges driven by typhoons. Tourism will also be impacted during the hottest seasons.

To mitigate these risks, several measures can be considered. Establishing marine protected areas can safeguard critical habitats and allow ecosystems to recover and thrive. Implementing sustainable fishing practices, such as catch limits and seasonal closures, can help replenish fish stocks and maintain biodiversity. Additionally, restoring mangroves can enhance coastal resilience, provide essential nursery habitats for fish, and improve carbon sequestration efforts. Engaging local communities in conservation efforts through education and sustainable livelihoods can foster stewardship of marine resources, ensuring that economic activities do not compromise the health of marine ecosystems. Finally, promoting policies that integrate ecosystem health into economic planning will be crucial to balance growth with sustainability, ultimately preserving the ocean's resources for future generations.

The following cross-cutting and sectoral/spatial recommendations could help build the foundations for a more resilient and sustainable marine economy in Viet Nam in the upcoming 2026–30 policy cycle.

Recommendations for 2026–30

Cross-cutting		Economic Co-Benefits	Mitigation Co-Benefits	Adaptation Co-Benefits
Develop a framework for marine economy accounting	• Adopt standardized methodologies: Use frameworks like the System of Environmental-Economic Accounting (SEEA), particularly the SEEA Ocean Accounting framework, to standardize the measurement of marine economic activities. • Define marine economic sectors: Clearly define sectors – such as aquaculture, ecosystem services, fisheries, renewable energy, shipping and tourism – to ensure comprehensive coverage. • Incorporate ecosystem services: Quantify the value of ecosystem services (e.g., carbon sequestration, coastal protection, biodiversity) provided by marine environments to be included as a part of satellite accounts.	Medium	Low	Low
Strengthen data collection and management	• Invest in marine data infrastructure: Develop robust systems for collecting, managing, and sharing marine data, including satellite imagery, oceanographic data, and fisheries statistics. • Leverage technology: Use remote sensing, AI, and big data analytics to improve the accuracy and timeliness of marine economic data. • Collaborate with stakeholders: Engage with industries, research institutions, and local communities to gather data on marine activities and their economic impacts.	Medium	Low	Low

Build institutional capacity	• Train professionals: Provide training for statisticians, economists, and policymakers on marine economy accounting methodologies. • Establish dedicated units: Create specialized units within the National Statistics Office to focus on marine economy accounting. • Foster collaboration: Strengthen collaboration between government agencies, academia, and the private sector to share knowledge and resources.	Medium	Low	Low
Sectoral/Spatial		**Economic Co-Benefits**	**Mitigation Co-Benefits**	**Adaptation Co-Benefits**
Operationalize marine economy accounting	• Policy integration: Use marine economy accounts to inform marine spatial planning, sustainable fisheries management, and blue economy strategies. • Incentivize sustainable practices: Develop economic incentives (e.g., subsidies, taxes, or payments for ecosystem services) to promote sustainable use of marine resources.	Medium	Low	Medium
Enforce marine spatial planning (MSP) regulations	• Draft and pass national MSP regulations within 12 months, linking them to marine economy indicators. • Establish an MSP task force to oversee implementation and ensure alignment with marine economic goals. • Launch pilot projects in three high-risk coastal regions to test and refine MSP frameworks.	Medium	Low	Medium
Accelerate nature-based coastal protection	• Restore and expand mangroves and seagrass plantations, aiming to restore 50,000 hectares of mangroves by 2030 with legal protection. • Designate 30 percent of national seagrass beds and coral reefs as protected areas to enhance biodiversity and ecosystem resilience. • Integrate nature-based solutions into all climate adaptation plans and infrastructure projects to align with marine economy accounting frameworks.	High	High	High
Ensure sustainable and inclusive tourism growth	• Launch a sustainable tourism certification program with biennial audits to ensure compliance with environmental and social standards.	Medium	Medium	Medium

INTRODUCTION

Viet Nam's ambition of becoming a high-income economy by 2045 is closely intertwined with its ability to achieve a resilient and sustainable development pathway. While it needs 6–6.5 percent annual average growth in the next two decades to reach this goal, the country is highly exposed to climate risk. Heat waves, floods, storms, and rising sea levels threaten the farms that feed communities, the factories and cities that drive growth, and the infrastructure that connects people and markets. Projections show that without action, climate impacts could affect Viet Nam's ability to realize high-income status by mid-century. And as super Typhoon Yagi recently demonstrated, these are not threats in the distant future, they are already a reality today.

At the same time, Viet Nam has become one of the world's fastest growing per capita carbon emitters over the last three decades. While Viet Nam's global contribution to GHG emissions stands at 0.8 percent (355 mtCO_2 emitted in 2020), between 1990 and 2021 its CO_2 emissions grew approximately three times faster than GDP. Viet Nam is one of the most GHG-intensive economies in East Asia with 1.1kg of CO_2 emitted per dollar of GDP (compared to 0.7kg and 0.4kg in China and the Philippines, respectively), while CO_2 emissions embodied in exports accounted for 36 percent of its total CO_2 emissions, one of the highest in the region.[24] To achieve its net zero emissions goal, Viet Nam must find ways to reduce emissions, while ensuring energy remains affordable and industries stay competitive.

The authorities have already begun laying the groundwork for a greener, more resilient future. On adaptation, the government established the Mekong Delta Region Coordinating Council, bringing together government, local communities and the private sector to align investments and actions to tackle climate risks across the entire delta. The government also adopted a Master Plan for the Sustainable Use of Coastal Resources to transform coastal regions into thriving centers of culture, economic opportunity, and sustainability. On mitigation, Viet Nam has accelerated its energy transition. Between 2019 and 2023, the country's installed solar power capacity surged from 4.5GW to more than 17GW, driven by policy incentives and private investment. Building on this momentum, the revised Eighth National Power Sector Development Plan (PDP8) now targets 73GW of solar power by 2030 — a more than five-fold increase from the earlier 12.8GW goal — while wind power ambitions nearly doubled from 21GW to 38GW. Concurrently, Viet Nam is advancing preparations for an Emissions Trading System (ETS), with pilot programs slated to launch in 2025 and full implementation expected by 2028 (Box i.1).

Viet Nam can climate-proof its economy and reconcile economic development and emissions reductions goals. This report provides new evidence and policy options to help Viet Nam reduce

[24] World Bank. 2024. *Viet Nam 2045 – trading up in a changing world – pathways to a high-income future.*

both transition and physical climate risks, while seizing emerging green growth opportunities. It points out that while the transition poses challenges, it will also unlock new drivers for growth and job creation. It seeks to answer three critical questions: what can Viet Nam do to adapt to climate change, how to engender growth-friendly emission reductions and how to unlock the potential of the marine economy?

In responding to these critical questions, this report updates and expands on the 2022 Country Climate and Development Report, particularly in the analysis of climate impacts, adaptation, and mitigation strategies. This report provides updated estimates of adaptation costs, incurred through three key and quantifiable impact channels – loss of labor productivity due to heat stress, capital losses in infrastructure, and impacts on agriculture – integrating climate adaptation measures and analyzing their distributional impacts across households. It warns that the macroeconomic cost of these climate impacts could reduce real GDP growth by an average of 0.33 percentage point up to 2050, leaving between 100,000 and 1.1 million people trapped in poverty by 2050. The study also quantifies the escalating economic toll of frequent extreme weather events, underscoring the urgency of resilience-building. For mitigation, the report evaluates the risks of delayed climate action, projecting significant GDP and employment losses in manufacturing exports if decarbonization stalls. It aligns with Viet Nam's updated sectoral strategies (power, transport, agriculture, industry), measuring their potential to meet national emissions targets and their broader economic trade-offs. It highlights that with current policies, Viet Nam could achieve its NDC target by 2030 – but would still fall short of its 2050 net zero target. Therefore, more needs to be done, including by accelerating the decarbonization of industrial and manufacturing sectors and efforts to create carbon sinks. The analysis emphasizes carbon pricing as a critical policy tool, estimating its emissions reduction potential, fiscal benefits, and socioeconomic impacts to inform equitable climate policymaking. A groundbreaking focus on Viet Nam's marine economy reveals its untapped potential to drive sustainable growth, including blue carbon ecosystems and offshore renewables, positioning coastal regions as engines of green development.

Box i.1: Viet Nam Country Climate and Development Report

The 2022 Viet Nam Country and Climate Development Report (CCDR) assesses how climate change risks affect the country's future development trajectory. The report provides analysis and prioritized policy recommendations to enhance resilience against climate risks and curb GHG emissions, while safeguarding development.

The CCDR finds that as the climate changes, it is increasingly disrupting Viet Nam's economy, and the costs are already starting to undermine growth. At the same time, the country's economic model and rapid growth, urbanization, and industrialization over the last 30 years have led to significant GHG emissions. The country's preparedness to cope with climate change risks is uneven, as strong government commitment has led to revised strategies that are yet to be implemented, and the private sector will need to make substantial investment to adapt to climate change. The CCDR suggests five priority policy packages.

CCDR suggested five policy packages and progress in implementation

Priority packages	Policy actions taken as of March 2025
A coordinated regional program for the Mekong Delta to focus on stemming land subsidence and saltwater intrusion.	The authorities inaugurated the Mekong Delta Region Coordinating Council in 2023 and held meetings in 2024.
An integrated coastal resilience investment program for key urban centers and connecting infrastructure.	An ambitious Master Plan on Sustainable Exploitation and Use of Coastal Resources for the 2021–30 period, with a vision to 2050 was adopted in December 2024.
An air pollution reduction program in the Hanoi airshed to reach the World Health Organization interim target by 2030 and enhance labor productivity gains.	The Capital Law (2024) was revised, and the city now boasts two newly approved master plans and a resolution to establish low emissions zones in a two-phase roadmap, with two pilots expected to be launched during 2025–30.
Accelerating the clean energy transition.	Eight National Power Development Plan (PDP8) for 2021–30 was adopted in 2023 and updated with a revised and more ambitious version of it in April 2025. An ETS framework is being developed. Piloting is to take place in 2025 and full implementation by 2028.
A new social contract to protect the most vulnerable people.	Progress was made in digitization of the social protection system in 2023–24, adding one million beneficiaries to the rosters. The adaptive social protection system and a comprehensive national skills program are still a work in progress.

Source: World Bank staff.

CHAPTER 1.
ADAPTING TO CLIMATE IMPACTS

Key messages

Q: What is the economic cost of inaction in the face of climate change?

A: Under the most likely scenario (RCP4.5),[25] climate change could result in losses of 9.1 percent from baseline GDP levels in the 2030s, climbing to 12.5 percent by 2050.[26] The rising cost of inaction over time could potentially prevent Viet Nam from achieving its ambitious development goal of becoming a high-income economy by 2045. This includes direct and indirect climate change impacts incorporating costs associated with reduced labor productivity, loss of infrastructure capital, and impacts on agriculture.

Q: What about the distributional impacts in various global climate change scenarios?

A: In line with projected GDP growth under all three global climate change scenarios, poverty will continue trending down, but inequality will edge up and regional vulnerability to climate change could potentially reverse some of the gains in poverty reduction. The relatively low poverty rate in Viet Nam, 4.2 percent (Lower Middle-Income Country (LMIC) line of US$3.65 PPP), is projected to dip below 1 percent by 2050. On the other hand, Viet Nam's inequality – as measured by the Gini index of inequality – stood at 36.1 in 2022 and is likely to worsen amid intensifying climate change impacts. If the Gini was to deteriorate by 5 percent (up to 37.9) by 2050, more than 400,000 additional Vietnamese would be in poverty. Also, climate change poses significant threats to regional livelihoods and poverty reduction. For instance, in the Mekong Delta, saline intrusion could trigger substantial and persistent income losses, leading to poverty reduction stalling by 2050, with the share of population living below the poverty line (25th percentile of per capita income of 2025) at or above 2024 shares.

[25] RCP 4.5 is described by the Intergovernmental Panel on Climate Change (IPCC) as a moderate scenario in which emissions peak around 2040 and then decline.

[26] The baseline scenario does not include losses from climate change or any adaptation measures. Results presented throughout the report will include deviations from the baseline across climate shock channels, with and without additional adaptation and mitigation efforts.

Q: How could investing in adaptive measures help?

A: Investing in adaptive measures, while costly, can reduce economic damage by building resilience. The additional investment needed for adaptation in agriculture, infrastructure and to protect human capital during 2025–50 is estimated to reach US$233 billion or 0.75 percent of GDP per year on average. Under the most likely scenario, such adaptation investment could help avoid a 5.8 percentage point loss in GDP —reducing the projected loss from 12.5 to 6.7 percent, a 46 percent reduction. Additionally, by accounting for induced economic benefits as well as environmental and social benefits, the cost-benefit ratio for these investments increases significantly. For example, the estimated benefits-to-cost ratio for a World Bank Mekong Investment project rose to 4.7 compared to the traditional 1.1 ratio.

1.1. Viet Nam's environmental context

With its long coastline and abundant geological and natural diversity, Viet Nam is among the most vulnerable countries to climate change in the Asia-Pacific region. To underline its exposure, mean annual temperatures have risen by 0.5–0.7°C since 1960, with the rate of increase most rapid in southern Viet Nam and the Central Highlands. During 1971–2010, the rate of warming was estimated at 0.26°C per decade, almost double the rate of global warming over the same period (Nguyen et al., 2013). Viet Nam ranked 99th out of 182 countries according to the Notre Dame University Global Adaption Index (ND-GAIN) in terms of vulnerability score.[27] According to the Global Climate Risk Index published by Germanwatch (2021), which analyzes to what extent countries and regions are affected by weather-related loss events, Viet Nam ranked 13th among nations most directly affected during 2000–19 due to its transboundary river basins and low-lying coastline exposed to rising sea levels.[28]

Temperatures are projected to rise and variances in rainfall and temperatures are expected to become more acute, potentially causing larger economic losses than already experienced. Viet Nam is projected to experience an average temperature increase of 1.5°C by 2080–2100 under the most likely climate change scenario (RCP4.5) where emissions peak in 2040 (Figure 1.1).[29] Rises in annual maximum and minimum temperatures in Viet Nam are expected to be larger than in average temperatures, likely to amplify impacts on human health, livelihoods, and ecosystems. A study by Katzfey et. al. (2014) suggested that temperature increases would be most acute in southern Viet Nam, but there is a high degree of uncertainty around sub-national comparisons, future precipitation trends (Figure 1.2), and the intensity of extreme events.

[27] Vulnerability measures a country's exposure, sensitivity, and ability to adapt to the negative impacts of climate change. ND-GAIN measures the overall vulnerability in six life-supporting sectors: food, water, health, ecosystem services, human habitat, and infrastructure.

[28] According to MONRE, Viet Nam has 13 rivers with basin areas of more than 10,000km2, with 10 sharing basins with China, Lao PDR or Cambodia. Viet Nam also has domestic transboundary river basins, such as Danang-Quang Nam.

[29] WBG Climate Change Knowledge Portal (CCKP, 2019). Climate Data: Projections. https://climateknowledgeportal.worldbank.org/country/Viet Nam/climate-data-projections.

Figure 1.1. Viet Nam historic and projected average annual temperature

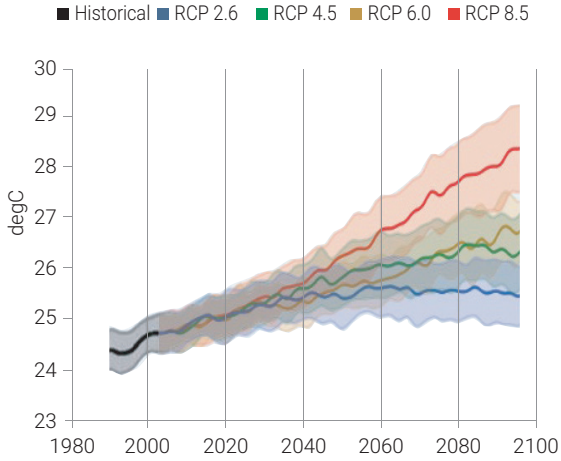
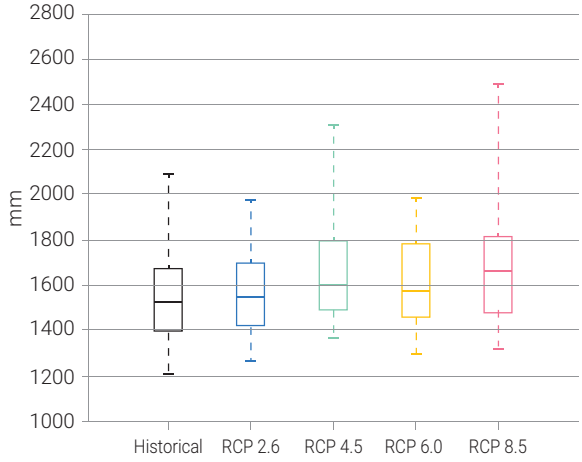


Figure 1.2. Viet Nam historic and projected average annual precipitation



Source: Climate Risk Country Profiles https://climateknowledgeportal.worldbank.org/country-profiles.
Note: RCP 4.5 is described by the Intergovernmental Panel on Climate Change (IPCC) as a moderate scenario in which emissions peak around 2040 and then decline. RCP8.5 is the pessimistic scenario where annual global emissions are assumed to continue rising during the 21st century. RCP2.6 is the optimistic scenario which requires rapid and systemic global action to achieve sufficient emissions reductions to reach net zero global emissions by 2080.

1.2. What is the economic cost of inaction in the face of climate change?

Climate change has significant social and economic impacts on Viet Nam through direct channels. Direct impacts affect the productivity and supply of production factors – such as labor, land and capital – leading to decreases in sectoral output with price rises. While the whole economy is impacted, in Viet Nam specific sectors bear the brunt of climate change, including agriculture and transport, as well as urban areas that include sizeable industrial activities. Climate shocks result in lower returns to production factors such as labor and capital in the short term, while destruction of capital stock tends to increase its cost. As assets are damaged by climate shocks people cannot fully engage in economic activity, household income and consumption fall, and productive investment is crowded out as governments reallocate funds to emergency responses. This, in turn, also implies a lower tax base and fiscal revenues. For Viet Nam, in 2020, private and public asset losses were estimated to reach 1.5 percent of GDP (US$2.7 billion) annually, rising to 2.07 percent when the social costs of disasters (human well-being) are considered.[30]

[30] Rentschler, J, de Vries Robbé, S, Braese, J, Huy Nguyen, D, van Ledden, M, and Pozueta Mayo, B. 2020. *Resilient shores: Viet Nam's coastal development between opportunity and disaster risk.* Washington, DC. World Bank, partly referencing Hallegatte et al. 2016.

Viet Nam is also susceptible to the indirect impacts of climate change. Disruptions in forward and backward production linkages, investment and trade substantially impact on the economy given it is highly integrated in global value chains. These chains facilitated a steady influx of foreign direct investment (17.5 percent of total annual investment) during 2010–23 and created millions of manufacturing jobs, contributing an estimated 10.3 percent of total employment by 2023.[31]

In rural areas, Viet Nam's agriculture sector is profoundly impacted by rising temperatures, variability in rainfall and storms. During 1990–2019, a 1 percent increase in temperature resulted in an estimated 3 percent long-term fall in the agricultural production index.[32] The variability of rainfall has multi-spectrum impacts on regional production with increased droughts in the Central Highlands significantly reducing coffee yields, while excessive rainfall in the Red River Delta has heightened flood risks, damaging rice and vegetable crops, as witnessed by the extensive flood damage left in the wake of super Typhoon Yagi in September 2024. Yagi damaged or destroyed about 262,000 hectares of rice, crops and fruit trees, among other damage,[33] causing an estimated US$2.44 billion in losses to the agricultural sector alone.[34]

Viet Nam's cities, industrial and export centers are also exposed to climate risks. Urban areas face rising temperatures and heat stress, with dense cities like Ho Chi Minh City suffering from "heat island" effects, pushing peak daytime temperatures several degrees higher than surrounding rural zones.[35] With its high population density (319 people per km2 in 2023) and 70 percent[36] living in coastal areas and low-lying deltas, Viet Nam's fast urbanization increases the risks of socioeconomic losses attributable to climate hazards. Moreover, climate hazards also inflict costs on industrial and export centers. In fact, 71 percent of apparel and 74 percent of electronics firms operate in areas at significant risk of heat stress. More than 3,600 apparel and 860 electronics firms operate in cities and provinces particularly vulnerable to extreme heat. High heat-risk areas place more than 1.3 million employees in the apparel and electronics sectors at risk, 70 percent of whom are female. These heat hotspots also host about US$17.6 billion and US$33.3 billion, respectively, of apparel and electronics sector assets, which could be affected by high heat. The pre-tax profit at risk due to high heat exposure is estimated at US$562.6 million for the apparel sector and US$3.1 billion for the electronics sector, which accounts for more than half of each sector's total revenue in the country.[37]

Industrial and export centers are also vulnerable to the effects of storm-related high winds, heavy rain, and flooding. These hazards cause physical damage, electricity cuts, and impassable roads that

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[31] Viet Nam General Statistics Office, 2023.

[32] Dao le Trang Anh, et. Al. 2022. *Climate change and its impacts on Viet Nam agriculture: A macroeconomic perspective.* Researchgate.net

[33] Dezan Shira and Associates. 2024. Viet Nam Briefing. https://www.vietnam-briefing.com/news/impact-of-typhoon-yagi-on-vietnam-economic-damage-and-recovery-efforts.html/

[34] Ministry of Finance and Ministry of Agriculture and Rural Development estimates.

[35] Rentschler, J, de Vries Robbé, S, Braese, J, Huy Nguyen, D, van Ledden, M, and Pozueta Mayo, B. 2020. *Resilient shores: Viet Nam's coastal development between opportunity and disaster risk.* Washington, DC. World Bank. Pgs. 37-39

[36] Data from www.worldometers.com

[37] World Bank. 2024. *Advancing competitiveness of Vietnamese industries through green and resilient transition.* Specifically, 9,493 firms (71 percent) in the apparel sector and 1,879 firms (74.3 percent) in the electronics sector are exposed to such risk.

curb or inhibit production and transport of goods, affecting firms' and workers' productivity, household income, and the regional and – to a lesser extent – the national economy. For instance, Typhoon Yagi severely affected industrial and construction sectors in northern Viet Nam, particularly due to power and communication losses causing delays in industrial production. Disruptions in supply chain production persisted into October with extended delivery times, though less severe than in September.[38] The city of Haiphong, a critical industrial center and home to one of the main national ports, sustained US$955 million in damage.[39]

Viet Nam's extensive transport system,[40] a critical enabler of its rapid economic growth, also faces significant vulnerabilities from climate hazards – exacerbated by outdated design standards and maintenance deficits. Geospatial analyses reveal that the potential risks of road failures due to river flooding are expected to increase by at least 40 percent between 2016 and 2030.[41] In the current climate, 188km of the national highway network is already exposed to extreme flash flooding, which primarily affects mountainous terrain. In contrast, under high-emission scenarios "1,000 year", flood events may occur as frequently as every five years. In some regions, annual rainfall could increase by more than 20 percent, with the frequency of extreme five-day rainfall events rising by up to 70 percent. Hazards are generally most severe in coastal areas, the northern mountains and Mekong Delta, where the convergence of high exposure and concentrated economic activity amplifies vulnerability. As early as 2015, excess heat was blamed for causing road subsidence, especially where asphalt was used and melted.[42]

Transport system vulnerabilities are exacerbated by outdated design standards, maintenance deficits and low adaptive capacity. In addition to the transport network's physical exposure, many road assets were constructed using design standards[43] that rely on historical climate data and do not incorporate high-resolution projections, such as anticipated increases in peak rainfall, increased fluvial flooding, or landslide susceptibility. Insufficient funding for transport infrastructure maintenance has also contributed to this deterioration. During 2011–20, only 50 percent of requested funding was granted, while funding ratios fell to 46 and 42 percent in the road and railway subsectors, respectively.[44] As a result, a substantial

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[38] S&P Global Viet Nam PMI, October 2024.

[39] Ministry of Finance, September 2024.

[40] Rentschler, J, de Vries Robbé, S, Braese, J, Huy Nguyen, D, van Ledden, M, and Pozueta Mayo, B. 2020. *Resilient shores: Viet Nam's coastal development between opportunity and disaster risk.* Washington, DC. World Bank. The country's primary network comprises approximately 1,250km of expressways, 24,300km of national highways, 2,660km of railways, and 5,400km of inland waterways predominantly serving the Mekong and Red River deltas. An extensive maritime network connects 45 ports and nearly 200 terminals across major coastal hubs, while road transport largely remains the dominant mode for freight and passengers.

[41] World Bank. 2019. *Addressing Climate Challenge in Transport – Volume 2: Pathway to Resilient Transport.* Viet Nam Transport Knowledge Series. Washington, D.C.

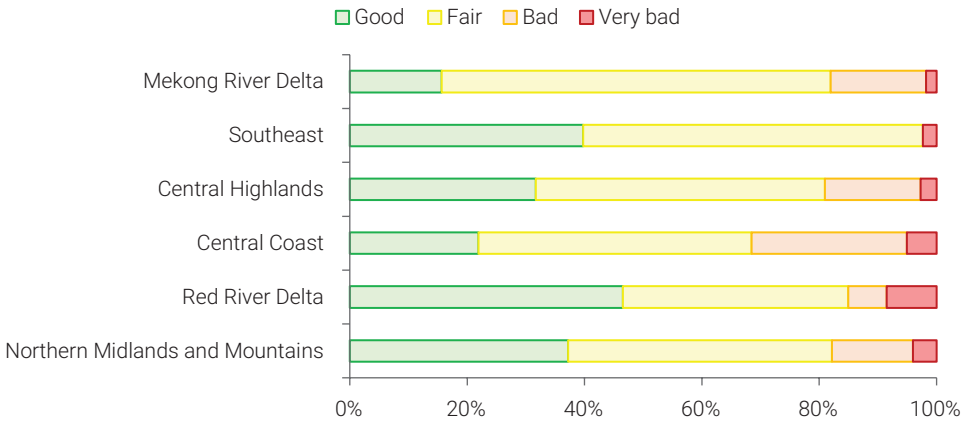
[42] *Viet Nam Investment Review,* June 10, 2015.

[43] TCVN4054:2005 for highways, TCVN5729:2012 for expressways, TCXD104:2007 for urban roads and TCVN10380:2014 for rural roads. TCVN9845:2013 is for calculation of flood flow characteristics, 22TCN-211-06 for flexible pavement design specifications and 22TCN-263-2000 for road survey specifications. QCVN07-04:2016 and QCVN07-02:2016 for infrastructure works for transport and drainage infrastructure.

[44] Ministry of Transport, Department of Planning and Investment. 2021. The government has disbursed a maintenance fund of VND115 trillion. The average disbursement ratio per request from the five subsectors is 50 percent. Road and railway subsectors received less than half of the requested budgets.

portion of the network has deteriorated, especially secondary and largely unpaved roads (Figure 1.3). Moreover, adaptive capacity is limited in certain corridors where network redundancy is thin, meaning that when disruptions occur, alternative routes to sustain essential services are scarce. The interconnected nature of Viet Nam's transport system means that disruptions in one mode or corridor can cascade throughout the entire network.

Figure 1.3. Conditions of national highways by region



Source: JICA 2021.

Given Viet Nam's hazard profile, to assess the future macroeconomic cost of inaction, this report focuses on the three most important and quantifiable impact channels: capital losses in infrastructure, loss of labor productivity, and impacts on agriculture.[45] Given uncertainties inherent in climate change and limitations in modeling these changes, three scenarios are used to provide a range of estimates for climate change impacts on the Vietnamese economy:[46] a most likely scenario (RCP4.5) as well as optimistic (RCP2.6) and pessimistic (RCP8.5) scenarios.[47] Incorporating damage costs into the updated version of the World Bank's macroeconomic MANAGE model captures direct and indirect climate change impacts on the economy.

This report finds that in the most likely scenario, climate change could slow Viet Nam's economic growth by an annual average of a 0.33 percentage point over 2020–50. The long-term real GDP growth

[45] While a wide range of potential climate shock impacts exist, this report focuses on the three most important and quantifiable ones (damage is listed in Annex 1.5, including the damage functions on water resources via the crop production channel).

[46] The Viet Nam Country Climate and Development Report (CCDR) published in 2022 attempted to estimate the costs of climate impacts using the computable general equilibrium model built for the Vietnamese economy (World Bank's Mitigation, Adaptation and New Technologies Applied General Equilibrium - MANAGE model), which was run against two global Representative Concentration Pathways (RCP2.6 and RCP4.5).

[47] RCP8.5 is the pessimistic scenario where annual global emissions are assumed to continue rising during the 21st century and RCP2.6 is the optimistic scenario which requires rapid and systemic global action to achieve sufficient emissions reductions to reach net zero global emissions by 2080. RCP2.6 is considered highly ambitious by the scientific community.

rates in the baseline scenario are expected to slow from a projected average of 5.7 percent in the 2020s to 4.6 percent in the 2040s as the economy matures (Table 1.1).[48] Compared to this baseline scenario, in the most likely scenario (RCP4.5) the macroeconomic cost of global climate change would shave off half a percentage point from real GDP growth on average annually in the 2020s, decelerating to an average of a 0.25 percentage point in the 2040s. Slower real GDP growth in turn affects real GDP paths (Figure 1.4), with projected losses of real GDP levels in the most likely scenario ranging from 9.1 percent in the 2030s to 12.5 percent by 2050 relative to the baseline scenario (Figure 1.5). Climate change-induced losses principally affect the economy through reductions in labor productivity in all sectors due to heat stress, followed by damage to the infrastructure stock and agriculture caused by increased frequency, variance, and intensity of weather events such as precipitation and floods. In turn, total public revenue would decline due to negative impacts on economic activities, with the fiscal balance projected to deteriorate by 0.8 percent of GDP by 2050.[49]

The increasing macroeconomic costs of inaction in the face of climate change could potentially prevent Viet Nam from becoming a high-income economy by 2045. To achieve its ambitious goal, Viet Nam's real GDP will need to sustainably grow about 7 percent per year over the next two decades. This growth rate would outperform the impressive 6.4 percent real GDP growth seen during 2000–20 and exceed estimated real growth rates in the long-term growth model baseline scenario (Table 1.1), which shows a slowing real GDP growth rate as the economy matures. Without adaptive measures, global climate change in the most likely scenario would further slow real GDP growth, widening the growth gap to achieve high-income status by 2045.

Table 1.1. Long-term real GDP growth rate in different climate change scenarios (%)

Scenarios	2020–30	2030–40	2040–50
Baseline	5.69	5.13	4.56
Optimistic (RCP2.6)	5.25	4.94	4.40
Most likely (RCP4.5)	5.21	4.93	4.30
Pessimistic (RCP8.5)	5.16	4.71	4.10

Source: World Bank staff calculation.

[48] Long-term growth assumptions from Viet Nam CCDR 2022.

[49] In the model, it is assumed that public consumption and investment are a constant share of real GDP. Therefore, when real GDP declines, real public consumption and real public investments fall and could explain the small impact on the fiscal balance.

Figure 1.4. Real GDP levels under various climate change scenarios

(Index 2018=100)

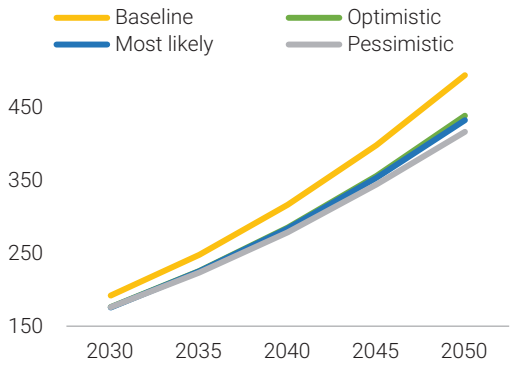
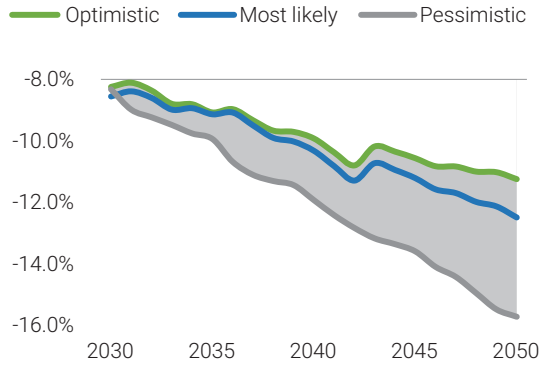


Figure 1.5. Impact of climate change on real GDP levels relative to baseline

(% deviation from baseline levels)



Source: World Bank staff simulations using MANAGE model.

Heat-induced negative shocks to labor productivity are expected to be large and intensifying, in turn impacting the economy. Given its tropical and subtropical latitudes, Viet Nam is one of the most vulnerable countries to productivity losses due to climate change (ILO, 2019). Its workforce is vulnerable to heat stress due to a high share of agricultural and construction employment. Ho Chi Minh City and Hanoi, its two main cities, are also subject to heat stress having experienced increased rates of temperature rises in the past several decades.[50] Hanoi was already defined as heat stressed during 1979–2005 in a 2022 study[51] and is expected to be one of the hottest secondary cities in South and East Asia to 2085. In the most likely scenario, projected decreased labor productivity from heat stress alone could reduce real GDP levels by 10 percent relative to the baseline, which accounts for 78 percent of total impacts on the economy (Figure 1.6). In turn, eroded labor productivity would reduce household income and by extension consumption by 10.1 percent compared to the baseline by 2050 in the same scenario. These findings are corroborated by other studies, such as the 2022 analysis focused on the Mekong region,[52] arguably the most vulnerable region to climate change in Viet Nam. This analysis finds a 1°C rise in temperature is expected to lead to a 0.5 percent reduction in working hours and an 11 percent drop in hourly wages, with women and elderly agricultural workers being disproportionately affected.[53]

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[50] Hung Dao Ngoc, et. al. 2022. *Assessment of heat stress change in Hanoi city.* Journal of Science Natural Science. This study calculated effective temperatures to evaluate spatial and temporal variations of heat stress in Hanoi during 1961 to 2020. Calculation results showed that effective temperatures increased markedly over time. During 1961–97 there were few, but from 1998 to 2020 hot months occurred frequently in June and July. The number of hot months in downtown Hanoi far exceeded those of surrounding areas.

[51] ADB, 2022. *Beating the heat: investing in pro-poor solutions for urban resilience.*

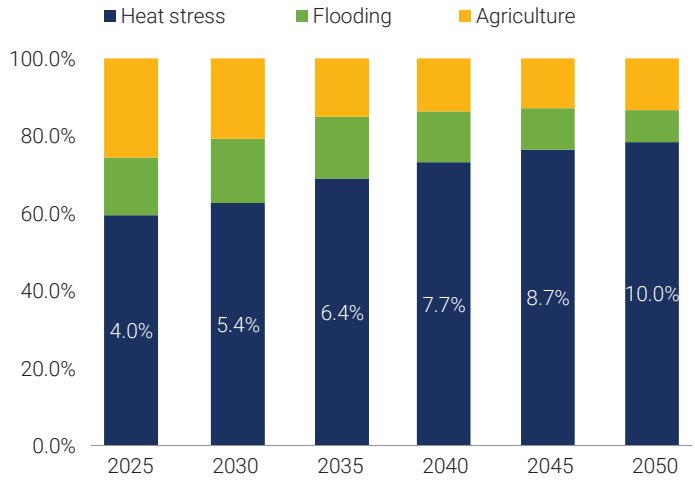
[52] Woillez, M.-N. and Espagne, E. (ed.), 2022. *The Mekong Delta emergency, climate and environmental adaptation strategies to 2050.* Final Report GEMMES Viet Nam project. Paris. Agence Française de Développement.

[53] Ibid.

In the most likely scenario, negative shocks triggered by river flooding, sea level rises and typhoons on the capital stock will reduce real GDP levels by 1.1 percent compared to the baseline by 2050. This constitutes 8.3 percent of total damage to the economy in 2050 (Figure 1.6). This result is corroborated by findings from other studies[54] that river floods, sea level rises and typhoons cause large losses to infrastructure – such as road stock, factories and housing – while lowering the national capital stock. In effect, Viet Nam has long experienced natural disasters, particularly along its coast and Danang city alone experienced 26 typhoons, 13 tropical depressions, and 46 flood incidents between 1998 and 2015. According to a World Bank catastrophe risk assessment in 2017, Viet Nam was expected to incur, on average, VND30.2 trillion (US$1.4 billion) per year in losses to private and public assets due to floods and typhoons. About 60 percent of these losses are caused by typhoons and accompanying storm surges (100 Resilient Cities 2017, World Bank DRFI Program 2019). In Viet Nam's transport sector, its interconnected nature means that disruptions in one mode or corridor can cascade throughout the entire network. For instance, looking ahead, major maritime ports, such as those in the Ho Chi Minh City seaport complex and Haiphong, are projected to become nearly five times more prone to flooding, potentially disrupting 68,000 to 106,000 tons of cargo flows per day. A vulnerability assessment suggests that some transport corridor disruptions could result in daily economic losses of up to US$89 million for Viet Nam's coastal provinces.[55]

Figure 1.6. Three main channels of climate change impacts on GDP

(Share of damage in most likely scenario - RCP4.5 compared to baseline - %)



Source: World Bank staff simulations using MANAGE model.
Note: Heat stress affects productivity; flooding affects capital losses in infrastructure.

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[54] Hallegatte, S., Green, C., Nicholls, R. et al. 2013. *Future flood losses in major coastal cities.* Nature Climate Change 3, 802–806 (2013). https://doi.org/10.1038/nclimate1979
Alfieri, L., Bisselink, B., Dottori, F., Naumann, G., de Roo, A., Salamon, P., Wyser, K. and Feyen, L. 2017. *Global projections of river flood risk in a warmer world.* Earth's Future, 5: 171-182.
Winsemius, H. C., Van Beek, L. P. H., Jongman, B., Ward, P. J., and Bouwman, A. 2013. *A framework for global river flood risk assessments.* Hydrol. Earth Syst. Sci., 17, 1871–1892, https://doi.org/10.5194/hess-17-1871-2013.

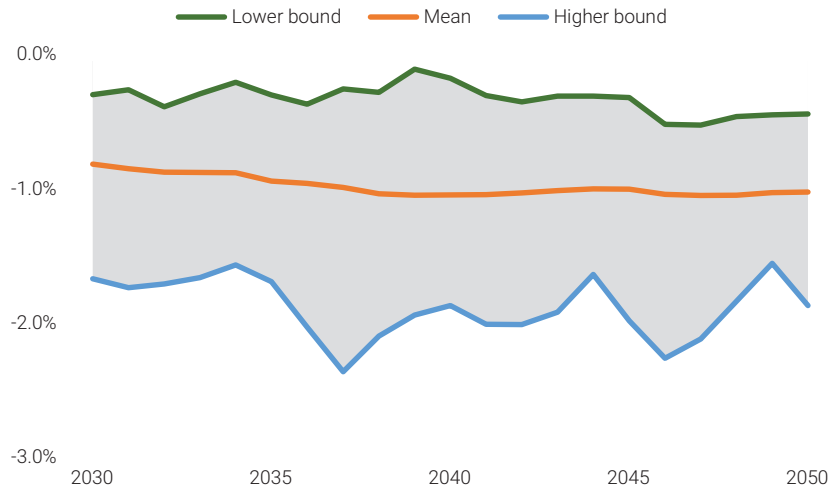
[55] Rentschler, J, de Vries Robbé, S, Braese, J, Huy Nguyen, D, van Ledden, M, and Pozueta Mayo, B. 2020. *Resilient shores: Viet Nam's coastal development between opportunity and disaster risk.* Washington, DC. World Bank. pg 79.

Increased frequency and intensity of weather events in Viet Nam raise short-term economic costs. An additional model simulation assesses the potential outcomes of a one-in-50-year flood occurring in 2030, estimating its immediate loss of value-added worth at 3.7 percent of GDP. The model simulation assumes 80 percent of the cost of reconstruction, which crowds out investment elsewhere in the economy. Also, assets that are damaged during the flood and period of reconstruction cannot be used, leading to further production losses.[56]

In the long run, increased frequency and intensity of weather events – such as flooding, storm surges and typhoons – could exacerbate damage. Figure 1.7 shows that extreme events could reduce real GDP level by an average 1 percent per year (deviation relative to baseline) under RCP4.5. This damage could escalate up to 2.5 percent of real GDP (deviation relative to baseline) if such events occurred more frequently or were more powerful, destroying infrastructure capital (such as roads, housing, and buildings). The size of damage is partly explained by the fact that these extreme events are localized and of short duration, while damage calculations only focus on capital or asset losses.

Figure 1.7. Impact of extreme events on real GDP levels under RCP4.5

(% deviation from baseline)



Source: World Bank staff simulations using MANAGE model.
Notes: the impact on real GDP levels from a random occurrence (stochastic simulation, 5,000 draws per year) of extreme events. The stochastic simulation is based on draws from a constructed distribution of damage for an RCP climate scenario. The confidence band is determined by using the historical recurrence table in the World Bank Viet Nam Catastrophe Risk Assessment Summary Report, 2014.

[56] Estimates undertaken using the Mindset model, with potential damage scaled. The hypothetical scenario is for the year 2030 and is based on estimates of vulnerability from the WRI Aqueduct model. Longer-term impacts would depend on how much of the lost capacity is replaced. Indirect supply chain effects are captured in the model, although the potential for supply chain bottlenecks is not explored.

Asset losses do not tell the full story. Loss of capital stock translate into output losses in the short run and net damage could reduce potential GDP in the long run. While there is uncertainty about changes in frequency and intensity of typhoons, IPCC (2021) expects the upward trend in typhoons observed in recent years to continue with a medium level of confidence. The cumulative capital loss is expected to range from 16.8 to 48.1 percent of the capital stock by 2050, depending on the climate scenario (Climate Analytics, 2022). Economic damage can also include disruptions to production and trade, as in the case of delays in shipments of inputs or outputs from companies engaged in global value chains. Loss of employment or wages, even temporarily, would add to the overall economic costs of an extreme weather event. One estimate places annual loss to people's well-being from natural disasters at US$11 billion in PPP terms (Hallegatte et al. 2016).

Climate change will significantly impact agriculture and rural households. Without adaptation measures, this key sector for Viet Nam could experience projected average yield losses of 9.1 percent relative to the baseline under the most likely scenario by 2050. Agriculture's contribution to GDP is projected to decrease by 1 percentage point compared to the baseline.[57] While climate change will have a negative impact on livestock farming (Chen et al., 2023) and fruit and grain production, the major impact will be on rice production in the Mekong Delta. Rice is the most important crop in volume terms, with Viet Nam the world's fifth and third largest rice producer and exporter in 2023, respectively. About 52 percent of national paddy rice production[58] and 90 percent of Viet Nam's rice exports[59] are from the Mekong River. A 2022 analysis[60] finds higher temperatures in the Mekong region reduce crop yields, particularly rice and fruits, diminish labor productivity and rural household income. Each additional hot day beyond 33°C reduces annual fruit crop income by a projected 1.89 percent and other agricultural income by a projected 1.48 percent. A sea level rise of 75–100 centimeters could also flood 47.3 percent of the Mekong Delta by mid-century, threatening its economic viability and worsening salinity problems.[61]

1.3. What are the distributional impacts of various global climate change scenarios?

In line with projected GDP growth under all three climate change scenarios, poverty will continue to trend down. This follows economic shocks experienced between 2018 and 2022 – COVID-19 and the commodity price shock – that stalled poverty reduction in Viet Nam. Poverty rates in 2022 stood at 19.8 percent (Upper Middle-Income Country (UMIC) line of US$6.85 PPP) and 4.2 percent (Lower

[57] Agriculture share of value-added (GDP) baseline in 2050: 11.97. Agriculture share of value-added (GDP) in 2050 (RCP4.5): 10.97. In the baseline, there is no assumption of actions to increase adaptation to or mitigation of climate change.

[58] World Bank, WBG Climate Change Knowledge Portal (CCKP, 2019).

[59] World Bank, 2024. PROGREEN. https://www.progreen.info/countries/knowledge/vietnam#:~:text=The%20Mekong%20Delta%20produces%20around,90%25%20of%20Vietnam's%20rice%20exports.

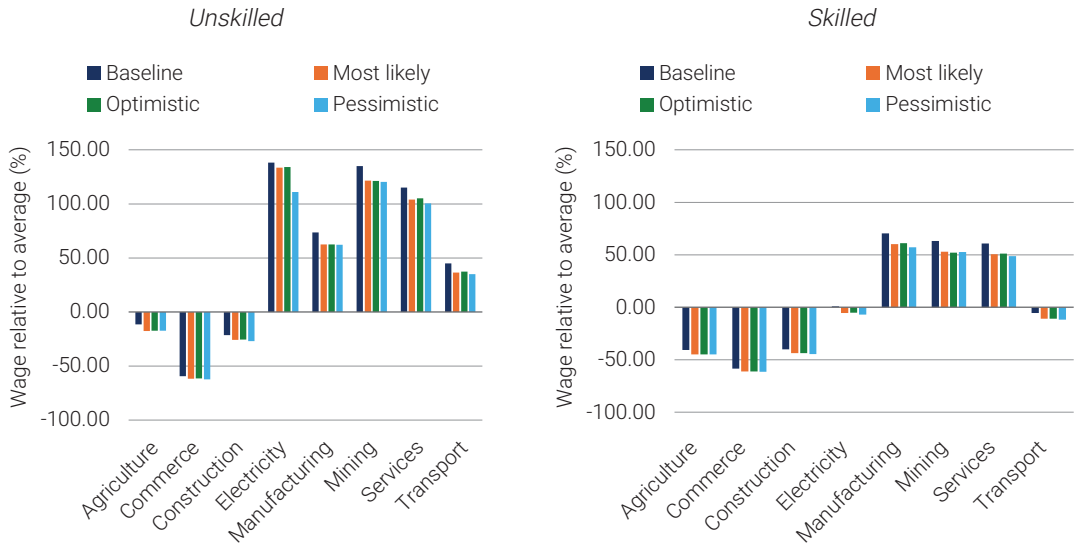
[60] Woillez, M.-N. and Espagne, E. (ed.). 2022. *The Mekong Delta emergency, climate and environmental adaptation strategies to 2050.* Final Report GEMMES Viet Nam project. Paris. Agence Française de Développement.

[61] MONRE. 2022. *Viet Nam's climate change scenario updated version in 2020.*

Middle-Income Country (LMIC) line of US$3.65 PPP), a slight increase from poverty rates in 2020. The already relatively low poverty rate in Viet Nam, coupled with the projected continuation of strong economic growth even in the face of increasing climate risks, means that poverty at the LMIC (US$3.65 PPP) line is estimated to be almost eliminated by 2040 and would remain lower than 3 percent for the higher UMIC line of US$6.85 PPP.

While household income is expected to grow in step with GDP growth, inequality is forecast to increase through multiple channels. While agriculture is set to grow under all projected scenarios, its pace of growth considerably lags that of services and manufacturing. The importance of agriculture in the economy is projected to starkly drop to roughly 10 percent by 2050. This structural transformation manifests primarily through changes in labor productivity and sectoral wages. By 2050, sectoral wage impacts show significant variation (Figure 1.8). Unskilled agricultural and commerce wages are projected to sit below the average unskilled wage, while those in sectors like construction and electricity are likely to be well above average. Similar patterns emerge for skilled workers across these sectors. This wage divergence is likely to exacerbate inequality, as households who heavily depend on agriculture are more likely to be found at the bottom of welfare distribution.

Figure 1.8. Change in wages relative to baseline by sector and skill level (by scenario, 2050)

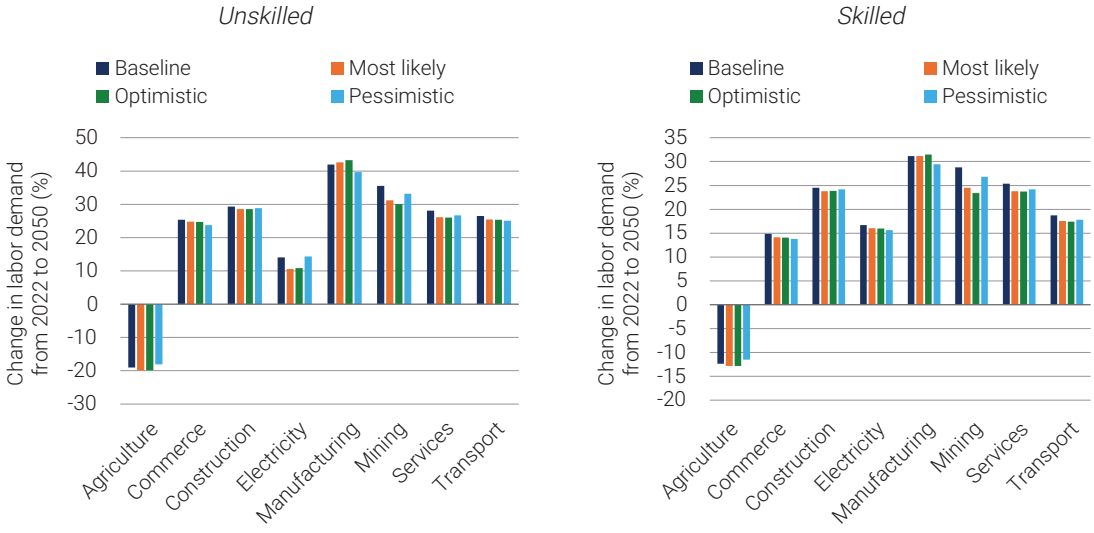


Source: World Bank staff simulations.

Labor market dynamics are expected to accelerate these distributional changes. Within the pool of unskilled workers, labor demand for unskilled agricultural work is projected to decline by almost 20 percent by 2050, while that for unskilled manufacturing labor is set to expand by more than 40 percent. By 2050, agriculture's share of the unskilled labor market is expected to fall by more than 30 percent compared to 2022, while manufacturing will increase considerably by 20 percent.

Similar patterns emerge in skilled labor markets, with a 30 percent forecast increase in manufacturing demand (Figure 1.9). In the absence of adequate social safety nets and skills training programs, this sectoral reallocation of labor could create significant adjustment costs for vulnerable households, particularly those currently dependent on agricultural income.

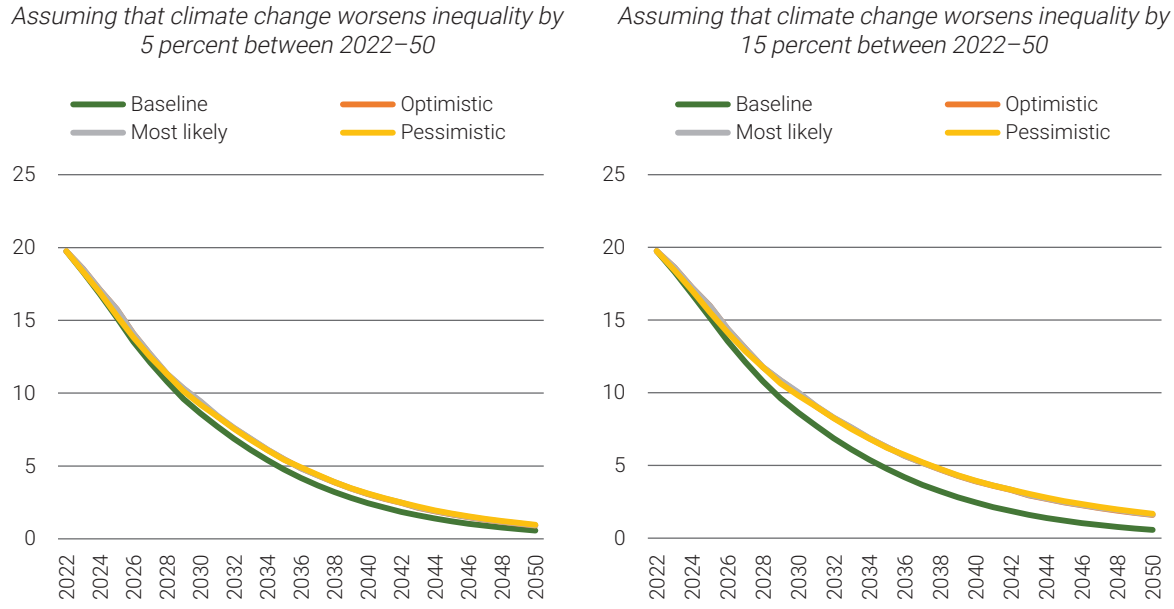
Figure 1.9. Change in labor demand relative to baseline by sector and skill level (by scenario 2050)



Source: World Bank staff simulations.

These structural changes are likely to compound inequality and poverty challenges. Viet Nam's inequality, as measured by the Gini index of inequality, stood at 36.1 in 2022 and is likely to worsen under climate change. If the Gini was to deteriorate by 5 percent (up to 37.9) by 2050, poverty would be nearly 0.4 percentage points higher than under the baseline scenario, translating to more than 400,000 additional Vietnamese in poverty. A more severe deterioration in inequality—a 15 percent increase in Gini to 41.5—would result in more than 1 percentage point higher poverty compared to the most likely scenario, pushing more than one million additional Vietnamese into poverty (Figure 1.10).

Figure 1.10. Poverty impacts of worsening inequality captured via an increase in Gini (US$6.85 PPP)



Source: World Bank staff simulations.
Note: Projections assume a lognormal distribution of expenditures per capita, and projected poverty rates are calculated after applying GDP per capita growth to expenditures from 2022 and increasing the Gini (Crow and Shimizu 1987).

In addition, climate change poses significant threats to regional livelihoods and poverty reduction. In the Mekong Delta, saline intrusion is a significant hazard expected to intensify with anthropogenic activities as well as climate change-induced sea level rises, especially under the most likely climate change scenario. Under RCP4.5, simulations of saline intrusion economic impacts on household incomes from 2025 to 2050 highlight the potential for substantial and persistent income losses, exacerbating long-term poverty trends, with cumulative losses limiting household recovery capacity. These losses could stall poverty reduction efforts, potentially keeping the share of population living below the poverty line (defined as the 25th percentile of per capita income in 2024) at or above baseline levels (Box 1.1).

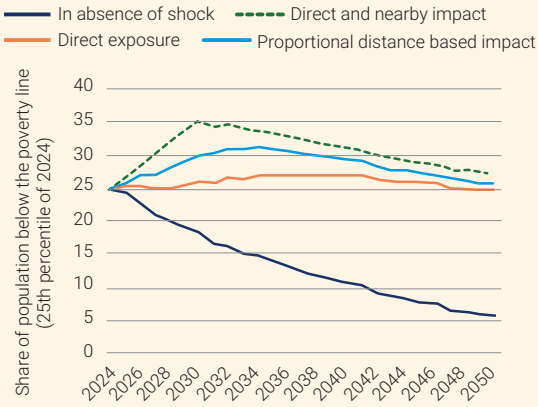
Box 1.1. Economic impact of saline intrusion in Viet Nam's Mekong Delta[62]

The analysis evaluates three impact scenarios: (i) direct exposure, (ii) direct and nearby impact, and (iii) proportional distance-based impact, and finds that saline intrusion leads to substantial and persistent income losses, exacerbating poverty trends. Under the 2050 RCP8.5 with an extreme sea level rise scenario, poverty rates rise significantly, peaking in 2035 before stabilizing at higher-than-baseline levels. The impact of saline intrusion is long-lasting, reflecting its detrimental effects on agriculture, freshwater access, and economic resilience.

Table B1.1 and Figure B1.1 Share of population living below poverty line (25th percentile of per capita income of 2025) (%)

	In absence of shock	Direct exposure	Direct and nearby impact	Proportional distance-based impact
2024	**24.9**	24.9	24.9	24.9
2030	18.4	26.2	35.1	30.1
2050	5.8	**24.7**	**27.4**	**25.7**

Source: World Bank staff estimates based on simulations conducted using Life in the Mekong Survey.



Compared to floods, droughts, and typhoons, saline intrusion exhibits some of the most severe income effects, with cumulative losses limiting household recovery capacity. While baseline poverty declines steadily over time (assuming annual income per capita growth rates of 6.5 percent), simulations show that saline intrusion disrupts this trajectory, leading to sustained economic hardship for affected communities Compared to floods, droughts, and typhoons, saline intrusion exhibits some of the most severe income effects, with cumulative losses limiting household recovery capacity. While baseline poverty declines steadily over time (assuming annual income per capita growth rates of 6.5 percent), simulations show that saline intrusion disrupts this trajectory, leading to sustained economic hardship for affected communities.

[62] Miki Khanh Doan, Ben Brunckhorst, and Paul Corral. 2025. Living or Leaving – Life in the Mekong Delta Region. World Bank. (forthcoming).

Mitigating saline intrusion's economic consequences requires targeted adaptation strategies. Investments in resilient infrastructure, such as salinity barriers and improved irrigation systems, can help protect agricultural productivity. Diversifying income sources beyond rice cultivation can reduce dependence on vulnerable crops and buffer agricultural losses. Additionally, strengthening social protection mechanisms is essential to safeguarding vulnerable households from prolonged economic hardship.

Note: The analysis uses a probabilistic event simulation in which spatial exposure to salinity is integrated to income data from 5,000 households surveyed in the 2024 Life in the Mekong Survey (World Bank). Households are identified as affected if salinity concentration in the dry season exceeds 4g/L (Eslami et al., 2021).[63] Income loss rates are based on historical panel data, with households affected by saline intrusion experiencing a 28 percent income reduction (Thach et al., 2023).

1.4. How could investing in adaptive measures help?

Effective adaptation could substantially reduce the negative impacts of climate change on GDP. Already, climate change responses have been pro-actively mainstreamed in Viet Nam's national strategies, with notable steps including the Law on Environmental Protection 2020, Plan to Respond to Climate Change in 2021–30 (February 2021), and the National Strategy on Climate Change (August 2022). In particular, the National Adaptation Plan 2021–30, with a vision to 2050 (NAP, July 2020), represents a comprehensive and specific national level framework for planning, designing and implementing climate adaptation measures. Adaptation interventions are classified into categories corresponding to three key adaptation targets: (i) strengthening resilience and enhancing adaptive capacity, (ii) mitigating risk and damage from climate change-related disasters and enhancing preparedness to respond to extreme weather and natural disasters and (iii) strengthening national adaptive capacity through institutional improvements, capacity building, securing resources, promoting international cooperation and meeting respective obligations. Vulnerable to the climate crisis, priority sectors for adaptation include agriculture, infrastructure and urbanization, industry and trade, natural resources, public health, transport and tourism.

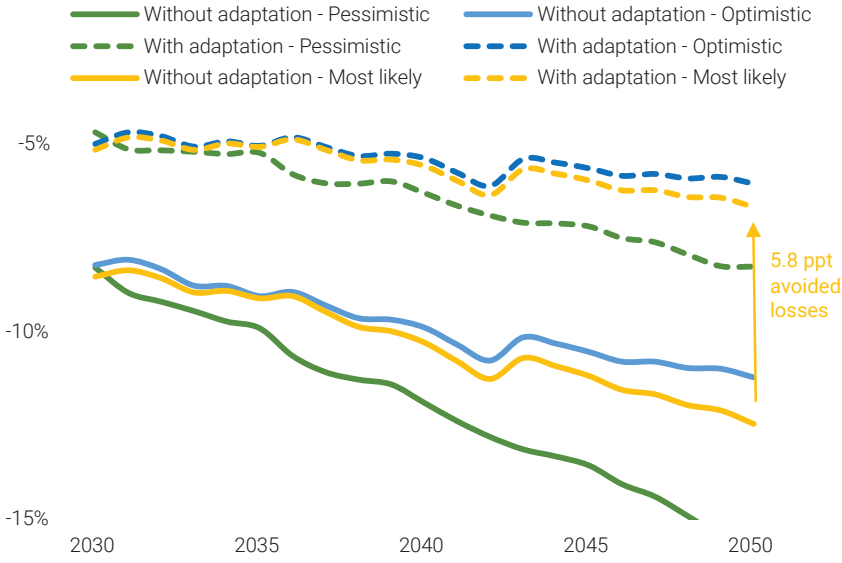
To showcase the potential impact of adaptive measures, we introduced select interventions into the most likely global climate change scenario and found they lessened the economic impacts of climate change from 12.5 to 6.7 percent of real GDP (or a 46 percent reduction) relative to the baseline by 2050. These adaptive measures would include investment in infrastructure which significantly contribute to national economic development, climate-smart agriculture and measures

[63] Eslami, S., Hoekstra, P., Minderhoud, P.S., Trung, N.N., Hoch, J.M., Sutanudjaja, E.H., Dung, D.D., Tho, T.Q., Voepel, H.E., Woillez, M.N. and van der Vegt, M. 2021. *Projections of salt intrusion in a mega-delta under climatic and anthropogenic stressors.* Communications Earth & Environment, 2(1), p.142.

to alleviate heat stress, especially in urban environments.[64] Adaptation investment is considered non-productive use and from public resources only works to reduce damage (World Bank, 2021).[65] At the same time, some adaptation investments—such as climate-smart agriculture, resilient infrastructure, and disaster preparedness—can be growth-enhancing even without the direct threat of climate change. Gains from adaptative measures also materialize in the optimistic and pessimistic scenarios, helping reduce GDP losses by 5.2 and 7.4 percentage points, respectively, by 2050 (Figure 1.11).

Figure 1.11. Impacts of adaptation measures on real GDP level relative to baseline

(with and without adaptation, %)



Source: World Bank staff simulations using MANAGE model.

Promoting climate-smart agriculture enhances farmers' resilience, reduces greenhouse gas (GHG) emissions and ensures food security.[66] In Viet Nam, climate-smart agriculture is recognized as an important tool for managing climate change impacts on this key sector. In 2014, climate-smart

[64] Adaptation measures were only selected if feasible to incorporate into the model. A protection parameter corresponding to each type of adaptation investment represents its effectiveness, such as how much adaptation investment mitigates the impacts of climate damage. We assume a protection parameter of 0.684 for adaptation infrastructure investment or avoiding 68 percent of the damage (Climate Change Group), 0.2 for agriculture adaptation (IPSARD, 2020) or avoiding 20 percent of the damage and 0.5 for cooling measures to alleviate heat stress or avoiding 50 percent of the damage.

[65] Adaptive investment does not affect the productive capital stock in the scenario. It comes primarily from a reallocation of existing resources, and could lead to trade-offs in the economy, including the crowding out of private investment.

[66] Climate-smart agriculture covers a wide array of practices in agriculture and agroforestry to enhance resilience to climate change. It consists of encouraging farmers to diversify crops to mitigate risks associated with climate change, improving water management and promoting efficient irrigation techniques, implementing soil conservation and management. Agroforestry, which involves integrating trees and shrubs with crops and livestock, is a key pillar of climate-smart agriculture. For instance, some practices adopted by Ma village consisted of biological bedding, vermiculture, and integrated home gardens.

agricultural technologies were first introduced in three villages in Viet Nam: Ma village in Yen Bai province, My Loi village in Ha Tinh province and Tra Hat village in Bac Lieu province, representative of different agro-ecological regions of the Red River Delta, North-Central and Mekong River Delta, respectively. These technologies allow smallholder farmers to be more productive and resilient to climate change impacts.

Enhancing the resilience and adaptability of infrastructure to climate change is essential for sustaining Viet Nam's economic development. The country remains highly vulnerable to climate change and natural disasters, particularly along its coast. Enhancing and expanding flood management infrastructure – such as dikes, levees and drainage systems – can help mitigate the impacts of increased flooding triggered by heavy rainfall and sea level rises. Updating building codes and infrastructure design standards to incorporate climate change projections is vital to ensure that new infrastructure is resilient to future climate challenges. Designing and upgrading transport infrastructure – such as roads, bridges and ports – to be more resilient to climate change can help ensure continuity of transportation networks during extreme weather events. This includes incorporating climate change considerations into infrastructure planning, design and maintenance practices. Related to coastal protection measures, nature-based solutions like mangrove restoration not only provide coastal protection, but they also offer additional benefits such as carbon sequestration and habitat restoration.

Box 1.2. Thu Duc city – building urban resilience for future growth

In 2000, Thu Duc city was established by merging Districts 2 and 9 and Thu Duc districts of the southern metropolis Ho Chi Minh City. Thu Duc city is one of the largest land development opportunities in Asia, spread across 21,000 hectares and is currently home to about one million people. If done well, Thu Duc will become the innovation engine of the country by attracting high-skilled workers and jobs to an attractive, liveable, and resilient city, housing approximately 2.2 million inhabitants by 2040. However, without investments in resilient development, the growth potential of the city will not be realized. This is because severe constraints in the form of flood risks will stifle urban networks of jobs, goods, and services.

Early results from an ongoing analysis suggests that with a coordinated approach in investment in Thu Duc – including flood defences alongside improved transport infrastructure, parks, and business services – output for Ho Chi Minh City could increase by up to US$35 billion per year by 2040, relative to the baseline. One-third of this growth is additional output which would not be realized without this investment. Reducing flood risks alters the long-term location preferences of firms and households across the city. Tracts of land in Thu Duc become more amenable to firms and households, and the greater provision of high-quality land across the city as a whole increases productivity and output. This is enhanced by providing services which attract businesses, and green spaces to increase the desirability of areas for households, alongside improved transport connectivity to facilitate interconnections with the greater metropolitan area.

By investing in flood defences alone, the greatest impact can be created by protecting northwest Thu Duc from flood risks, bolstering output by US$10 billion by 2040. This area is contiguous to the existing

urban core, and so development acts to enhance existing business clusters, with additional agglomeration effects. Firms benefit from connectivity to each other, with spillovers through labor and goods markets, and knowledge networks.

Source: World Bank. 2023. *Thu Duc City - Resilient Development Program: An Analysis using a Spatial Computable General Equilibrium Model* (draft study).

Investing in initiatives to adapt to rising temperatures will be a key component of ensuring future resilient economic growth. With Viet Nam projected to experience rapid heating, if the most likely climate scenario were to materialize, projected average daily temperatures will increase by 1.4°C, with a projected range of 0.1–2.7°C, during 2040–59 compared to 1986–2005.[67] Rises in annual maximum and minimum temperatures are expected to be larger than increases in average temperature, likely intensifying the impacts on human health, livelihoods, and ecosystems. To adapt to heat stress, investments will be needed in indoor and outdoor spaces. Investments in indoor spaces will involve more efficient cooling systems to tackle heat stress, while reducing energy and emission requirements and improving building designs (green or cool roofs) and materials (better insulation of walls, doors and windows). Investments in outdoor spaces will involve urban design and landscaping that promote environmental sustainability (such as increased planting of heat-resistant vegetation and trees) and public health measures.

Private sector investment in adaptation could increase the number of green jobs across Viet Nam's economy.[68] Green jobs comprised only a 3.6 percent of total employment (1.7 million jobs) in 2021. The current top five occupations with the highest Green Task Intensity (GTI) index are environmental protection professionals, environmental engineers, refuse sorters, meteorologists, and rangers (professionals). Green jobs exist in all industries, and those with the highest concentration of green jobs are electricity, gas, and water supply (23 percent), mining and quarrying (5 percent), as well as market services (5 percent). These industries might not provide environmental goods and services directly, but they include green occupations such as environmental engineers in mining and quarrying. Agriculture has the highest concentration of such jobs, at 83 percent.[69] Looking ahead, as the economy transitions to greener and more resilient practice, demand for green jobs is expected to rise.

Additional investments needed for adaptation in agriculture, transport infrastructure, and cooling/ heat stress measures during 2025–50 are estimated to reach US$233 billion or 0.75 percent of GDP

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[67] World Bank Group and Asian Development Bank. 2021. Climate Risk Country Profile (page 7).

[68] Abla Safir, et, al. 2024. *Green jobs – upskilling and reskilling – Viet Nam's workforce for a greener economy.* World Bank. Using a task-based approach, 39 out of 441 occupations in Viet Nam's Labor Force Survey 2021 are "green". Green tasks are activities essential to producing the output for which the job was created. Green tasks are performed in a position that involves developing or using green technologies. The Green Task Intensity (GTI) index is calculated as the proportion of green tasks to the total number of tasks in an occupation.

[69] Ibid.

per year on average.[70] As the most extensive requirement is related to heat stress that affects human life and productivity, the highest additional investment (an estimated US$172.7 billion cumulative to 2050 or an average 0.5 percent of GDP per year) is needed for measures to adapt to rising temperatures. Investments in infrastructure (US$38.6 billion cumulative to 2050 or an annual average 0.15 percent of GDP) and agriculture (US$21.7 billion cumulative to 2050 or an average 0.1 percent of GDP per year) for 2025–50 are modest by comparison.

Beyond the macroeconomic benefits, adaptation investments often yield multiple dividends at the micro level. In addition to regular benefits accruing from adaptation investments, there are also multiple co-benefits. A project-based methodology called triple dividends of resilience71 teases out these additional gains. This methodology considers: (i) actual investment needed to mitigate climate impacts, (ii) induced economic benefits such as increased productivity and profits or employment created, and (iii) even if the climate risks do not materialize, the additional environmental and social benefits of undertaking such investment. This can be undertaken before the start of a project (ex-ante) or after its conclusion (ex-post). Figure 1.12 summarizes the ex-post reassessment of World Bank's Mekong Delta Integrated Climate Resilience and Sustainable Livelihoods Project (ICRSL). The analysis focuses on three representative sub-projects, each reflecting distinct hydro-geographic zones: upstream (An Phu), estuary (Ba Tri), and peninsula (An Minh – An Bien). The assessment highlights the project's innovative preparation and implementation, showcasing benefits beyond traditionally avoided damage. The second dividend (economic and livelihood benefits) achieved a benefit-to-cost ratio of 12.02, significantly higher than the traditional ratio of 1.27 (based solely on avoided damages). The third dividend (social and environmental co-benefits) further amplified the project's impact. When all three dividends were integrated, the project-wide benefit-cost ratio rose to 14.67, compared to 1.27 when only the first dividend was considered.

A second project, the Can Tho Urban Development and Resilience project,[72] was also chosen to assess its potential additional benefits. The project had two-fold objectives of disaster risk management and sustainable development. The ex-ante triple dividends of resilience assessment sought to identify the investment costs and anticipated project benefits along the three pillars of resilience dividend: (i) avoided losses when disasters strike, (ii) stimulating economic activity because of reduced disaster risk, and (iii) development co-benefits or multiple use infrastructure. The analysis found that the rate of return to investment would be 13.4 percent in a base case scenario, where benefits include gains from avoided loss savings and co-development, but exclude land appreciation gains against total project costs. A second scenario only considered the benefits of land appreciation from the second and third dividends against total project costs and found investment rates of returns of 31.1 percent, highlighting the importance of potential additional project benefits to Can Tho's economy.

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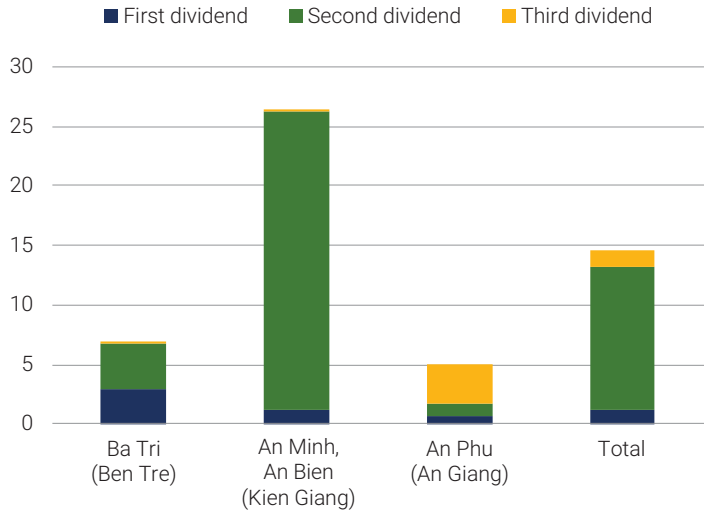
[70] This study provides new sectoral estimates for adaptation investment needs. The aggregate new estimate could be much higher if considering additional adaptation measures not modelled in this study. Viet Nam CCDR (2022) considered a more comprehensive approach and estimated a total of 4.7 percent of GDP per year for aggregate investment needs. However, in the CCDR, adaptation was not included in the modelling to show avoided losses as is the case here, and therefore it did not provide estimated investment numbers for specific sectoral adaptation.

[71] World Resources Institute. 2022. *The triple dividend of building climate resilience: taking stock, moving forward.* Harald Heubaum, Carter Brandon, Thomas Tanner, Swenja Surminski and Viktor Roezer. https://www.wri.org/research/triple-dividend-building-climate-resilience-taking-stock-moving-forward

[72] M. Forni and R. Reig. 2017. *Triple dividend of resilience –- case study of the Can Tho urban development and resilience project.* World Bank.

Figure 1.12. Triple Dividend Resilience methodology (%)



First Dividend (total): Avoided damage from climate-related events.
Benefit/cost ratio returns = 1.20

Second Dividend (total): Such as increased income and better livelihoods or employment opportunities.
Benefit/cost ratio returns = 12.02

Third Dividend (total): Reduced GHG emissions reductions, ecosystem services, water management.
Benefit/cost ratio returns = 1.38

All Dividends:
Benefit/cost ratio = 14.67

Source: World Bank estimates, 2024. World Bank's Mekong Delta Integrated Climate Resilience and Sustainable Livelihoods Project (ICRSL)

While the government plays a pivotal role, approximately two-thirds of adaptation investments are expected to be undertaken by the private sector and households. Encouragingly, there is growing evidence of individuals and firms in Viet Nam proactively responding to climate risks. In the Mekong Delta, some farmers are implementing sustainable rice cultivation techniques such as alternate wetting and drying (AWD) irrigation and using drones for precise fertilizer application.[73] These practices not only enhance resilience and reduce methane emissions, but also lower production costs and open access to premium organic markets. In urban areas, there is evidence that manufacturing firms in Ho Chi Minh City, often SMEs, have installed portable high-capacity pumps to rapidly remove floodwaters and elevate critical machinery and electrical panels above historical high-water marks, enabling operations to resume within hours of inundation and significantly reducing downtime and asset damage.[74]

However, several barriers limit the adaptation responses of firms and households, including incomplete information about the impacts of climate change and credit constraints. To facilitate a broader adaptation response, government policies must create an enabling environment. Certain public goods and infrastructure investments, such as urban flood protection, necessitate direct government action. While some measures, like the expanded use of air conditioning by households, can be adopted independently by the private sector, others may require government support to encourage private sector adoption. Even when adaptation measures (e.g., flood protection and rainwater harvesting systems) are cost-effective over time, the initial capital outlay may deter adoption. This is especially acute among small

[73] World Bank. 2022. *Viet Nam Sustainable Agriculture Transformation Project (VnSAT)*, 2015–22.

[74] R. Leitold, M. Garschagen, V. Tran & J. Revilla Diez. 2021. *Flood risk reduction and climate change adaptation of manufacturing firms: Global knowledge gaps and lessons from Ho Chi Minh City*. International Journal of Disaster Risk Reduction, vol. 61, p. 102351.

enterprises and low-income households that lack sufficient collateral or cash flow to finance adaptation investments. Government incentives or financial support may therefore be needed. Providing accessible, localized climate information to inform decision-making is also crucial to businesses and communities to implement effective adaptation strategies.

1.5. Which policies would support resilient growth?

Adapting to climate change will take a large number of cross-cutting and sectoral policies and measures, while the role of institutions and the public sector cannot be overstated.[75] Beyond the well-established need to green the budget cycle, the government will need to move decisively to fulfill its roles as an investor in critical adaptation infrastructure and a facilitator of this transition, a rule setter in creating new financial and regulatory instruments to ease the transition as well as a regulator and provider of incentives to encourage individuals' and private sector changes in behavior. Additionally, the increasing frequency and severity of transboundary and multi-province development challenges call for coordinated actions across all levels of government. A 2025 World Bank report[76] notes that current fragmented inter-governmental fiscal arrangements based on central-provincial systems need to be reformed to enable regional, province-to-province, transboundary public investment and policy reforms. The report further delves into the needed institutional transformation to help Viet Nam reach high-income status by 2045, including by adopting sustainable practices.

The following table proposes a select set of cross-cutting and sectoral recommendations for the upcoming five-year policy cycle (2026–30), that require public and private sector uptake. The sector-level measures respond to the three main impact channels identified (heat stress affecting labor productivity, agriculture, and infrastructure). The focus is on the design and implementation of government policies, but these are intended to create an environment that enables, and in some cases, encourages adaptation actions and investments by firms and households. This implies ensuring private sector actors have both the incentives and information they need to manage risks. The table indicates which actions are expected to generate economic co-benefits above and beyond reducing climate risks, such as jobs creation and growth, and which will simultaneously contribute to climate change mitigation.

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[75] Climate change is largely absent in current fiscal and investment decisions by the Vietnamese Government, while climate change adaptation is not fully accounted for in overall fiscal strategy nor in prioritization of projects for budget funding. Despite high-level policy commitments, the Ministry of Finance and the Ministry of Planning and Investment have yet to associate action plans with credible estimates of their fiscal implications. Thus, there are insufficient numbers of green and disaster/climate-resilient infrastructure investments. On the other hand, most budget allocations include funding for complementary measures to make projects more sustainable and resilient, with a contingency for unforeseen circumstances, including climate-related events. Additionally, despite having 65–70 percent of the country's aggregate public investment resources at their full discretion, sub-national governments are least prepared to assess and mitigate physical and transition risks of climate change on investments and assets as they lack policies and processes. Scant information on the value of assets and their risk exposure increases the cost of insurance for sub-national governments. Digitizing these core public finance and asset management functions and engaging in more proactive risk management would help address some of these challenges.

[76] World Bank. 2025. *Viet Nam 2045 – Breaking Through – Institutions for a High-Income Future.* (forthcoming).

Table 1.2. Recommendations for 2026–30

Cross-cutting		Economic Co-Benefits	Mitigation Co-Benefits
Leverage innovative financing tools	• Create financial products that blend public, private, and donor resources for investment in climate-resilient infrastructure and adaptive investments.	Medium	Low
Develop the insurance market and adopt new risk-sharing mechanisms	• Roll-out parametric insurance to encourage rapid payouts when triggers (like rainfall or heat thresholds, or wind speeds) are exceeded, accelerating the recovery process. • Launch rapid contingency financing to ensure that critical infrastructure remains operational during large-scale disruptions and facilitate immediate repairs when needed. • Facilitate development of private insurance products that incentivize adoption of climate-smart technology and investment in resilient housing and production practices.	Medium	Low
Develop a public investment program adapted to climate change risks	• Integrate climate risk considerations into existing and upcoming infrastructure projects. Identify and prioritize infrastructure vulnerable to climate shocks (such as transport, water supply, urban, agriculture). • Ensure effective cross-governmental coordination to align public investment planning across ministries and provinces, ensuring that infrastructure, climate adaptation, and economic development projects are synchronized to avoid duplication and maximize efficiency.[77]	High	Low
Ensure effective disaster risk management	• Ensure that disaster risk management and recovery plans as well as early warning systems are regularly updated in a participatory process at the national and regional levels and well-funded • Roll-out a rapid contingency financing instrument to support businesses and an adaptive social safety net to support households in the event of climate-driven disasters.	Medium	Low
Provide information and data to enable risk management by firms and households	• Provide comprehensive and detailed information on climate risks and weather data to support households and private sector actors in making risk-based decisions about their coping strategies, including investment decisions.[78]	Medium	Low

[77] World Bank. 2025. *Viet Nam 2045: Breaking through – institutions for a high-income future* (forthcoming).

[78] A 2025 World Bank report found that with knowledge about extreme temperatures on agricultural output, farmers in Peru adjusted the area and mix of crops. In Tanzania, firms exposed to climate risk primarily through their supply chains hold larger inventories and build larger supplier networks. Because information is a public good, there is a role for government to support its production and dissemination. Forhad J. Shilpi et. al. 2025. *Rethinking resilience: how to help people to pre-pare, recover, and adapt.* Washington, DC: World Bank (forthcoming).

Resilient cities		Economic Co-Benefits	Mitigation Co-Benefits
Align fiscal incentives to enhance land use and urbanization patterns	• Adjust land or property taxes to discourage settlement in high-risk areas and reward resilience investments (such as property tax rebates for upgrading building standards). • Ensure adjustments are paired with sufficient resources and training for implementation of the new taxes and building codes.	Medium	Low
Strengthen building resilience	• Revise building codes and standards so that residential, commercial, and public buildings meet expected higher temperatures and stricter storm-resilience criteria.	High	Medium
Build adaptive urban infrastructure	• Incentivize adaptative private investments that reduce urban heat and increase energy efficiency of buildings, such as green roofs.[79] • Invest in flood-resilient urban drainage combining gray infrastructure (pumps, sluice gates) with green infrastructure (wetlands, bioswales) to reduce peak flood flows, control stormwater runoff, and enhance groundwater recharge. • Undertake proactive public maintenance of existing urban infrastructure at risk of weather events.	Medium	Medium
Resilient transport		**Economic Co-Benefits**	**Mitigation Co-Benefits**
Establish robust adaptation planning	• Establish a unified risk database that consolidates climate, hydrological, and infrastructure condition data to enable more precise vulnerability assessments and asset management decisions.	Low	Low
Develop technical standards and protocols for maintenance of existing assets	• Develop technical standards commensurate with risk levels, and technical specifications and norms for both routine and emergency maintenance that include climate vulnerability zoning to complement targeted adaptation investments. • Establish clear protocols for maintenance prioritization using geospatial data to help ensure that limited resources are directed to the most vulnerable and critical segments.	Low	Low

[79] US EPA. https://www.epa.gov/heatislands/using-green-roofs-reduce-heat-islands

Resilient agriculture		Economic Co-Benefits	Mitigation Co-Benefits
Diversify crops and livelihoods	• Support farmers to diversify to climate-resilient crops through subsidies, technical assistance, and access to markets. Alternative products include drought-resistant and low-emission rice and saline-tolerant maize, vegetables, corn, banana, mulberry and shrimp farming.	High	High
Mitigate the impacts of irregular rainfall and droughts	• Use of Alternate Wetting and Drying (AWD) can reduce water use, while maintaining yields and lowering methane emissions. • Efficient irrigation systems, including drip irrigation (or solar-powered drip irrigation) and rainwater harvesting, improve water conservation in drought-prone regions.	High	High

CHAPTER 2.
RECONCILING GROWTH AND EMISSION REDUCTIONS

Key Messages

Q: Can the mitigation policies adopted by Viet Nam support its climate goals?

A: Yes, partly. Simulation results show that if five key government mitigation policies adopted to realize global climate change commitments were implemented, Viet Nam could achieve its Nationally Determined Contribution (NDC) targets by 2030. However, it would not be on-track to meet its 2050 net zero goal. Key policies include sectoral initiatives in energy (PDP8), agriculture and transport, complemented by energy efficiency gains and carbon pricing. If these policies are implemented, greenhouse gas (GHG) emissions would fall 37 percent by 2030 compared to the baseline scenario, contributing 85 percent to the NDC target of a 43.5 percent GHG reduction by 2030. However, current mitigation policies would imply a contribution of 55 percent to the net zero target by 2050, with this ambitious goal's achievement dependent on further technological innovations and carbon sequestration efforts.

Q: Can mitigation policies support the country's economic growth?

A: Yes. The economic costs of the net zero transition will be modest and could be reduced by additional gains (drivers) from mitigation policies. GDP could be 0.02 percent lower than the baseline in 2030 and this loss would increase over time, reaching 2.76 percent in 2050 mainly from the effect of rising energy prices associated with shifting the energy mix and carbon pricing, alongside reductions in household income and consumption. On the other hand, accounting for additional gains – such as increased labor productivity, competitiveness due to transitioning to green production, and the recycling of collected carbon revenues to households and for investment – helps counter the economic costs of the net zero transition on GDP. In fact, it would lead to increases in GDP of 1.81 and 1.39 percent compared to the baseline by 2030 and 2050, respectively.

Q: What more needs to be done to get Viet Nam on the path to net zero by 2050?

A: In addition to policies already adopted, the country needs to accelerate decarbonization of the industrial sector and efforts to create carbon sinks. Implementing additional measures

for decarbonizing industry, reforestation and increasing carbon sinks[80] will position Viet Nam to reduce GHG emissions by 74 percent in 2050 relative to the baseline scenario, closer to net zero objectives thanks to cost-effective energy efficiency improvements in industry and the lowering of energy services costs for households and businesses. In turn, these efficiency gains and lower energy services costs will contribute to real GDP level increases of 2.3 percent in 2030 and 4.4 percent in 2050 compared to the baseline.

Q: Will a carbon tax be effective?

A: Achieving Viet Nam's NDC emission reduction commitments by 2030 will come within reach with the introduction of a carbon tax that will tax fossil fuels in proportion to their carbon content, unlike the current fuel excise tax. In addition to reducing GHG emissions, a carbon tax will provide additional revenues of 1–2.5 percent of GDP for public investment or transfers to households. Combining a carbon tax with a feebate in the power sector would effectively support the shift in energy mix towards greater use of renewable energy. However, a carbon tax should be complemented by other national policies – such as green subsidies, standards and regulations on energy efficiency – along with sector policies and investments in agriculture, energy and transport most prominently to achieve net zero emissions by 2050.

Q: What are the distributional effects of a carbon tax?

A: The distributional and poverty impacts of carbon taxation would be relatively small because the direct consumption of fossil fuels and electricity is relatively similar across income groups, with poorer and richer households devoting similar shares of their budget to energy-related items. The distributional impact of a carbon tax could be made neutral with small redistributive transfers.

Q: Which growth challenges does Viet Nam face in the context of carbon emissions mitigation?

A: Despite its ambitious climate change commitments, Viet Nam faces two main growth challenges. First, its economic growth model remains highly carbon intensive, which poses risks to its competitiveness and export-oriented growth. Second, in 2022 more than half of all exports—US$223 billion—went to key OECD markets, where new country-level climate-trade policies and climate commitments of firms are changing import demands. Viet Nam's climate commitments have significant implications for the transformation of the agriculture, energy and transport sectors as well as energy efficiency gains.

[80] The Accelerated Decarbonization Scenario (ADS) includes the five areas of existing policies, benefits from implementing these policies (such as increased labor productivity due to cleaner air), as well as additional measures to adapt energy savings materials and equipment in production processes, and measures to reduce emissions from land use, land-use changes, and forestry as suggested in the Viet Nam Country Climate and Development Report (2022). These include increased subsidies for forest services, forest conservation and sustainable soil management, and requires new investments by the private and public sectors.

Q: Is Viet Nam pursuing green growth opportunities?

A: The Government of Viet Nam estimated that green economic activities generated US$6.7 billion in 2020 or 2 percent of total GDP, with 10–13 percent annual growth during 2018–20. Over the past decade, Viet Nam has started to take advantage of green growth opportunities in energy and manufacturing, increasing exports of specific products, such as solar panels. Given its geography, it is well positioned to take advantage of the global expansion in demand in solar and wind energy and has further opportunities for production and the export of green technologies, goods and services exports.

2.1. Can current mitigation policies realize Viet Nam's net zero objective?

2.1.1. How do these policies stack up?

While Viet Nam's total emissions are relatively small, its economy remains relatively carbon-intensive (Figure 2.1). Viet Nam's total emissions accounted for a modest share of 0.99 percent of global GHG emissions in 2023. Similarly, its per capita emissions are relatively low at 5.2 tCO_2e/capita, slightly below the average of middle-income economies (5.6 tCO_2e/capita).[81] However, reflecting its reliance on coal for energy production and energy-intensive industrial sectors, Viet Nam's carbon intensity—measured as GHG emissions per unit of GDP—exceeds the middle-income country average by 45.6 percent. What is more, GHG emissions in Viet Nam continue to grow rapidly, increasing at an annual rate of 6.2 percent over the last decade. The main sources of emissions in Viet Nam are the power sector (30.4 percent), agriculture (17.6 percent), industrial process emissions (32.4 percent), and transport (7.6 percent) (Figure 2.2).

Viet Nam has made ambitious emissions pledges as part of its NDC update in 2022 and net zero goal in the National Strategy on Climate Change (NSCC). The 2022 NSCC includes a net zero emissions commitment with an intermediate 2030 target equal to that year's updated conditional NDC. The NSCC's mitigation goal requires a nationwide 43.5 percent GHG reduction compared to the baseline scenario by 2030, with carbon emissions to peak in 2035 and fall sharply thereafter to achieve net zero by 2050. The sector breakdown of what needs to be achieved by 2030 and 2050 is outlined in Figure 2.3 and Table 2.1.

[81] World Bank. 2024. *Viet Nam 2045 – Trading Up in a Changing World – Pathways to a High-Income Future.*

Figure 2.1. Viet Nam's development has been carbon intensive (1950–2022)

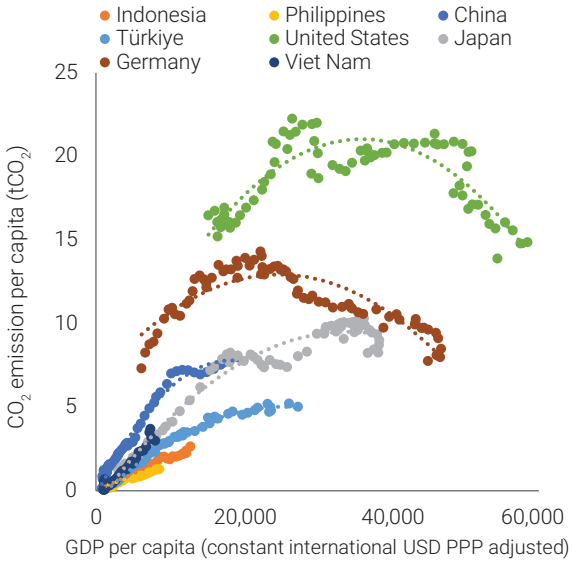
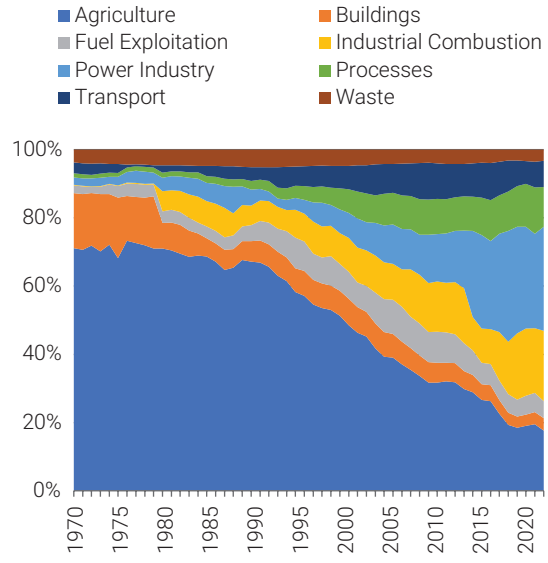
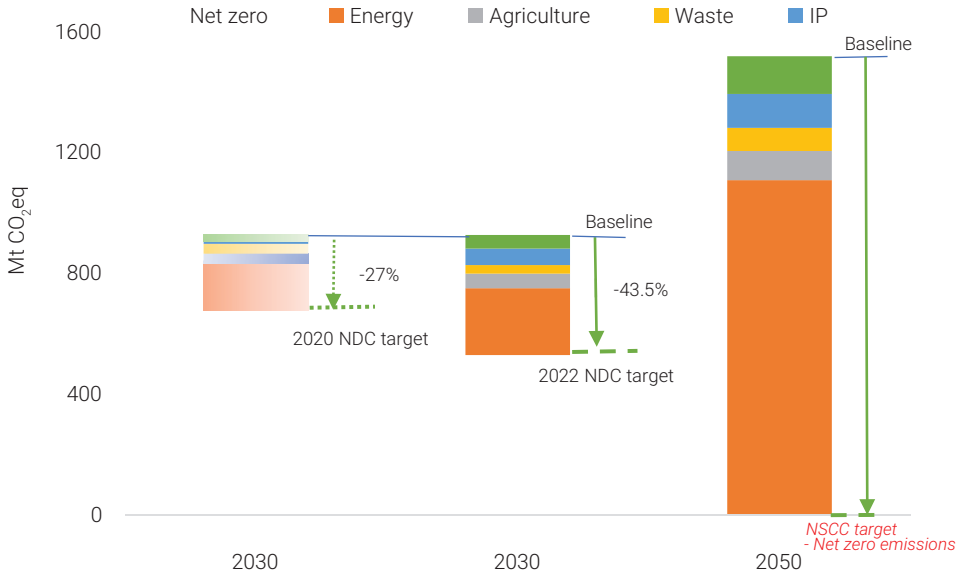


Figure 2.2. Viet Nam's emissions profile



Source: Maddison Project (2023), Global Carbon Budget (2024) – processed by Our World in Data and World Bank staff calculations.

Figure 2.3. Mitigation goals of Viet Nam (2030 and 2050)



Source: World Bank staff calculations, based on NDC and NSCC declarations.

Table 2.1. Sector breakdown of mitigation goals in NSCC (2030 and 2050)

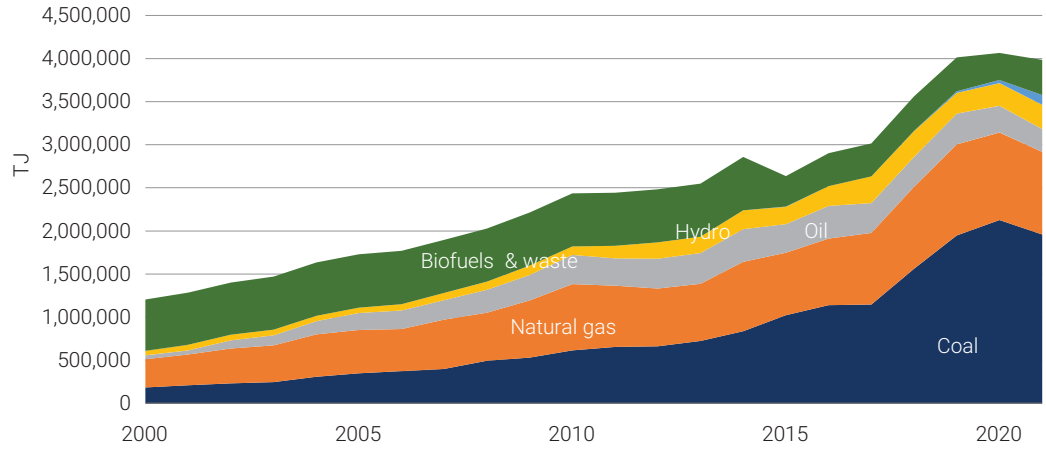
Sector	2030		2050	
	% change	Not > than million tons CO_2e	% change	Not > than million tons CO_2e
Energy sector	32.6	457	91.6	101
Agriculture	43.0	64	63.1	56
LULUCF reduction	70	-95 (Total)	90	-185 (Total)
LULUCF absorption	20		30	
Waste	60.7	18	90.7	8
Industrial processes	38.3	86	84.8	20

Source: NSCC 2022.

The government is emphasizing five broad policy areas to put Viet Nam's emissions plans into action towards realizing its NDC and net zero goals. These policy areas encompass energy, transport and agriculture, complemented by energy efficiency gains and carbon pricing. These policies are outlined as follows and in Annex 2.1.

1. **The energy transition will be the most important component of Viet Nam's net zero transition.** Energy sector-related emissions will account for two-thirds of national GHG emissions, with 60 percent from the power sector alone due to the rapid rise in coal-based power supply (Figure 2.4). On the supply side, Viet Nam has committed to increase the share of renewable energy in the total primary energy supply. The Eighth Power Sector Development Plan 2021–30 with a vision to 2045 (PDP8) built on this strategy and is expected to further reduce planned coal-fired power generation capacity. The revised PDP8, adopted in April 2025, envisages 73GW of solar power by 2030 — a more than five-fold increase from 12.8GW previously — while wind power targets almost doubled from 21GW to 38GW. Investments in grid modernization and flexible storage, including 18 pumped-storage projects, are set to support this shift. In the transport sector, which accounts for 7 percent of total GHG emissions in 2021, the authorities have adopted an action program to decarbonize the sector through electrification and shifts to lower emission transportation modes. In the agriculture sector, which accounts for 15 percent of total emissions, Viet Nam has made a commitment to reduce 30 percent of methane emissions by 2030 compared to 2020. Viet Nam's power mix in 2022 as reported in the NDC was dominated by coal (32.3 percent), hydropower (28.5 percent) and solar power (21 percent) (Figure 2.5).

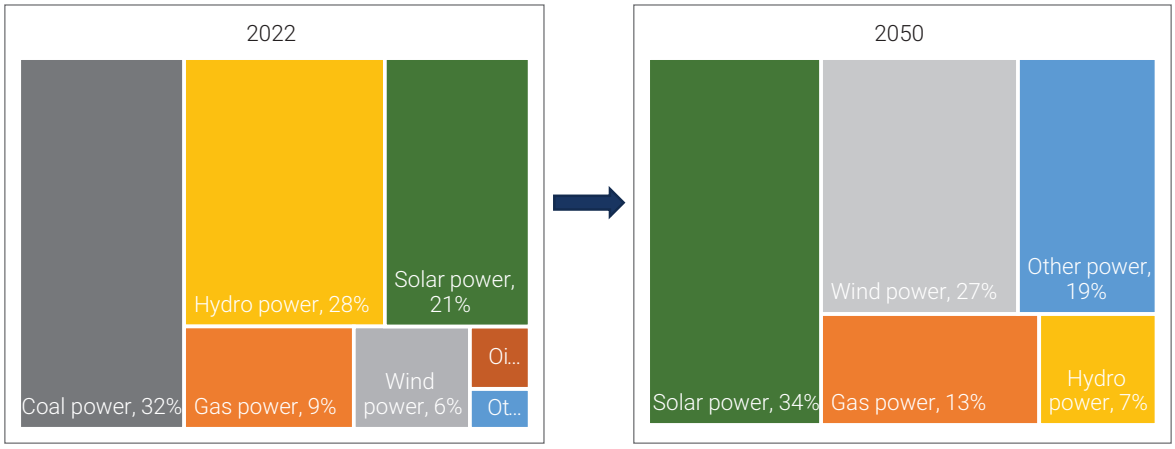
Figure 2.4. Total energy supply by source (TJ)



Source: IEA.
Note: TJ is terajoule, or a trillion joules, a unit of measurement of energy. 1 TJ = 0.278 GWh.

Figure 2.5. PDP8 envisions a backloaded scale-up of renewable energy by 2050

Power mix in 2022 and as proposed under PDP8



Source: PDP8 (2023).

2. **Viet Nam's third National Energy Efficiency Plan (VNEEP3) also outlines ambitious energy consumption reduction targets.** While these energy savings objectives, 8–10 percent by 2030 relative to a baseline scenario,[82] are challenging for a growing economy like Viet Nam's – if the actions outlined in VNEEP3 are put in place, they would help curb energy consumption growth. Annex 2.2 provides further information on the energy efficiency plan and its objectives.

[82] https://vneec.gov.vn/gioi-thieu/c15/introduction.html

3. **Additionally, Viet Nam has introduced incentives to promote renewable energy and green production, although implementation and results have been mixed.** In 2018–19, generous feed-in tariffs were rolled out to encourage investment in renewable energy sources like solar, wind and biomass, with notable success in FDI-led solar investments. These tariffs guarantee a fixed price for electricity generated from renewable sources, providing financial stability for investors. However, lack of investment in the transmission grid hampered any resulting large-scale production and consumption. The government also offers several tax incentives, such as Corporate Income Tax reductions, import duty exemptions for renewable energy equipment, land use fee reductions for renewable energy projects, and tax reductions for electric vehicle (EV) imports and production.

4. **While Viet Nam is developing an emissions trading system (ETS) as a carbon pricing tool, it does not have an effective carbon tax.** Decree No.06/2022/ND-CP provides a roadmap for development of a domestic carbon market. Once in place this should motivate enterprises, including in sectors producing the highest emissions, to realize reductions through the adoption of green technology and practices.[83] In the meantime, authorities are considering revising the coverage and incentive structures of the existing Environmental Protection Tax[84] and Natural Resource Tax to promote GHG mitigation, enhance environmental protection as well as coverage and revenue collection.

5. **Greening the transport sector can also help reduce GHGs, given its share of total emissions and government commitments.** The transport sector contributed 7 percent to total GHG emissions in 2021. Decarbonizing the transportation sector will largely depend on the decarbonization of passenger and freight road transport. Recently, Viet Nam has seen rapid growth in e-mobility. While motorbikes account for more than 90 percent of total vehicle stock, the market share of electric motorbikes comprised 12 percent of sales in 2022 (408,000 units). An action program[85] aims to reduce in air pollution and GHG emissions to help meet the NDC by 2030 and net zero target by 2050. Using Avoid-Shift-Improve metrics, this program shows that the electrification of fleets across all transport modes is expected to play a major role in decarbonizing the sector.[86]

6. **In agriculture, Viet Nam has made a commitment to reduce 30 percent of methane emissions by 2030 compared to 2020 and joined the Glasgow Declaration on Forest and Land Uses at COP26**.

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[83] Decision No.01/2022/QD-TTg mandated a list of sectors and facilities that must conduct GHG inventories – encompassing energy, transportation, construction, industrial processes, and agriculture-forestry – which are the largest contributors to Viet Nam's total GHG emissions.

[84] The Law on Environment Protection Tax (No.57/2010/QH12). It is an excise tax on fossil fuels introduced in 2010 as an indirect tax collected on products and goods that, when used, are deemed to cause negative environmental impacts, especially petroleum and coal. The Natural Resources Tax is payable by industries exploiting Viet Nam's natural resources such as petroleum, minerals, forest products, seafood and natural water. Tax rates vary depending on the natural resources being exploited and are applied to the production output at a specified taxable value per unit. This tax is allocated to local government budgets to finance the restoration of the environment in areas where natural resources are exploited and to ensure social benefits, reducing the negative impacts of natural resources exploitation on local communities. The fees related to environmental protection include the environmental protection fee for wastewater, for exploitation of minerals and recently the environmental protection fee for emissions, which has been submitted for National Assembly approval.

[85] Green energy transportation: reduction of carbon and methane emissions of the transportation sector (Decision No.876/QD-TTg, dated July 2022).

[86] World Bank. 2024. *Recommendations to the National E-Mobility Roadmap and Action Plan.*

Agriculture is the third largest contributor of national GHG emissions (15 percent of total emissions in 2021), despite increased forestry plantations compensating for deforestation and land clearing in agriculture and positive changes in LULUCF (land use, land use changes and forestry) from a net emitter to a carbon sink since 2011 (Annex 2.2). Cultivation and livestock account for 68 and 32 percent of the sector's emissions, respectively, with rice cultivation producing around two-thirds of emissions in cultivation (Annex 2.2). In addition, methane and nitrous oxide are two main GHG types of the sector. The agriculture sector action plan for emissions reductions is anchored on mitigative measures for three key subsectors: cultivation, livestock and forestry. In cultivation, the focus is on smart water and irrigation management, while more efficient manure management, improved feed and fodder management will be targeted in livestock. In forestry, the focus is on the adoption of agroforestry. These practices are also classified as climate-smart agriculture that contribute to adaptation objectives mentioned in Chapter 1 of this report.

2.1.2. What can these current policies achieve?

Analysis shows that if government mitigation policies are implemented in these five main areas of intervention (PDP8, energy efficiency, transport, agriculture, carbon pricing), Viet Nam could achieve its NDC target by 2030 – but would still fall short of its 2050 net zero target. This analysis, with model and assumptions outlined in Annex 2.1–2.5, shows a 37 percent decline in emissions in 2030 compared to the baseline, contributing 85 percent to the NDC's target of a 43.5 percent reduction in 2030.[87] Also, without additional major technological changes,[88] current mitigation policies would imply a contribution of 55 percent to the ambitious net zero target by 2050 (Figure 2.6), but fall short of the target.[89] In fact, achieving net zero requires a steep decline in carbon intensity in many countries, highlighting the challenge to meet such an ambitious goal (Figure 2.8). Implementing the PDP8 energy transition plan will make a major contribution towards the net zero goal, reducing emissions by 4.7 percent in 2030 and 15.3 percent by 2050 compared to a baseline scenario (Annex 2.6).

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[87] The NDC target would be achievable if current mitigation policies were fully implemented, while a partial implementation would result in lower carbon reductions by 2030 and 2050.

[88] New technologies include: (i) battery storage systems, by integrating large-scale battery storage to manage the intermittency of solar and wind energy, ensuring grid stability, (ii) green hydrogen can be used for hard-to-abate sectors like heavy industry and transport, offering a zero-emission alternative, (iii) carbon capture, utilization, and storage (CCUS) can reduce emissions from existing fossil fuel infrastructure, enabling a smoother transition to renewable energy, (iv) smart grid technology that facilitates efficient energy distribution, better integrates renewable energy, and allows for demand-response mechanisms and (v) advanced energy efficiency technologies, which reaches beyond basic efficiency measures, adopting advanced technologies like smart meters, building automation systems, and high-efficiency industrial processes.

[89] CGE models in general, including the MANAGE model, are limited in terms of projecting technological change, the wide range of potential technology pathways and historically declining costs. Therefore, their projections of long-term outcomes should be viewed as indicative and the results of assumptions made. For the MANAGE model, technological change is assumed to be captured as increased competitiveness (additional gains of the policies adopted – see Annex 2.1).

Figure 2.6. Current mitigation policies vs. NDC/NSCC targets

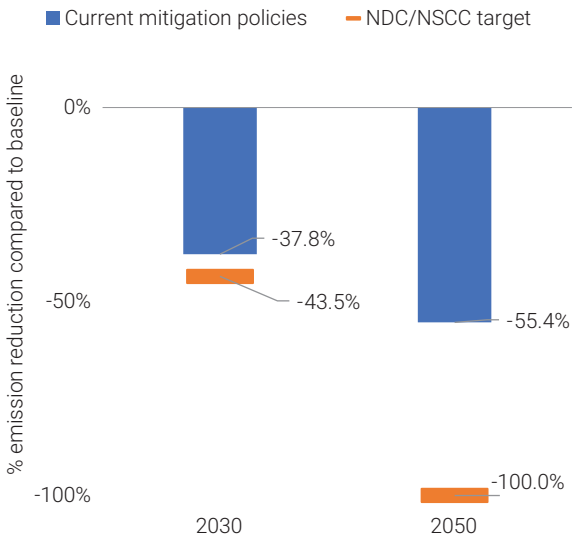
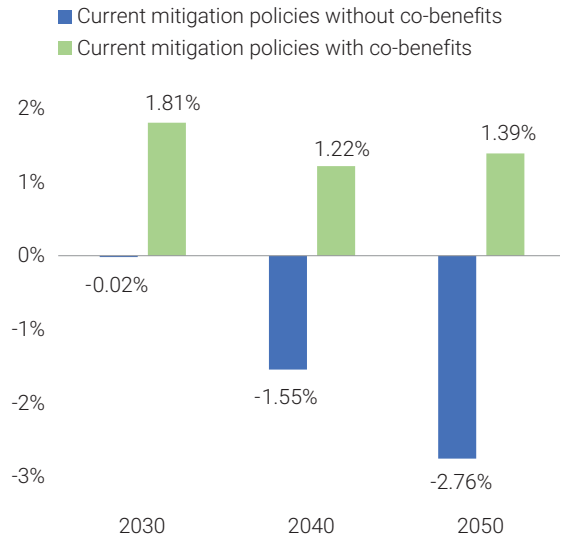
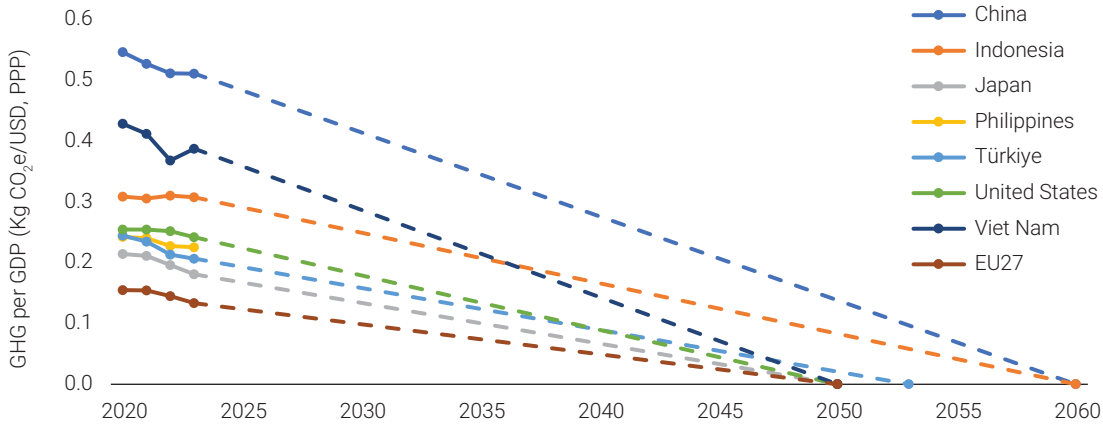


Figure 2.7. Impact on real GDP levels compared to baseline



Source: World Bank staff simulations using MANAGE model.

Figure 2.8. Decline in carbon intensity to achieve net zero



Source: World Bank indicators.

The emissions reduction path is expected to vary by sector (Figure 2.3). The power sector, the largest emitter—leads the way, with emissions set to decline rapidly over the next two decades. Coal use is expected to be steadily phased down, replaced by least-cost domestic solar and wind, supported by expanded battery and pumped storage to meet rising power demand, including from electrification in downstream sectors such as industry and transport. Power market reforms will be essential to build a competitive, nationally integrated power system capable of efficiently managing a high share of variable

renewable energy. Industrial emissions could be reduced in the near term through efficiency gains and electrification. In transport, decarbonization will require not just expanded public transit and rail networks, but also advancements in low-carbon fuels for hard-to-electrify modes. Buildings will see emissions drop through electrification, clean district heating, and energy efficiency improvements. Finally, nature-based solutions – such as changes in agricultural practices, reforestation and ecosystem restoration – will play a key role in offsetting residual emissions from hard-to-abate sectors, helping Viet Nam move towards carbon neutrality. These measures, grounded in the MANAGE model's assumptions and results, collectively form a comprehensive strategy for achieving sustainable emissions reductions.

The reduction in emissions will be driven by global innovation and falling costs of alternative technologies for electricity production, altering the energy sector's demand for various fuels. Estimates from Bloomberg NEF suggest that a solar plus battery storage system (or photovoltaic connected solar system - PVS) is set to become cost competitive against a new coal and gas plant by the end of this decade in Viet Nam. The Levelized Cost of Electricity (LCOE) of a PVS system is expected to fall to US$55–114/MWh by 2030 and US$33–72/MWh by 2050, thanks to declining costs of solar and lithium-ion batteries. Also, Viet Nam has the lowest LCOE from wind energy in ASEAN and one of the lowest for solar (Lee et al., 2020). In addition, the introduction of new sources of fuel, such as biofuel and LNG, is expected to support the energy transition in the longer run.

Changes in regulations, standards, energy use practices, and price incentives set out in national policies will also impact energy pricing and demand by producers and consumers. Energy efficiency standards, carbon pricing, including use of an ETS along with tax breaks and other incentives for green investments are expected to drive price-induced substitution effects, altering energy use by economic agents in the manufacturing and services sectors (Annex 2.3). More efficient technology and higher energy prices would also alter and reduce household energy consumption. In the transport sector, easing access to financing for high-performing e-motorbikes would boost their uptake compared to gasoline-fueled models.[90]

In the transport sector, the application of the Avoid-Shift-Improve (ASI) approach would contribute to emissions mitigation. The ASI approach involves avoiding the need to travel and use of transport by coordinating the planning of urban and industrial areas with transport plans, shifting demand from cars to less polluting modes (rail and waterways for freight, and public transport and walking/biking for passenger (urban) transport) and improving emissions from vehicles (by promoting EVs and more strict emissions regulations).

While the e-mobility transition is only one of the drivers of emissions reductions expected to play a limited role in achieving the 2030 NDC goals, it could also be an important contributor to achieve the 2050 net zero target.[91] The level of GHG reductions from e-mobility until 2030 is modest at 5.3 $MtCO_2$ equivalent under a scenario that assumes stated government policies are implemented (SPS scenario

[90] Ibid 57.

[91] World Bank. 2024. *Viet Nam: Recommendations to the National Roadmap and Action Plan for the Electric-Mobility Transition.* Washington, D.C.

– targets set by government Decision No.876/QD-TTg), contributing around 8 percent to unconditional NDC emission reduction targets set for the overall energy sector, including transport. Implementing the more ambitious Accelerated Decarbonization Scenario (ADS)[92] leads to a 15 percent reduction. This limited impact is due to the majority of electrified vehicles being electric motorbikes (or e-2wheelers) by 2030. Beyond 2030 and particularly from 2035, emission reduction impacts will rapidly scale up as the e-mobility transition shifts from motorbikes to passenger cars, trucks, and intercity buses. Total GHG emissions reductions achieved by the transition represent a 60 percent reduction from the NDC baseline scenario. Under ADS, total emissions reductions could increase to 66 percent from the baseline.

Propagation of climate-smart agriculture (CSA) can act as a driver of GHG reductions, while supporting farmers' income. The promotion of sustainable rice farming technology packages, such as the "One Must Do, Five Reductions (1M5R)"[93] across 180,000 hectares of rice land in the Mekong Delta[94] resulted in the reduction of GHG emissions by 8 metric tons of CO_2e per hectare. Meanwhile, farmers' net profits from rice farming increased by approximately 30 percent compared to traditional methods and total production costs decreased by about 25 percent. The success of this new CSA approach has laid a solid foundation for the ambitious national program of "1 million hectares high-quality and low-carbon rice" in the Mekong Delta.

While implementing the five key mitigation policy areas would reduce GHG emissions, it could have a moderate adverse effect on real GDP levels. These levels would be negligibly lower (0.02 percent) than the baseline in 2030 with losses increasing over time to 2.76 percent in 2050 (Figure 2.5). These GDP losses mainly result from rising energy prices associated with shifting the energy mix, including the large initial investment to change the power sector structure as well as improve the energy efficiency of industries which crowd-out productive investment of other sectors of the economy.[95] Climate mitigation policies – such as carbon pricing, emissions trading systems, and regulations on emissions – could lead to increased costs for businesses mostly in carbon-intensive sectors (Martin, de Preux, and Wagner, 2014). These might include higher energy costs, as well as those related to new regulations, reporting requirements, compliance measures or the need to invest in new technologies. Higher prices also translate into a reduction in household consumption, compared to the baseline, driven by the loss in income.

On the positive side, climate mitigation policies also offer co-benefits stemming from fostering innovation, creating new industries, and improving public health that supports economic growth. Investing in green technologies can lead to energy efficiency which not only reduces emissions, but also

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[92] The Accelerated Decarbonization Scenario (ADS) includes the five areas of existing policies, the benefits from implementing these policies (such as increased labor productivity due to cleaner air), as well as additional measures to adapt energy savings materials and equipment in production processes, and measures to reduce emissions from land use, land-use changes, and forestry as suggested in the Viet Nam Country Climate and Development Report (2022). These include increased subsidies for forest services, forest conservation and sustainable soil management, and requires new investments by the private and public sectors.

[93] 1M refers to "must use certified seeds", 5R refers to "reducing water use, reducing fertilizer, reducing pesticides, reducing seedling rates, and reducing the post-harvest loss".

[94] World Bank, the Viet Nam Sustainable Agriculture Transformation (VnSAT) project.

[95] This is a key assumption of the MANAGE model on the crowding-out effect. However, it is important to note that the empirical evidence on investment multipliers is mixed, with potential positive GDP impacts if this assumption about crowding out is loosened.

lowers production costs and enhances competitiveness in the long run. It can have spillover effects across other sectors, leading to broader technological advancements and economic benefits (Popp et al., 2020). In addition, reducing transport sector emissions can improve air quality and lead to better public health outcomes, which can positively impact labor productivity.

The transition to a low-carbon economy can create new job opportunities in many industries, including renewable energy, EVs and sustainable agriculture. Transitioning to high-tech farming, organic agriculture and sustainable forestry would lead to green job creation. The e-mobility transition could result in 6.5 million new jobs cumulatively across the EV value chain, with 61 percent from the EV charging infrastructure industry, by 2050.[96] The domestic EV market evolution is expected to yield significant growth across the entire EV value chain, that includes vehicle and battery production as well as charging infrastructure and EV maintenance and recycling. These "green jobs" can help offset job losses in traditional industries as green industries tend to be more labor intensive and less capital intensive than brown ones, resulting in higher job creation multipliers (Jaeger, 2021).

Simulations suggest that these co-benefits could contribute to GDP growth. Increased labor productivity, exports, and public investments could contribute 1.81 percent to real GDP compared to the baseline in 2030 and by 1.39 percent in 2050 (Figure 2.5). Labor productivity gains are linked to reduced air pollution exposure and increased exports are due to adoption of low emission production technologies (+10 percent relative to a baseline scenario over 2023–50), while increased competitiveness and collected carbon revenue are recycled into public investment and cash transfers to households to compensate for price increases and support private consumption (Annex 2.1). These drivers will not contribute to further emissions reductions, but counter the argument that mitigation policies would be undertaken at the cost of economic growth.

2.2. What more will it take to put Viet Nam on the net zero emissions path?

To make progress towards net zero emissions, in addition to policies already adopted, it is critical to accelerate the decarbonization of industrial and manufacturing sectors and efforts to create carbon sinks. Current mitigation policies – focused on emitting sectors such as agriculture, energy, transport as well as energy efficiency gains and carbon pricing – will reduce GHG emissions, but are insufficient to achieve net zero by 2050. Among the remaining emitting sectors, the decarbonization of Viet Nam's manufacturing sector is a crucial component of the country's broader climate action strategy. Industrial processes contribute significantly to Viet Nam's carbon footprint, with manufacturing alone accounting for 20 percent of the nation's total carbon emissions (Annex 2.7). The largest emissions are from energy-intensive industries such as cement, chemicals and steel. The Ministry of Industry and Trade (MOIT) is developing a low-carbon industrial strategy, targeting industrial parks and enterprises, promoting energy

[96] Ibid 57.

audits, and supporting the use of renewable energy in production. However, significant challenges remain including the high initial capital costs for implementing cleaner technologies and the need for a robust carbon pricing mechanism. A well-designed emissions trading system can drive significant reductions in the industrial sector by incentivizing cost-effective emissions cuts, fostering innovation in cleaner technologies, and creating a market-driven pathway to achieve climate targets.

Carbon sinks play a vital role in Viet Nam's efforts to decarbonize its economy and mitigate climate change. Forests, wetlands, and coastal ecosystems serve as significant carbon sinks, absorbing carbon dioxide from the atmosphere and helping offset emissions from various sectors, particularly agriculture and industry. The Government of Viet Nam has incorporated forest conservation and expansion into its climate action plans, recognizing the potential of these natural systems to achieve emission reduction goals. The government has implemented several initiatives to expand and protect forests, including the Viet Nam Forest Development Strategy (2011–20) that emphasizes sustainable forest management and reforestation efforts to enhance carbon sequestration. Additionally, the country has been part of international initiatives such as the REDD+ (Reducing Emissions from Deforestation and Forest Degradation) program, which provides financial incentives for the protection of forests and sustainable land use practices. Development of mangrove and coastal wetland restoration programs has also garnered attention, as these ecosystems are especially effective at absorbing carbon and mitigating climate change impacts, such as coastal erosion and flooding. In the agricultural sector, transitioning to sustainable practices such as agroforestry and reduced tillage is another way to enhance carbon sequestration. Despite these efforts, challenges threaten the effectiveness of carbon sinks in Viet Nam, especially illegal logging, forest degradation, and land use conflicts.

Taking additional steps towards industrial decarbonization, to stimulate reforestation and increase carbon sinks,[97] will significantly contribute to reaching the net zero objective. It will lead to cost-effective energy efficiency improvements in industry and lower the cost of energy services for households and businesses, helping Viet Nam reduce GHG emissions by 74 percent in 2050 relative to the baseline scenario, closer to net zero objectives (Figure 2.9). In turn, these efficiency gains and lower costs of energy services will contribute to real GDP level increases of 2.2 percent in 2030 and 4.4 percent in 2050 (Figure 2.10) compared to the baseline. Figure 2.11 reflects the outcomes of mitigation policies in major sectors of the economy – agriculture, electricity production, manufacturing and transport – in the ADS versus baseline scenarios, highlighting that well targeted and implemented policies could have substantial impacts on the direction and size emissions.

[97] The ADS includes the five areas of existing policies, the benefits from implementing these policies (such as increased labor productivity due to cleaner air), as well as additional measures to adapt energy savings materials and equipment in production processes, and measures to reduce emissions from land use, land-use changes, and forestry as suggested in the Viet Nam Country Climate and Development Report (2022). These include increased subsidies for forest services, forest conservation and sustainable soil management, and requires new investments by the private and public sectors.

Figure 2.9. GHG emission reductions

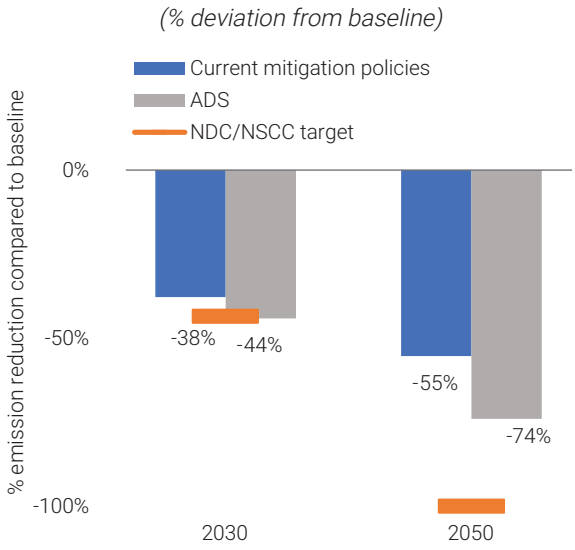
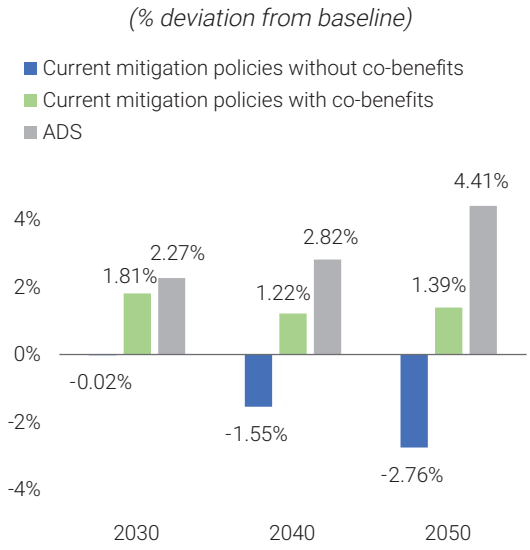
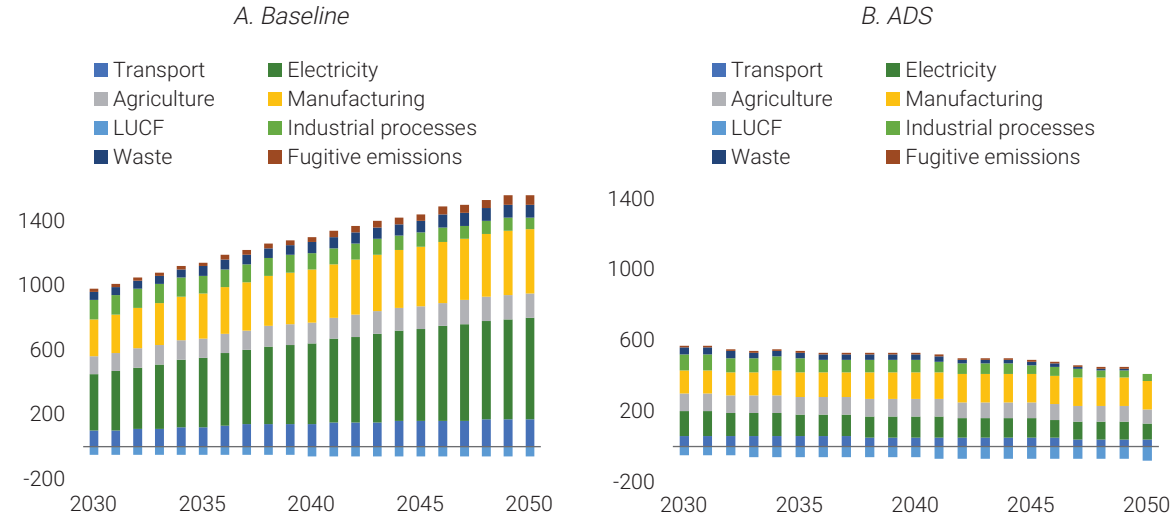


Figure 2.10. Impact of current mitigation and accelerated decarbonization policies on real GDP level



Source: World Bank staff simulations using MANAGE model.

Figure 2.11. GHG emissions by sector under baseline and ADS scenarios (mt CO_2e)



Source: World Bank staff simulations using MANAGE model
Note: The 2030 carbon emission values are different in the two scenarios as model simulations initiate in 2019 and ADS policies have already impacted emissions by 2030.

2.3. Will a carbon tax reduce GHG emissions?

Fiscal policies can be a powerful tool in the government's policy toolbox to help achieve Viet Nam's climate goals. Section 2.1 featured analysis on the use of carbon taxation as part of a set of long-term mitigation and green growth policies. This section highlights results from a short-term analysis focused on the potential for forward-looking fiscal policies, such as carbon taxation, as one of the drivers of the green transition.

A carbon tax can be an effective tool for climate mitigation through providing economic incentives to reduce GHG emissions. By assigning a cost to carbon emissions, it encourages businesses and individuals to adopt cleaner technologies and practices, ultimately driving a transition to a low-carbon economy. This market-based approach not only promotes energy efficiency and innovation, it also generates revenue that can be reinvested in sustainable projects, such as renewable energy and climate adaptation initiatives. Additionally, by internalizing the environmental costs of carbon emissions, a carbon tax helps create a more equitable economic system, supporting efforts to address climate change while fostering long-term economic resilience.

While Viet Nam has low environmental protection taxes and is developing explicit carbon pricing instruments, it does not have a carbon tax. The authorities are planning to launch an ETS, starting with a pilot in 2025, and full implementation in 2028. To this end, the regulatory framework has been revised to develop a domestic carbon market and implement the ETS, including by revising the Law on Environmental Protection in 2020, and issuing Decision No. 232/QD-Ttg on the establishment of an emissions market, cap setting, and methodology for allowance allocation. Meanwhile, Viet Nam does not have fossil fuel subsidies and the Environmental Protection Tax (EPT) has remained an excise tax on fossil fuels since introduced in 2010,[98] currently raising revenues amounting to 0.8 percent of GDP (Rodriguez et al. 2023). The EPT is not currently considered a carbon tax for two reasons, despite it being able to incorporate economic incentives. First, as shown in Table 2.2, the EPT is not as comprehensive as it does not tax some fossil fuels, such as natural gas and LPG. Second, the EPT does not tax fossil fuels in proportion to their carbon content. For instance, under the EPT, coal is taxed at VND15,000–VND30,000 per ton compared to VND2,000 per liter of gasoline, despite a ton of coal producing more than 1,000 times more CO_2 than a liter of gasoline.[99] As a result, the EPT taxes CO_2 emitted from coal much less than from other sources, creating arbitrage opportunities counter-productive for a mitigation strategy. EPT also restricts its use as a comprehensive carbon tax as it places a low cap on maximum allowable tax rates (see column 'EPT+' in Table 2.2). If the EPT was to become a true carbon tax, the last column of Table 2.2 provides the appropriate carbon pricing for each fuel type.

[98] While Viet Nam currently has no carbon tax, introducing carbon pricing mechanisms was debated, for instance in 2020's Law on Environmental Protection.

[99] World Bank calculations based on CPAT tools and IEA conversion factors.

Table 2.2. Existing environmental protection tax (EPT & EPT+) and its equivalent in carbon pricing

Fossil Fuel Energy	Unit	Share of final consumption (%)	Current EPT rates, VND	Maximum EPT rates (EPT+), VND	Reformed EPT with a US$7.5 /ton carbon tax, VND
Coal	ton	51	15,000–30,000	30,000–50,000	500,000
Diesel	liter	11	1,000	2,000	1,000
Natural gas	liter	9	Not taxed	Not taxed	10,000
Gasoline	liter	8	2,000	4,000	2,000
LPG	GJ	2	Not taxed	Not taxed	500
Kerosene	liter	1	1,000	3,000	1,000
Other oil products	liter	1	600	2,000	600

Source: World Bank staff calculations.
Note: EPT+ corresponds to the maximum tax rates allowable by 2010's ETP Law. Source: National Assembly.

Five scenarios are analyzed by the Carbon Pricing Assessment Tool (CPAT) to estimate the effectiveness of different fiscal tools, as well as offer a quantitative assessment of the cost benefits. A brief description of each of the five scenarios is shown in Box 2.1.

Box 2.1. Fiscal instruments to support mitigation efforts

The CPAT is a partial equilibrium model designed to assess the first-order climate-macro implications of climate tax reform on mitigation, air pollution, transportation, and distributional impacts. The CPAT can be used to provide a first-order diagnostic of the potential benefits of a carbon price reform across multiple key dimensions including not only emissions reduction potential and macroeconomic aggregates, but also air pollution, road fatalities and congestion, and distributional impacts. It allows for the rapid quantification of impacts of climate mitigation policies, including on energy demand, prices, emissions, revenues, welfare, and GDP, among other metrics.

The baseline level of emissions considers the historical emission trajectory, current taxation system (including EPT and fossil fuel subsidies), and the evolution of GHG emissions as countries develop. The modelled baseline scenario conforms to comparable baseline calculations used for all countries under CPAT but differs from the baseline developed by the Government of Viet Nam in 2020, which projected a significantly higher emission level of 928 $mtCO_2$ in 2030 (Viet Nam CCDR, 2022).

Table B2.1.1 Five Viet Nam-specific scenarios for CPAT analysis

Scenario	Description
Business-as-usual (EPT baseline)	Current tax and transfer systems, including EPT, no carbon tax, and emissions follow historical trajectory.
Option 1 (EPT reform 'EPT+')	Increases EPT rates to their maximum allowable by the 2010 EPT law on all eligible fossil fuels (average effective carbon tax of US$7.5/tCO$_2$e). This scenario explores how much can be achieved within the current fiscal system.
Option 2 (Carbon tax)	Baseline + carbon tax at the same initial rate as Option 1 (US$7.5/tCO$_2$e in 2024) and progressively increasing to US$15/tCO$_2$e in 2030. This scenario explores to what extent a carbon tax at plausible levels can achieve in terms of GHG emissions reductions.
Option 3 (Power feebate)	Baseline + introduces a carbon tax focused on the power sector with the same tax rates and progression as in Option 2. In addition, it also provides a rebate on the use of renewable energy for power. This scenario explores how GHG emissions reductions and an energy transition can be achieved in the power sector by using a feebate approach instead of carbon taxes.
Option 4 (Combined scenario)	Combines baseline + carbon tax and power feebate (Options 2 and 3) corresponding to an effective carbon tax starting at US$15/tCO$_2$e in 2024 and progressively increasing to US$30/tCO$_2$e in 2030. This scenario explores the extent of GHG emission reductions obtained through a combined approach.
Option 5 (Ambitious scenario)	Baseline + introduces a carbon tax and a power feebate at higher carbon price levels (US$50/tCO$_2$e in 2024 to US$90/tCO$_2$e in 2030) in line with international recommendations for carbon price levels (Stiglitz et al. 2017, Viet Nam CCDR). This scenario explores the extent of GHG emission reductions achieved with an ambitious carbon tax proposal.

As with other models, CPAT has some limitations. These include a reliance on simplified assumptions, difficulties in capturing complex interactions and changes (such as employment effects or non-linear responses to large policy changes). Further, interactions with other countries' climate policies and the pace of technological progress also create uncertainties around outcomes, especially in the long run. As such, this report presents results up to 2030 on the impact of carbon pricing measures. Finally, CPAT focuses on CO_2 emissions, the major form of GHG emissions.[100] Other GHG emissions include methane and nitrous oxide.

Source: World Bank CPAT Analysis, 2024

[100] CO_2 emissions represented close to 75 percent of global GHG emissions in 2016 (Climate Watch, WRI 2020).

Reforming the EPT fuel tax only yields limited emission reductions, highlighting the need for a carbon tax or more ambitious actions to achieve emission reduction targets by 2030. Under the EPT+ scenario, annual emission reductions are limited to 7 $mtCO_2$ on average, or 1 percent of emission levels in 2020 (Figure 2.12a). Small and marginal reductions from EPT reform reflect its limited ability to tax carbon emitted from coal. Emission reductions under the power feebate scenarios are more impactful and would reach -34 $mtCO_2$ in 2030, but would not be sufficient to achieve NSCC commitments nor the net zero pathway. The carbon tax scenario or combined scenario (carbon tax and power feebate) would achieve more significant reductions of -61 and -89 $mtCO_2$ by 2030 respectively, sufficient to achieve the 2022 NSCC commitment by 2030. The ambitious scenario (carbon price of US$50/$tCO_2$ in 2024 to US$90/$tCO_2$ in 2030) would achieve significantly more reductions and bring GHG emissions closer to the net zero pathway.[101]

The fiscal impact of the five policy scenarios (Table 2.1.1) ranges from 0.3–3 percent of GDP in additional revenue raised per year, with the highest revenues generated by the combined and ambitious scenarios. Additional fiscal revenues are modest under an EPT reform scenario (+0.2 percent of GDP) as the effective carbon price is limited (Figure 2.12a). The fiscal impact of the power feebate scenario is also small as additional revenues are used as a subsidy for renewable electricity. The scenarios incorporating a carbon tax (carbon tax, combined, ambitious) all generate large and positive fiscal impacts (1.1, 1.2 and 2.9 percent of GDP by 2030, respectively) as their corresponding carbon prices impose a larger tax on the use of fossil fuels (Figure 2.12b).

Figure 2.12a. Carbon price trajectory (US$ per tCO_2e) by policy scenario

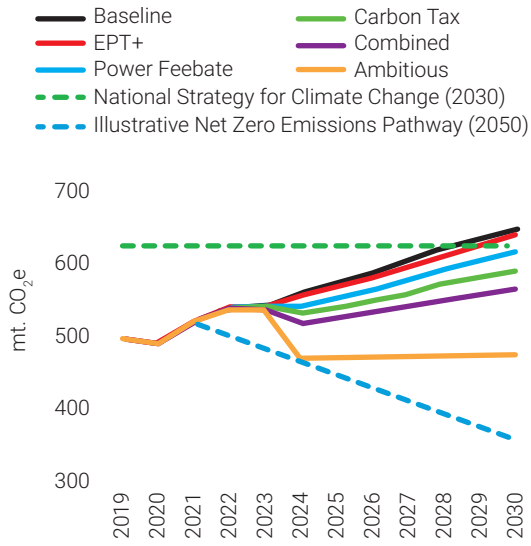
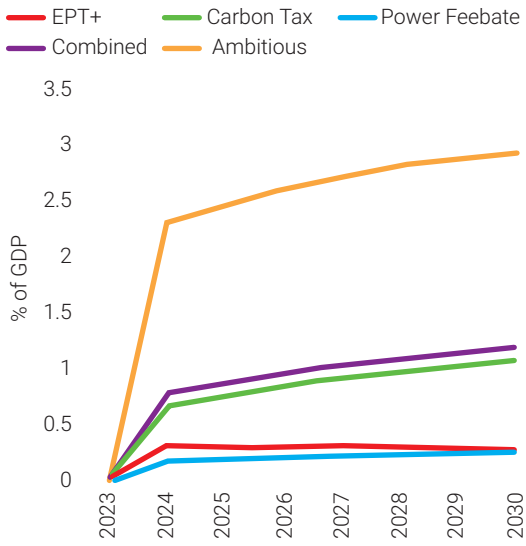


Figure 2.12b. Additional fiscal revenues (% GDP)



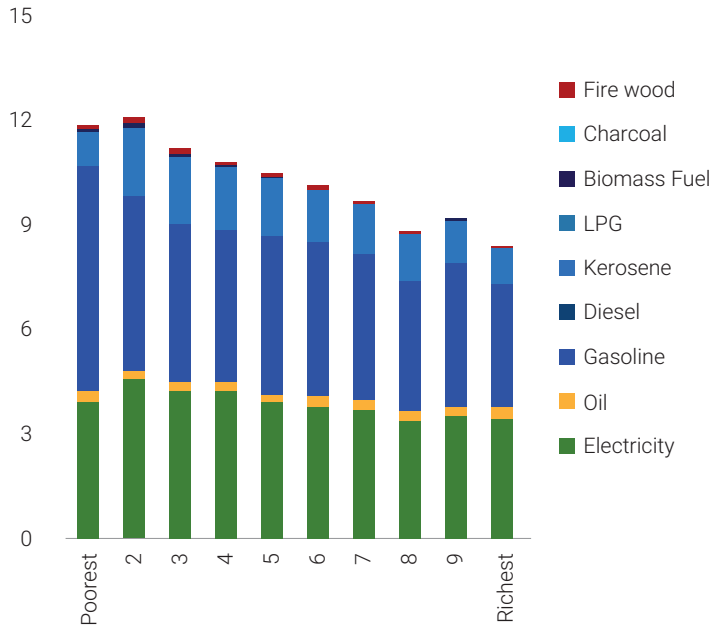
Source: World Bank staff simulations using CPAT.

[101] Carbon pricing scenarios will lead to slower growth of total energy consumption. The analysis of how energy consumption will change in the various scenarios, and how this will reduce fossil fuel use and increase renewable energy generation is included in the annex.

Distributional impacts of carbon taxation could be relatively neutral in Viet Nam. This is because direct consumption of fossil fuels and electricity has a relatively neutral pattern, with poorer and richer households devoting similar shares of budget to these items. Fossil fuels and electricity represent about a tenth of household budgets on average. The share is closer to 12 percent for the poorest two deciles and declines slightly to 8–9 percent for the top deciles. Of total fuel and energy consumption, electricity and gasoline are the largest components. Electricity consumption hovers around 3–4 percent of the household budget for all deciles (Figure 2.13). The gasoline budget is more regressive, representing 6.4 percent of the budget for the poorest decile, but only 3.5 percent for the richest.

Figure 2.13. Household budget shares by household consumption decile

(fossil fuels and electricity – %)



Source: World Bank staff simulations based on 2018 VHLSS.

The poverty impacts of carbon tax policies would also be small. The poverty rate in Viet Nam, at the international UMIC poverty line of US$6.85 (2017 PPP), is 22.2 percent. As carbon taxation policies represent an increase in prices paid by households, this would have a negative impact on poverty reduction. However, this impact is small (Table 2.3). The EPT+ policy would increase poverty by less than half a percentage point,[102] while a carbon tax would lift it by half a point and a power feebate has almost negligible impact on poverty. The marginal impact of carbon taxation policies on poverty results from the small change in household consumption, even for the lowest deciles of household income distribution.[103] Under the more ambitious scenario, large increases in carbon tax (from US$15/

[102] This is similar to the marginal poverty reduction contribution of the existing EPT (-0.03 points).

[103] These impacts can be considered upper-bound as these do not take into consumer behavior. If consumers respond to prices changes, these impacts would be lower.

tCO_2e to US\$30/tCO_2e in 2024, reaching US\$90/tCO_2e by 2030) would lead to poverty at the UMIC poverty line to rise by 1.7 percentage points (or 1.7 million people). The negative impacts on poverty in the ambitious scenario could be offset by a well-targeted cash transfer program that could include labor market policies to retrain workers for new green sectors, financed using a small fraction of revenues accrued from the policy.

Table 2.3. Poverty and inequality impact of carbon tax policies

	Inequality impact (marginal contribution)	Poverty impact (marginal contribution) Percentage point, unless otherwise noted			
	Gini	US\$3.65	US\$3.65 gap	US\$6.85	US\$6.85 gap
At disposable income	35.7	5.3	1.4	22.2	6.9
EPT+	-0.03	-0.1	0.0	-0.3	-0.1
Carbon tax	-0.03	-0.1	0.0	-0.5	-0.2
Power feebate	0.00	0.0	0.0	-0.1	0.0
Combined	-0.03	-0.1	-0.1	-0.6	-0.2
Ambitious	-0.09	-0.5	-0.2	-1.7	-0.6

Source: World Bank simulations from CPAT and VHLSS 2018. Note: a negative sign implies an increase in poverty.

The additional revenue generated by carbon taxation policies could be used to expand the social protection system in Viet Nam. Current social protection expenditure, at less than 1 percent of GDP, is low compared to most upper and lower middle-income countries. This results in relatively low benefits from cash transfers (7 percent of market income for the bottom decile) and low coverage (13 percent nationally and 25 percent of people in the bottom decile receive cash transfers) (Table 2.3). Some revenues from carbon taxation could offset small poverty impacts through an expansion of cash transfers to poor and vulnerable households and to increase the social protection system's effectiveness to reduce poverty and inequality across the country.

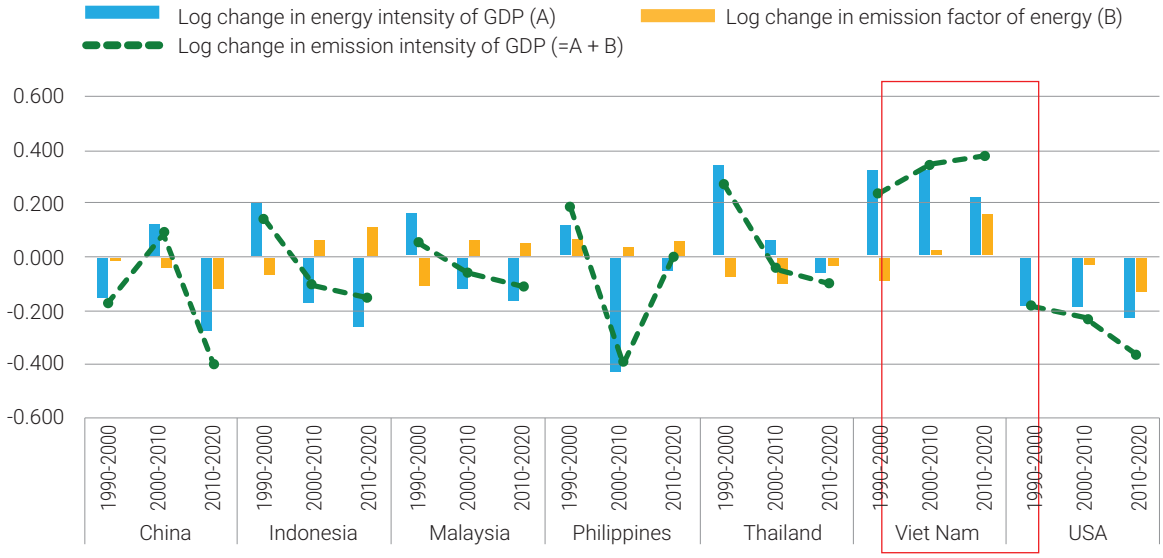
In summary, the analysis of carbon tax scenarios to 2030 using the CPAT model offers the following main conclusions: (i) a modest EPT reform, such as increasing EPT rates within existing brackets, will be ineffective at inducing meaningful GHG reductions and generate marginal fiscal gains, (ii) among the scenarios considered, those including a carbon tax were most effective at reducing carbon emissions, while generating positive GDP impacts in the medium term, (iii) combining carbon taxes with a feebate in the power sector would effectively support the shift in energy mix towards more use of renewable energy and (iv) various carbon tax policies have only small and relatively neutral effects across household income distribution, reflected in negligible impacts on inequality and poverty.

2.4. Which growth challenges does Viet Nam face amid carbon emissions mitigation?

Despite its ambitious climate change commitments, Viet Nam's economic growth model remains highly carbon intensive with significantly higher cumulative emissions growth vis-à-vis GDP growth compared to peer countries. Viet Nam is the only country in the EAP region with an increased carbon intensity in energy consumption, reflecting an energy mix more reliant on fossil fuels over time with an increasing energy intensity of GDP, reflecting a development model that demands more energy per unit of output over time (Figure 2.14).

Figure 2.14. Viet Nam is the only EAP country with an increased carbon intensity of the energy mix and energy intensity of GDP over the past decade

Changes in energy and emissions intensity of GDP



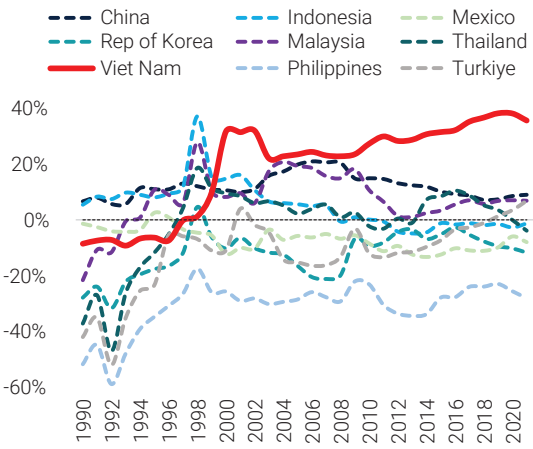
Source: World Bank staff calculations.

This high carbon intensity of production poses risks to Viet Nam's competitiveness and export-oriented growth model. Net export-related CO_2 emissions have been historically higher than comparators since the early 2000s and continued to rise to 36 percent of production by 2021 (Figure 2.15a). In 2024, more than half of all exports—US$225 billion—went to key OECD markets (Figure 2.15b). However, today more than 90 percent of global GDP is generated in countries that have been committed to achieving net zero emissions in coming decades (Figure 2.16), changing their import demands. The European Union (EU) plans to implement a Carbon Border Adjustment Mechanism (CBAM), which will tax imports of five carbon intensive products based upon carbon intensity of production. While these products account for less than 4 percent of Viet Nam's exports to the EU,

plans to expand the mechanism to further products could have greater impacts.[104] In addition, MNCs are increasingly adopting commitments to reduce GHG emissions along their value chains. For example, RE100 initiative,[105] to have 100 percent of firm-level energy consumption from renewable sources by 2030, could make access to clean energy a clear competitive advantage. World Bank (2022) analysis estimated that two-thirds of MNCs headquartered in high-income countries have net zero or other stringent climate commitments for their operations. There is also growing pressure on MNCs to measure, disclose and lower their environmental impacts. For example, the EU's Corporate Sustainability Due Diligence Directive (CSDDD) will oblige companies to disclose environmental footprints and demonstrate actions taken to protect the environment. Around 70 percent of Viet Nam's export value is from MNCs operating in or sourcing from the country (Baochinhphu, 2022). As a result, Viet Nam's industries could face reduced market access and lower demand if they fail to transition to greener practices, making it crucial to align domestic decarbonization efforts with global market trends to safeguard export opportunities and maintain growth.

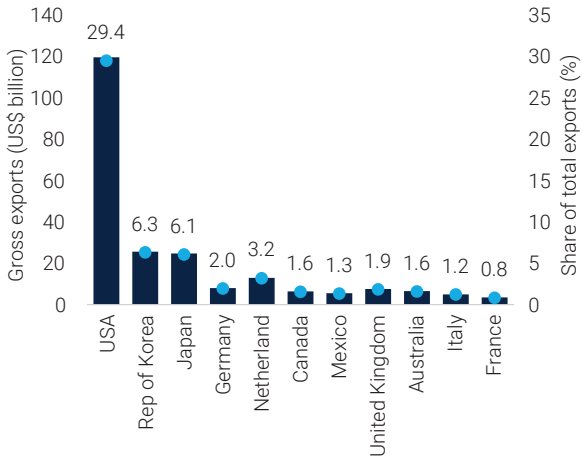
Figure 2.15. Viet Nam growth model's reliance on carbon-intensive exports to OECD countries

a) Net export-related CO_2 emissions as % of production



Source: World Bank staff calculations.

b) Exports to key OECD countries in 2024

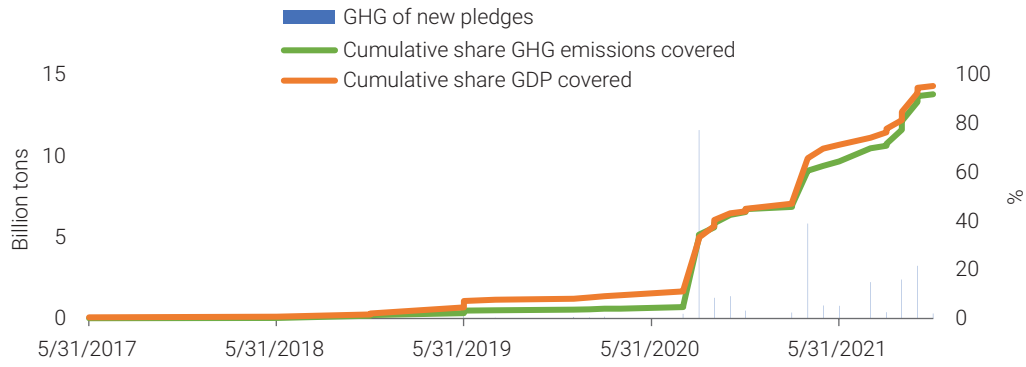


Source: OECD.
Note: Trade values in US$ billion expressed as a share of Viet Nam's total exports.

[104] The scope of the CBAM could potentially be expanded in the coming years to include a broader range of sectors and emissions, reinforcing its role in promoting global decarbonization and ensuring a level playing field for industries.

[105] The RE initiative is a group of more than 400 large MNCs committed to consuming 100 percent of renewable energy in their global operations by 2040 at the latest.

Figure 2.16. Share of global GDP and emissions covered by net zero pledges



Source: Net Zero Tracker (https://zerotracker.net/) and WDI, and World Bank staff calculation.

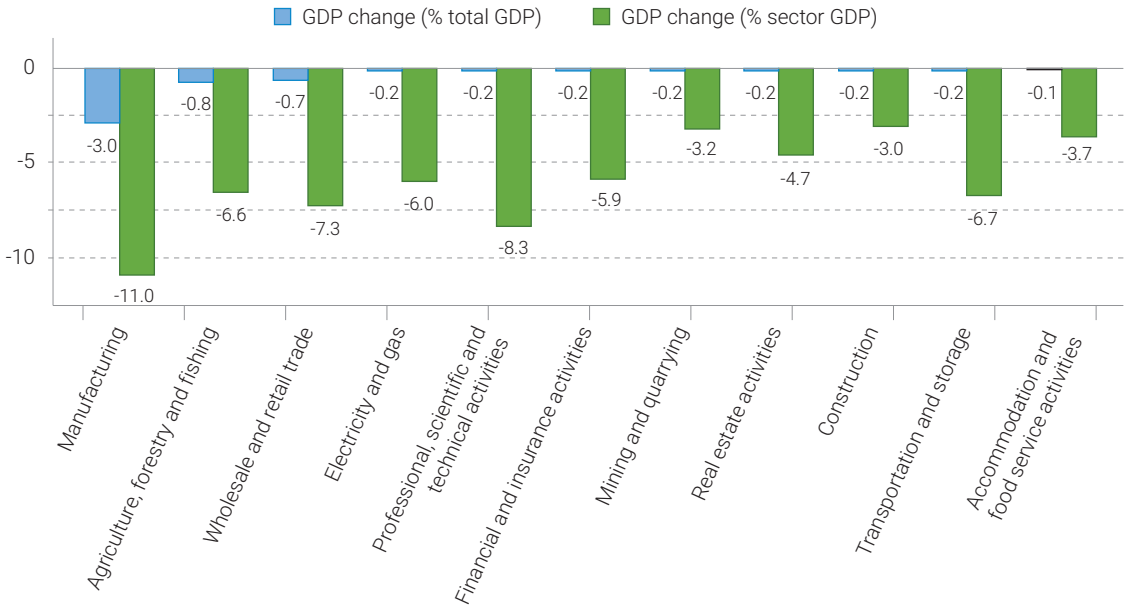
In the absence of mitigation measures reducing Viet Nam's export carbon intensity, there is a risk of OECD-based MNCs dropping Viet Nam as a supplier with potential sizable impacts. Simulations using the MINDSET model[106] illustrate how a decline in Viet Nam's OECD exports might affect GDP and labor markets. Under a hypothetical 30 percent fall in exports to OECD countries, Viet Nam's GDP would be around 6 percent lower than in a no-impact reference scenario by 2030. With around 70 percent of Viet Nam's exports by MNCs and two-thirds of OECD MNCs having stringent climate commitments, this scenario is not implausible. Yet, it does reflect a likely worst-case outcome. While manufacturing and agriculture would account for the largest losses, falling by 3 and 0.8 percent of total GDP respectively, these impacts would be broad based and affect a large number of sectors through upstream and downstream linkages (Figure 2.17). Loss of employment would also be high at almost 3 percent of total jobs, dominated by lower skilled manufacturing and agricultural positions. In occupational terms, lower-skilled workers might bear the brunt, while women could lose slightly more jobs than men. As a result, presumably, the loss of relatively lower-paying jobs would particularly hurt low-income households.

A loss of OECD-bound exports would also have a stronger impact on certain provinces. The provinces facing the largest shares of job losses are those with employment concentrated in export-oriented manufacturing and agriculture, particularly aquaculture. Bac Lieu is the country's second-largest shrimp producer after neighboring Ca Mau province, but both would lose around 4 percent of jobs compared to the reference case. Similarly, southern manufacturing hubs Binh Duong and Dong Nai provinces could also see job losses hit 4 percent. In absolute terms given their size, Hanoi and Ho Chi Minh City as the two largest cities would see the highest job losses.

[106] The MINDSET model (Model of Innovation in Dynamic Low-Carbon Structural Economic and Employment Transformation) is a demand-driven global macroeconomic model. The current version of MINDSET is designed to rapidly analyze short- and medium-term sectoral output, labor demand, and carbon-related cross-border competitiveness effects of climate and development policy mixes. The sectoral analysis is linked to detailed labor market impacts using Viet Nam 2019 Labor Force Survey data. Based on global GLORIA Multi-Regional Input-Output (MRIO) database (Lenzen et al., 2017, 2021).

Figure 2.17. Decline in OECD countries' demand for Viet Nam's exports would impact upstream and downstream linkages

Sectors accounting for the largest GDP losses in the scenario with a 30 percent export loss to OECD countries (larger than 0.1 percent of total GDP)



Source: World Bank staff simulations based on MINDSET model
Note: Scenario is 30 percent reduction of OECD-destined exports

2.5. Where are the green growth opportunities for Viet Nam?

While its economic growth model is still highly carbon intensive, Viet Nam's private sector has started to take advantage of green growth opportunities. Over the past decade green economic activities have grown rapidly in Viet Nam and today make an important contribution to GDP growth.[107] The government estimated that green economic activities generated US$6.7 billion in 2020 or 2 percent of total GDP, with 10–13 percent annual growth during 2018–20 (MPI, 2023).[108] Of this, the largest contributions were from the energy sector at 41 percent of the total, followed by agriculture and forestry (28 percent) and industrial activities (14 percent). The government also estimated that the green economy helped create more than 400,000 jobs in 2020, with more than half coming from what the government defines as "high technology" and "industrial activities" mainly in producing equipment, machinery and spare parts to serve renewable and clean energy production.[109] In addition, Viet Nam ranked the eighth highest country

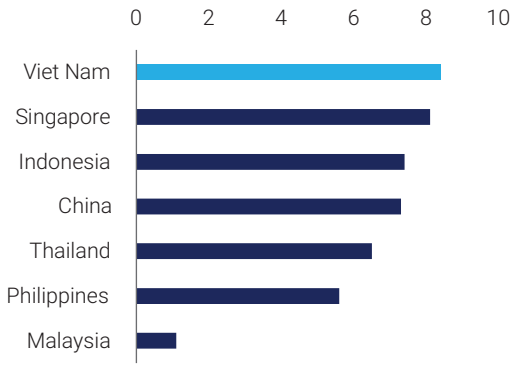
[107] Draft report by the MPI for implementation of resolution by the National Steering Committee for Green Growth Strategy. Definition of "green economic activity" is by the Government of Viet Nam (see footnote 23).
[108] Estimated by MPI research group based on 2017 State Bank of Viet Nam categorization of green economic activities in Official Letter 9050/NHNN-TD.
[109] MPI Viet Nam & BCG. 2023. *Green growth: breakthrough opportunity and direction for Viet Nam.*

globally and the leader in EAP in terms of cross-border clean energy investment relative to GDP during 2016–20, as shown in (Figure 2.18a).

Viet Nam has recently witnessed rapid growth in the manufacturing and exports of green technologies from a low base, but its exports are vulnerable to global trade frictions. In 2023, Viet Nam accounted for 5 percent of global solar panel exports. The exports of solar value chain parts and components grew nearly 10-fold during 2012–22, while exports within wind turbine and EV value chains also climbed rapidly (Figure18.b). These exports face challenges in export markets, including scrutiny of solar panels exports to the United States, its main market, by the American authorities, with a preliminary anti-subsidy finding against Viet Nam in October 2024.

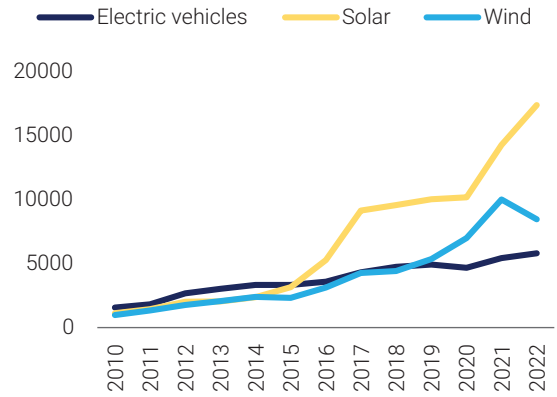
Figure 2.18. Viet Nam's rapid growth in exports and FDI in clean energy industries

a) Cross-border renewables investment in 2016–20 as % of GDP (10=highest investment globally)



Source: IRENA, MTI Technology Review. Displays total renewables public investment received and provided in 2016–20 as a % of GDP

b) Exports by value chain (US$ millions)



Source: UNCOMTRADE, World Bank analysis. Value chains are as defined in Rosenow and Mealy (2024)

Increasing imports of environmental goods – such as carbon-efficient technologies – can help mitigate environmental impacts, enhance energy efficiency, and facilitate adaptation to evolving climatic conditions.[110] Currently, Viet Nam's environmental goods only comprise 3 percent of total goods imports, compared to 5 and 6 percent by Singapore and Republic of Korea, respectively. This is despite Viet Nam's applied tariff rate on environmental goods (0.3 percent) being significantly lower than the global average (2 percent) due to Asia-Pacific Economic Cooperation commitments. The regulatory framework in Viet Nam includes extensive non-tariff measures (NTMs) that may constrain

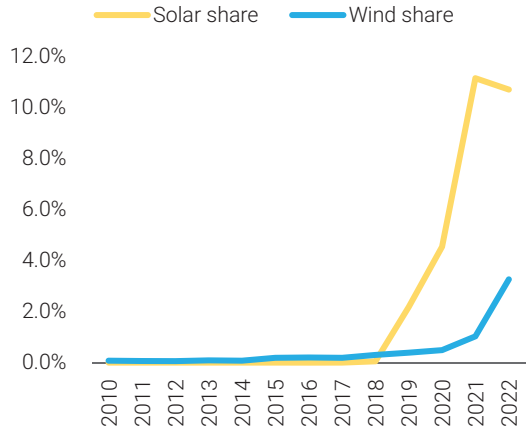
[110] World Bank. 2024. *Viet Nam 2045 – trading up in a changing world – pathways to a high-income future.*

the trading of goods, including environmental ones. For instance, in 2020 Viet Nam had 199 NTMs on 54 environmental products, with renewable energy products facing the largest number of NTMs (62), followed by waste management (55) and monitoring equipment (48).[111]

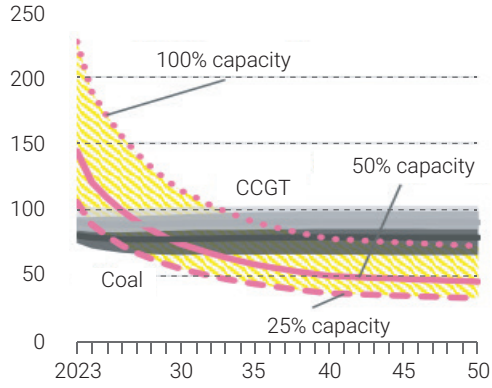
Viet Nam has seen a sharp increase in domestic green energy capacity amid a sharp fall in prices, but faces institutional challenges to develop the sector. The share of electricity generation capacity from solar and wind energy grew from nearly zero in 2018 to 13 percent of electricity generation in 2022 (Figure 2.19a) as the Levelized Cost of Electricity (LCOE) generation for solar declined sharply after 2019, when the country's generous solar feed-in tariff schemes drove large volumes of solar deployment. While no other country globally has added more renewable power as a share of total installed capacity in such a short period, the industry is still grappling with policy and institutional issues related to transmission of this new electricity generation capacity, resulting in the increased capacity remaining mostly dormant.

Figure 2.19. Viet Nam's rapid growth in generation capacity for solar and wind energy (Panel a) reflecting declining costs (Panel b)

a) Solar and wind share of electricity generation capacity (%)



b) LCOE of a solar-plus-battery project compared with a new coal and gas plant in Viet Nam ($/MWh, 2022 real)



Source: Panel a) IRENA. Panel b) Bloomberg NEF2024
Note: Levelized cost of electricity ranges for solar-plus-battery represent storage sized between 25 and 100 percent of solar capacity. Does not account for additional costs that may be incurred through local cost provisions on equipment. CCGT is combined-cycle gas turbine.

Looking forward, Viet Nam is geographically well positioned for its private sector to take advantage of the global expansion in demand for green technologies, goods and services, with both high potential and low-cost green energy. An important advantage for Viet Nam is its preeminent suitability

[111] World Bank. 2022. *Taking Stock January 2022 – no time to waste – the challenges and opportunities of cleaner trade for Viet Nam.*

in Southeast Asia to develop wind and solar energy, offering a new form of comparative advantage. The country has the greatest technical potential for wind and solar in the region, estimated at 1,000GW per year, driven largely by its high technical wind potential.[112] Also, it has the lowest LCOE from wind energy in ASEAN and one of the lowest for solar (Lee et al., 2020). Bloomberg NEF estimates LCOE of a PVS system to fall to US$55–114/MWh by 2030 and US$33–72/MWh by 2050, due to falling costs of solar and lithium-ion batteries (Figure 2.19b). Likewise, an onshore wind project paired with batteries is also expected to become cheaper than a new coal and gas plant by the first half of the 2030s. This gives Viet Nam's business community and authorities a unique opportunity to attract companies seeking more environmentally friendly ways of production, like members of the Climate Group RE100.

The private sector is central to Viet Nam's efforts to reduce emissions and transition to a low-carbon economy. Mobilizing private capital is essential to meet investment needs, particularly in sectors where private entities can effectively drive innovation and efficiency. According to the World Bank's Country Climate and Development Report (CCDR), with appropriate policy reforms, the private sector could provide a majority of financing across multiple sectors, including energy and industry. Private investments have already significantly contributed to the country's renewable energy capacity; for instance, Viet Nam's solar energy sector expanded from nearly zero in 2017 to 17GW today, largely due to private sector involvement. Beyond renewable energy, the private sector is also instrumental in driving energy efficiency and emissions reductions across various industries. Industrial decarbonization, particularly in sectors like cement, and steel will require substantial private investment in low-carbon technologies and processes. This includes adopting energy-efficient practices, transitioning to cleaner fuels, and investing in carbon capture and storage solutions.

2.6. Which policies will support Viet Nam on its 2050 net zero path?

Given the net zero transition commitments both domestically and abroad, Viet Nam should adopt a comprehensive approach that integrates nation-wide policies with incentives, regulations, and standards in key emitting sectors, such as energy and transport. Current policies have relied more heavily on planning mechanisms such as renewable energy targets in the Power System Development Plans. Shifting the policy mix towards a more market-driven approach could enhance efficiency and reduce the cost of emission abatement by leveraging the power of market forces and incentives. Market instruments, by imposing a cost on carbon emissions, shift relative prices, and these price signals can accelerate the adoption of low-carbon technologies by making them more competitive. These instruments include the launch of the pilot ETS[113] planned in 2025, with full

[112] McKinsey & Company. https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/putting-renewable-energy-within-reach-vietnams-high-stakes-pivot.

[113] Decree No.06/2022/ND-CP provides a roadmap for development of a domestic carbon market, with Viet Nam set to launch an ETS pilot by 2028, for three main sectors (power, cement, and steel).

implementation expected in 2028. Viet Nam is also participating in voluntary carbon markets, along with transactions under the Article 6 of the 2015 Paris Agreement that defines the certification and trading of carbon credits. The introduction of a carbon tax to complement the ETS would further bolster Viet Nam's ambitious goal of achieving net zero emissions by 2050. Finally, enhancing access to green finance and reducing regulatory barriers will enable businesses to undertake necessary investments in clean technologies and infrastructure. Table 2.4 provides a set of cross-cutting and sectoral recommendations for the upcoming five-year policy cycle (2026–30). Potential economic and adaptation co-benefits are highlighted.

Table 2.4. Recommendations for 2026–30

Cross-cutting		Economic Co-Benefits	Mitigation Co-Benefits
Implement carbon pricing: ***Emission Trading System (ETS) and a complementary carbon tax to accelerate the transition to low-carbon technologies***	• Pilot the planned ETS for three main sectors (power, steel and cement) by its 2025 deadline. • Introduce a moderate carbon tax (US$7.5–15/ton) to complement ETS coverage, avoiding double taxation: - Reform the EPT fuel excise tax to reflect carbon content, starting with coal. - Complement with a feebate system to incentivize cleaner technology adoption in polluting industries like power.	High	Low
Introduce green subsidies to support transition to cleaner technologies	• Provide tax rebates, VAT reductions, or investment write-offs for green products, such as energy-efficient machinery, to stimulate demand and private sector investments.	Medium	Low
Leverage voluntary carbon markets to attract private sector climate investments	• In parallel with the development of the official ETS, support the realization of a private carbon trading market underpinned by clear MRV standards, engage with global carbon markets and partner with international stakeholders, including Article 6 projects, to mobilize private sector funding for renewable energy and sustainable development projects.	High	Low
Implement energy efficiency standards and behavioral change programs	• Launch technical standards and sector-specific initiatives, such as consumer awareness campaigns, to improve energy efficiency in industrial, commercial, and residential sectors. • In the industrial sector, strengthen energy efficiency standards to align with international benchmarks.	Medium	Low

Facilitate accessibility of green financing to firms	• Issue clear guidelines and a framework that defines green projects (e.g. green taxonomy). • Build technical capacity and verification systems in Vietnamese financial institutions to address skills gaps in evaluating and managing green bond projects.	Medium	Medium
Empower the private sector to invest in mitigation	• Facilitate the availability of climate policy information related to firms' key export markets, MNCs' requirements, support for implementing adaptation measures and investing in mitigation technology, and the cost-benefit analysis of these investments. • Strengthen green certification standard systems for major export products and help firms adopt international certifications.	Medium	Low
Sustainable Energy		**Economic Co-Benefits**	**Mitigation Co-Benefits**
Implement the revised PDP8	• Streamline project approvals for PDP8 implementation: reduce delays by establishing time-bound regulatory approval processes, digital platforms for tracking, and clear institutional roles for PDP8 energy transition projects.	Medium	Low
Adopt least-cost planning and clarify procurement rules for PDP8	• Ensure dynamic, least-cost planning to optimize energy security and affordability. Streamline procurement methods across laws and establish clear investor selection criteria.	Low	Low
Strengthen Energy Service Companies (ESCOs) for efficient implementation	• Enhance the capacity of ESCOs by improving access to financing mechanisms, technical training, and enabling regulations to scale-up energy efficiency projects.	Low	Low
Sustainable Transport		**Economic Co-Benefits**	**Mitigation Co-Benefits**
Accelerate green urban mobility	• Expand bus rapid transit systems and metros. • Promote low emission zones to improve air quality.	Medium	Low
Support the transition to low emission vehicles and electric vehicles	• Put in place better vehicle fuel economy standards for new internal combustion engine vehicles (cars and motorcycles). • Implement incentives and standards for low emission vehicles. • Invest in public charging stations and electric bus pilots.	Medium	Low

Table 2.5. Non-fiscal interventions in other countries

Appliance standards and labelling – Thailand
Thailand Energy Label: Thailand's Ministry of Energy introduced the label to promote energy efficiency and conservation. It is applied to refrigerators, air conditioners, washing machines, lighting, and other products. It provides consumers with information on energy consumption and efficiency ratings to encourage selection of energy-efficient appliances. Thailand also sets a minimum energy performance.
Behavioral Change Programs – Japan
Japan - Cool Biz Campaign: The Ministry of the Environment launched this annual initiative to promote energy-saving practices during the summer months. The campaign encourages businesses and individuals to dress casually and set air conditioning temperatures at 28 degrees Celsius (82.4 degrees Fahrenheit) to reduce energy consumption. By changing societal norms and promoting energy-conscious behavior, the Cool Biz Campaign contributes to significant energy savings and GHG emission reductions in Japan.
Financing energy efficiency gains – Singapore
Building Retrofit Energy Efficiency Financing (BREEF) scheme: It provides financial incentives and support for building owners to undertake energy-efficient retrofit projects. The scheme offers financing options, technical assistance, and incentives, such as grants and rebates, to encourage implementation of energy-saving measures in existing buildings. This initiative aims to enhance building energy performance and reduce carbon emissions in Singapore.

Source: World Bank staff compilation

CHAPTER 3.
MARINE ECONOMY – A CRUCIAL NEXUS FOR CLIMATE ADAPTATION AND MITIGATION

Key messages

Q: What is the marine economy and why is it important?

A: The marine economy, also known as the 'blue economy,' refers to the economic activities and industries directly or indirectly connected to oceans and coastal areas, including fisheries, shipping, tourism, and offshore energy. While the marine economy by its very nature is vulnerable to the impacts of climate change, it also presents significant opportunities to contribute to climate change mitigation. The sector is poised for robust growth in Viet Nam, thanks to its essential natural assets critical to key economic segments, such as offshore wind and tourism. As climate change intensifies, protecting and conserving marine resources becomes crucial to sustain and enhance their economic value as well as to support a habitable planet for human life.

Q: What is the marine sector's current contribution to the economy, and what are its anticipated growth prospects?

A: The marine sector's contribution to Viet Nam's overall economy has been newly estimated at from 5.04 percent to 5.83 percent, except for 2020 with a decline to 3.18 percent on account of the fall in travel and tourism in that year, marking the first time such a comprehensive economic valuation has been made. Projections for 2030 indicate a three-fold increase in the value of Viet Nam's marine sector compared to 2020 in real terms.

Q: What are the main challenges hindering the sustainable growth of Viet Nam's marine economy?

A: The marine economy faces significant challenges due to overfishing, climate-induced ocean acidification and pollution, amongst other threats. Viet Nam is among the world's top five ocean polluters, contributing 0.28–0.73 million metric tons of marine plastic debris annually. Other issues include natural resource degradation, climate change risks, poorly planned rapid infrastructure development, weak regulatory enforcement, and a lack of

coordination across regions and sectors. In Viet Nam, 11.8 million coastal residents are at risk from severe flooding, and more than 35 percent of settlements are on eroding coastlines.

Q: What is the value of Viet Nam's marine ecosystem services?

A: The total value of all marine ecosystems in Viet Nam is VND14,158.7 billion at 2010 prices, with mangroves contributing 94 percent of the total value, open ocean systems (3 percent), coral (2 percent) and coastal systems (1 percent). These ecosystem services collectively amount to 0.60 percent of the Gross Value Added (GVA) of the entire economy.

Q: What is the government's vision for the marine economy in Viet Nam as outlined in the landmark Resolution 36 adopted in October 2018, and what additional action is necessary to achieve the GDP target?

A: By 2030, Viet Nam targets substantial advancements in six marine sectors to contribute a significant 10 percent to GDP. These sectors, ranked as prioritized, are: 1) marine tourism and related services, 2) maritime economy, 3) exploitation of oil, gas, and other marine mineral resources, 4) fishing and aquaculture, 5) coastal industry and 6) and renewable energy. However, to ensure resilience against climate change, investments in infrastructure must be climate-proofed, and improved risk management strategies are needed for coastal protection. Planning decisions should incorporate worst-case risk scenarios associated with climate change, and fishery management must integrate climate impacts for sustainable resource management. Lastly, protecting marine ecosystems from damage due to excessive growth of key sectors is essential to preserve their vital services.

Q: How can policies and institutions ensure the sustainable implementation of Resolution 36 for the marine economy?

A: The government's endorsement of plans for marine economic development, coupled with the establishment of a National Steering Committee, marks significant progress towards implementing Resolution 36. However, effective coordination among ministries and provinces, as well as institutional reforms to engage non-State actors, are imperative to drive sustainable marine economic growth.

3.1. Why focus on the marine economy?

Viet Nam has a clear competitive advantage in the development of its marine economy.[114] The country has a 3,260km coastline, a more than 1 million square kilometer marine surface area that triples the mainland and more than 3,000 islands. Nearly half (28) of Viet Nam's 63 provinces are coastal, including 125 coastal and 12 island districts. The coastline and ocean's wealth of resources and natural beauty offer direct economic opportunities to about half of Viet Nam's 100 million population.[115] Based on the OECD ocean-based industry classification, data for the marine sectors in Viet Nam comprise the following seven economic sectors (with ISIC codes[116]) and four ecosystems that support these sectors:

Table 3.1. Data availability of Viet Nam's marine economic sectors and ecosystem services

Viet Nam's core marine economic sectors based on Resolution 36	Marine Economy Sector Core Categories (based on the United State's Type 1 Account, known as the Economics National Ocean Watch (ENOW)	Viet Nam economic industries system (VSIC 2018) - 2-digit
Fishing and aquaculture	Living Resources	Fishing and aquaculture - 03
Exploration of oil, gas and other marine mineral resources	Minerals	Extraction of crude petroleum and natural gas - 06
Renewable energy and other new marine economic sectors	Energy	Offshore Wind - no code
Coastal industry	Transport and Trade	Land transport and transport via railways and via pipelines - 49 (inland transport) Water transport - 50 Warehousing and support activities for transportation - 52
Tourism and marine services	Tourism and Recreation	Passenger transport: Land transport, transport via railways, via pipeline; Water transport; Air transport; Warehousing and support activities for transportation; Postal and courier activities - 49, 50, 51, 52

[114] The marine economy refers to the sustainable and integrated development of economic sectors in a healthy ocean. This is based on the World Bank definition of a 'blue economy'.

[115] The country has 63 provinces and cities, of which 28 are coastal and nearly half of the population lives in coastal provinces and cities (as cited in several government documents).

[116] ISIC stands for International Standard Industrial Classification and is used to classify statistical units, such as establishments or enterprises, according to the economic activity in which they mainly engage. The codes given are those promulgated by Decision No.27 (July 6, 2018) of the prime minister.

		Accommodation; Food and beverage service activities - 55, 56 Administrative and supporting activities: Travel agency, tour operator and related activities - 79 Art, entertainment and recreational activities: Creative, art and entertainment activities; Libraries, archives, museums and other cultural activities; Lottery activities, gambling and betting activities; Sports activities and amusement and recreation activities - 90-93
Maritime economy	Ship & Boat Building	Manufacture of other transport equipment - 30 Repair, maintenance and installation of machinery and equipment - 33
	Relevant supporting industries (Seafood processed products; Oil and gas manufacturing)	Manufacture of coke and refined petroleum products - 19 Manufacture of food products - 10
Ecosystem services	Coastal systems (excluding mangroves); mangroves, coral reefs, open ocean systems.	

Source: World Bank staff.

Diverse marine and coastal ecosystems provide crucial ecological services to sustain economic development. Coastal forests cover 1.8 million hectares across 28 coastal provinces, of which mangrove forests account for about 250,000ha. They protect seven million people, more than 0.3 million hectares and US$6.5 billion worth of property from flooding, as well as store 84 million Mt of CO_2, with an estimated economic value of US$9,000–72,000 per hectare.[117] More than 20 types of marine ecosystems and six marine biodiversity areas provide natural habitats for approximately 11,000 marine species. There are five marine Ramsar sites and 10 other marine nature reserves across the country.[118] These natural assets are important to key economic sectors such as fisheries and tourism, as well as providing coastal resilience such as erosion control, carbon storage and sequestration.

[117] Menéndez, P., Losada, I.J., Torres-Ortega, S., Narayan, S., and Beck, M.W., 2020. *The global flood protection benefits of mangroves. Scientific reports,* 10(1), pp.1-11.

[118] A Ramsar Site is a wetland area designated as being of international importance under the Ramsar Convention, an international treaty signed in 1971 in the city of Ramsar. The convention's primary purpose is to promote the conservation and sustainable use of wetlands worldwide, recognizing their ecological, economic, cultural, and scientific value.

Viet Nam's marine economy, integral to its national prosperity, faces heightened risks from climate change. The nation's extensive coastline and reliance on maritime industries – such as fisheries, aquaculture and coastal tourism – significantly expose it to the adverse impacts of rising sea levels, increased storm intensity, and ocean acidification. Coastal erosion and saltwater intrusion threaten critical infrastructure and habitats, undermining the livelihoods of millions of people who depend on these sectors. Fisheries are particularly at risk, with warming sea temperatures and changing ocean currents disrupting marine ecosystems and fish migration patterns, leading to declines in fish stocks and biodiversity. Moreover, the intensification of extreme weather events, like typhoons and heavy rainfall, poses severe risks to coastal communities, ports, and the broader maritime supply chains. This vulnerability is compounded by the economic dependence on these fragile ecosystems and the limited adaptive capacities of many coastal regions.

The marine economy holds substantial potential to help accelerate Viet Nam's climate change mitigation efforts. By harnessing the vast resources of its coastal and oceanic environments, Viet Nam can drive sustainable development and reduce GHG emissions. Expanding renewable energy sources, like offshore wind and wave energy, presents a significant opportunity to decrease reliance on fossil fuels and lower the carbon footprint of its energy sector. According to a 2021 World Bank report Offshore Wind Roadmap, the potential capacity of offshore wind power (OWP) in Viet Nam is about 475GW, with research by other institutions suggesting this could exceed 900GW, through harnessing the particularly strong winds in central, south-central and some north coastal regions. Similarly, mangrove restoration and the protection of seagrass beds and coral reefs are crucial, as these ecosystems act as natural carbon sinks, capturing and storing significant amounts of carbon dioxide. By adopting these strategies, Viet Nam's marine economy can strengthen its resilience against climate change impacts as well as contribute to broader mitigation efforts.

While the growth potential of these marine economy sectors is significant, some also face conflicting uses and interests that could diminish sectoral potential if not addressed. These include a range of human-driven factors such as overfishing, pollution and climate change-induced ocean acidification, among others. Viet Nam was recently estimated as among the top five ocean polluters in the world, with 0.28–0.73 million metric tons marine plastic debris leaking into the ocean.[119] Other challenges to marine economy development include natural resource degradation, climate change risks, poorly planned rapid infrastructure development with a focus on short-term gains, weak regulatory framework enforcement and a lack of regional and sectoral coordination. Continuing on a business-as-usual track is not feasible if the country is to make effective use of its assets in coastal areas and the ocean over the long-term.[120] Furthermore, approximately 11.8 million people in coastal provinces are exposed to the threat of intense flooding and more than 35 percent of settlements are located on eroding coastlines.[121]

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[119] World Bank. 2022. *Towards a national single-use plastics roadmap in Viet Nam: strategies and options for reducing priority single-use plastics.*

[120] World Bank. 2022. *Supporting resilient coastal economies in Viet Nam: informing the operationalization of Viet Nam's Marine Strategy with international experiences.*

[121] Rentschler, J, de Vries Robbé, S, Braese, J, Huy Nguyen, D, van Ledden, M, and Pozueta Mayo, B. 2020. *Resilient shores: Viet Nam's coastal development between opportunity and disaster risk*. Washington, DC. World Bank.

This chapter begins by analyzing the contributions of marine economic sectors to national growth, including future scenarios, and explores the challenges and opportunities for marine economic development. It then examines how to balance economic growth with ecosystem sustainability, followed by a brief assessment of Viet Nam's policies, institutions, and investments in the marine economy. The chapter concludes with key recommendations for policymakers aimed at fostering a sustainable marine economy that enhances growth, employment opportunities, and environmental benefits.

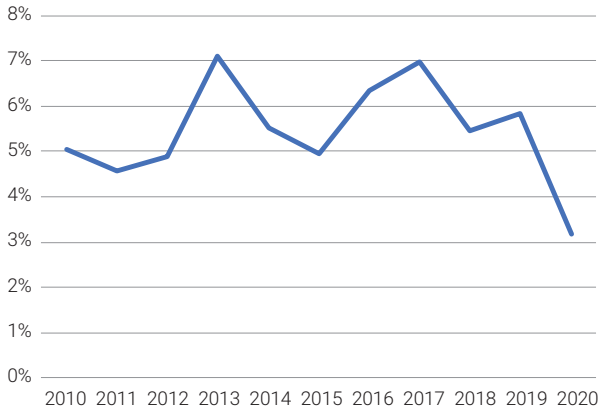
3.2. How does the marine sector contribute to the economy, and what are its growth prospects?

Marine and coastal economic activities play a crucial role in driving Viet Nam's economic growth and improving livelihoods.[122] Analyzing the economic impact of marine sectors, through measuring GVA and employment from 2010 to 2020, paints a comprehensive picture of their contributions to Viet Nam's economy. Over the decade, the GVA from these sectors increased slightly, from 5.04 to 5.83 percent of national GVA, with a decline in 2020 to 3.18 percent (Figure 3.1). However, their impact on employment is more substantial, representing about 8–9 percent of the total workforce, despite a minor decline of 0.4 percent during the same period. Except for 2020 when the COVID-19 pandemic negatively affected tourism, marine travel and tourism were the largest contributors over the last decade, making up nearly half of total GVA from these sectors in 2019, followed by extraction and manufacturing of oil and gas, and marine transportation, with the rapidly growing offshore wind industry also emerging (Figure 3.2). Since 2014, offshore wind has been the fastest-growing sector, with significant expansion also noted in the oil and gas industries. Conversely, fishing and aquaculture saw a decline from the peak in 2017 (Table 3.2).

In terms of employment, preliminary analysis highlights the dominance of travel and tourism, accounting for 98 percent of jobs in the marine sectors, with around four million employed in 2018. In contrast, aquaculture and fishing enterprises formally employed approximately 32,000 workers in 2020, marine transportation (41,000), and oil and gas (9,000). Employment data for the offshore wind sector is unavailable. This overall estimate could be conservative since many sectors are still considered informal. Additional research is needed to better understand these sectors' employment impacts (Table 3.3).

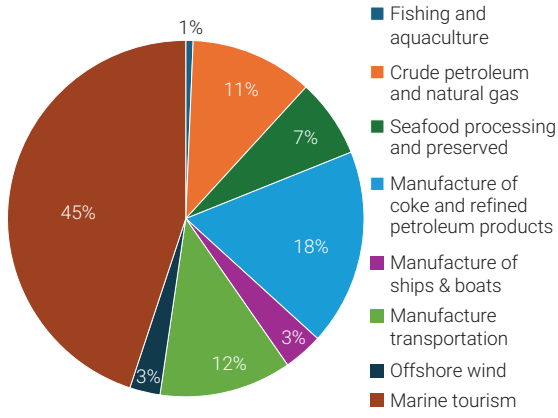
[122] Marine economic activities refer to industries and practices that take place in or directly depend on the open ocean, such as deep-sea fishing, offshore energy production, and maritime shipping. Coastal economic activities, on the other hand, are centered around areas where land meets the sea, including coastal tourism, shoreline fishing, port operations, and aquaculture in nearshore waters.

Figure 3.1. A Trend of Total Value Added (as % of GVA)



Source: World Bank staff calculations.

Figure 3.2. Contributions to GVA in 2019



Source: World Bank staff calculations.

Table 3.2. GVA in marine-related industries in Viet Nam (VND billion 2010 prices)

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2030(F)
1	Fishing and aquaculture	1,041	1,315	1,448	1,711	1,941	2,386	2,323	2,577	1,944	1,724	1,658	**1,880**
2	Oil and gas	23,500	12,102	20,409	48,829	12,309	33,016	20,477	24,808	26,845	28,837	24,070	**69,024**
3	Manufacture of food products (seafood processing and preserved)	9,354	9,928	10,466	11,292	12,189	14,602	16,263	18,428	18,393	18,497	18,539	**111,231**
4	Manufacture of coke and refined petroleum products	15,988	17,676	18,893	19,848	21,724	23,234	25,145	28,285	32,923	46,224	47,885	**140,470**
5	Manufacture of other transport equipment (with share of maritime transportation industry) - Manufacture of ships and boats	4,573	4,714	6,241	5,883	6,118	7,310	8,736	9,012	9,119	9,280	9,114	**35,634**
6	Water transportation	17,362	20,397	17,124	20,572	23,566	26,103	27,744	29,281	29,759	31,080	31,829	**46,376**
7	Offshore wind	0	0	0	0	17	76	101	165	1,699	7,166	10,054	**178,800**
8	Travel and tourism	23,253	25,882	29,795	51,811	53,648	60,321	70,591	89,241	105,263	116,475	1,071	**3,180**
	Total Value Added (VA)	95,071	92,015	104,376	159,946	131,512	167,047	171,381	201,798	225,945	259,283	144,218	**586,596**
	Marine as % of GVA	5.04%	4.56%	4.88%	7.10%	5.52%	4.96%	6.34%	6.98%	5.46%	5.833%	3.179%	**9.650%**

Source: Multiple Government of Viet Nam data sources, 2024. World Bank staff calculations.

Table 3.3. Employment in marine-related industries in Viet Nam

		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	Fishing and aquaculture	36,473	38,544	40,482	40,770	44,970	48,691	47,006	53,207	42,201	39,884	32,461
2	Oil and gas	7,643	8,200	9,770	10,779	10,857	9,048	8,645	7,786	8,253	8,790	9,075
3	Offshore wind	-	-	-	-	-	-	-	-	-	-	-
4	Water transportation	36,473	46,163	46,070	42,954	43,748	46,855	47,627	44,696	43,440	43,406	41,394
5	Travel and tourism		4,018,900	4,120,300	4,098,900	3,966,100	3,778,400	4,002,800	4,060,900	4,116,800		
6	Manufacture of food products (seafood processing and preserved)	496,446	524,945	509,103	518,520	527,593	542,339	553,879	547,335	539,867	538,557	536,390
7	Manufacture of coke and refined petroleum products	5,410	4,838	5,054	5,136	5,704	5,996	5,590	7,016	7,036	6,685	7,609
8	Manufacture of other transport equipment (with the share of maritime transportation industry). Manufacture of ships and boats	93,768	98,669	97,199	96,445	98,677	105,153	124,178	121,784	125,647	127,073	110,837
	Total	676,213	4,740,259	4,827,978	4,813,504	4,697,649	4,536,482	4,789,725	4,842,724	4,883,244	764,395	902,691
	Total Employment	50,392,900	51,398,400	52,348,000	53,245,600	53,748,000	53,984,200	54,445,300	54,819,600	55,388,000	55,767,400	54,842,900
	Marine as % of Total		9.2%	9.2%	9.0%	8.7%	8.4%	8.8%	8.8%	8.8%		

Source: Multiple Government of Viet Nam data sources, 2024. World Bank staff calculations.

Comparing Viet Nam's marine sector to those of other nations, with insights from the OECD study,[123] highlights distinct contrasts in economic contributions and employment. Table 3.4 from the OECD report illustrates wide variations in the marine sector's share of GVA among countries. Viet Nam's marine sector, contributing around 5–6 percent to the national GVA (except for 2020 with 3 percent), aligns closely with Republic of Korea's, but is higher than Japan's and notably lower than Singapore's. This figure is also modest compared to the extremes seen in other countries, such as Ireland at 0.7 percent and Iceland at 26 percent. In terms of employment, Viet Nam's marine sector stands out more prominently. With an estimated four to five million individuals employed, Viet Nam surpasses all other countries except China and the United States in absolute numbers. When viewed as a percentage of the total workforce, Viet Nam's marine employment constitutes approximately 8.8 percent, positioning it higher than most countries, trailing only China, Iceland, and the United States. This comparative analysis, as depicted in Figure 3.3, not only reflects the stage of a country's development, it also underscores the significant role of the marine sector in Viet Nam's labor market, despite its relatively lower GVA contribution compared to some other nations.

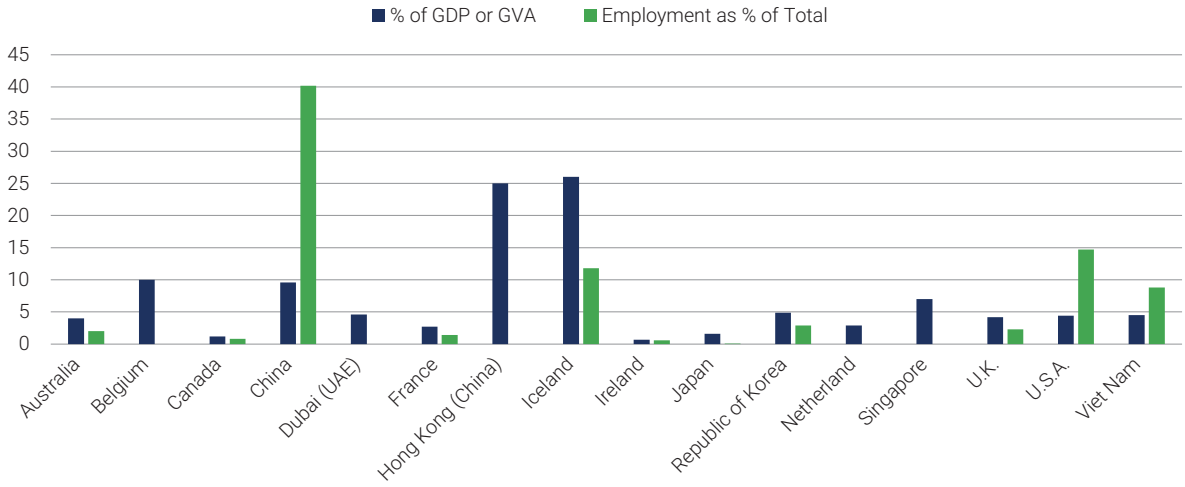
[123] OECD. 2016. *The Ocean Economy in 2030.*

Table 3.4. Selected estimates of value of ocean-based industries

Country	% of GDP or GVA	Employment (number)	Employment as % of Total
Australia	3.6	253,130	1.7
Belgium	10		
Canada	1.2	171,365	0.8
China	9.8	340,240,000	40.2
Dubai (UAE)	4.6		
France	2.7	460,396	1.4
Hong Kong (China)	25		
Iceland	26	30,000	11.8
Ireland	0.7	17,425	0.6
Japan	1.6	98,124	0.1
Republic of Korea	4.9	919,314	2.9
Netherlands	2.9	21,000	0.2
Portugal	2.5		
Singapore	7.0		
U.K.	4.2	890,416	2.3
U.S.A.	4.4	28,000,000	14.7
World	3.2		

Source: OECD (2016) – Data ranges from the 2000s to 2010s.

Figure 3.3. Viet Nam's marine employment outpacing competitors



Source: Created based on Table 3.4. Data spans from the 2000s to 2010s.

Estimating the marine sector's future contribution to Viet Nam's economy, particularly by 2030, requires analyzing various targets outlined in Resolution 36, and Resolution 48. Importantly, Resolution 48 was adopted in 2023 on the approval of strategy for sustainable exploitation and use of resources and protection of the marine and island environment until 2030, with a vision to 2050. Projections have been formulated based on targets set for different economic sectors, primarily by comparing anticipated increases in physical outputs from 2020 to 2030, while assuming stable unit values (prices). Although this approach serves as an approximation, projecting price changes necessitates further extensive analysis. Utilizing data depicted in Figure 3.4, projections indicate substantial growth across key sectors:

- Aquaculture and fishery output is projected to climb from 3 million tons in 2020 to 9.8 million tons by 2030,[124,125] reflecting a 48 percent increase in aquaculture and a 28 percent decline in capture fisheries. This 9.8 percent rise, overall, aligns with the value increase if prices remain unchanged.

- Oil and gas production targets for 2030 range between 175–195 million Tons of Oil Equivalent (TOE)[126] representing a notable surge from 68 million TOE recorded in 2020. Assuming prices remain constant, this 187 percent jump directly corresponds to the value increase.

- The expansion of offshore wind capacity, projected to reach 3,557MW by 2030 from 200MW in 2020, signifies a significant boost.[127] If production output aligns with capacity growth and electricity prices remain stable, the value of output is estimated to soar 17.8-fold.

- Water transportation is expected to witness a rise in cargo transport from 0.88 million tons in 2020 to 1.14–1.42 million tons by 2030,[128] reflecting a 62 percent increase in value if prices remain consistent.

- Tourism projections, based on Resolution 36's growth target of 11.5 percent annually from 2020,[129] indicate a promising trajectory for this sector's contribution to the economy. These projections collectively underscore the potential growth and significance of Viet Nam's marine sector in shaping the nation's economic landscape by 2030.

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[124] Viet Nam Association of Seafood Exporters and Producers (VASEP), (n.d.), https://seafood.vasep.com.vn/why-buy-seafood/fishery-profile

[125] Decision No.1664/QD-TTg approving the project to develop marine aquaculture until 2030, with a vision to 2045. Resolution 48/NQ-CP, of the government, approving the strategy for sustainable exploitation and use of resources and protection of the marine and island environment until 2030, with a vision to 2050.

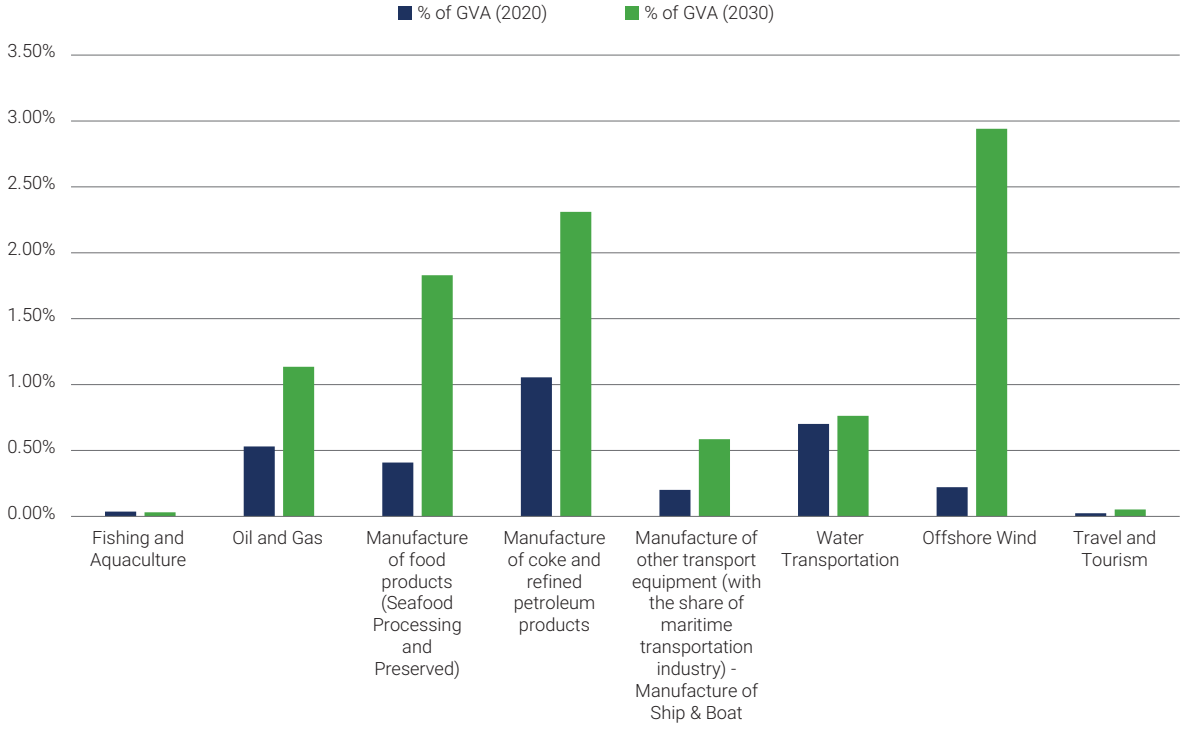
[126] Ibid.

[127] National Power Development Plan for 2021–30 (NPDP8), Decision No.500/QD-TTg of the Prime Minister on approving the national electricity development plan of 2021–30, with a vision to 2050.

[128] Resolution No.48/NQ-CP, of the government, approving the strategy for sustainable exploitation and use of resources and protection of the marine and island environment until 2030, with a vision to 2050.

[129] Ibid.

Figure 3.4. Comparing 2030 projections with 2020 (as % of GVA by sectors)



Source: World Bank staff calculations.

Projections for 2030 indicate substantial 1.7-fold and three-fold increases in the value of Viet Nam's marine sector compared to 2019 and 2020, respectively, in real terms. This significant growth is reflected in the sector's share of national GVA, which rises from 3.2 percent in 2020 to 9.7 percent in 2030, given a projected GVA for 2030 that is nearly a 50 percent jump in projected GVA for 2030. Despite this considerable rise, it falls short of Resolution 36's marine sector target to reach 10 percent of GDP by 2030. This discrepancy may stem from differences in what is considered part of the marine economy in the resolution compared to the approach taken here.[130] Projections for employment are challenging without extensive further analysis due to various factors affecting marine sector employment, including changes in sectoral productivity that require thorough investigation. Additionally, currently, there is no available information on employment in the offshore wind sector. These projections, therefore, underscore both the substantial growth potential of Viet Nam's marine sector and the need for continued research and refinement to achieve targeted economic objectives.

[130] The economic sectors are selected from a wider list drawn up by OECD, consisting of 20 sectors (OECD 2016). Data are only available for the five sectors listed, which in fact cover eight of the OECD sectors.

3.3. What are the main challenges hindering sustainable growth of Viet Nam's marine economy?

Viet Nam's coastal industrialization has driven economic growth, but at a high environmental cost. The rapid expansion of ports, factories, and energy projects has led to widespread marine pollution, oil spills and saline intrusion, threatening both ecosystems and livelihoods. While Viet Nam has strengthened environmental regulations, enforcement remains inconsistent and struggles to keep pace with industrial development.

Industrial pollution and oil spills remain a major concern, with factories commonly discharging untreated chemicals, heavy metals, and plastics into rivers and coastal waters. This trend is headlined by 2016's Formosa Ha Tinh disaster, where cyanide and phenol released into the ocean off the province killed millions of fish, crippled fisheries, and slashed local incomes by 46 percent. Similar industrial incidents, such as a titanium mining sludge spill in Binh Thuan province in 2016, have inflicted lasting damage on marine habitats and tourism. Despite companies paying billions in compensation, weak regulatory oversight and fragmented governance continue to enable environmental violations.[131] Meanwhile, oil spills are a recurring crisis, with Viet Nam ranking among the top five most affected countries over the past three decades.[132] The 2022 sinking of 1,000 tons of diesel oil in Diem Dien Sea devastated aquaculture, wiping out hectares of clam farms and disrupting the livelihoods of nearly 100 households.[133] Beyond immediate economic losses, such incidents erode fisheries, tourism, and coastal resilience, creating long-term cycles of environmental and economic instability.

Excessive groundwater extraction for industrial and agricultural use has intensified saline intrusion, contaminating freshwater sources critical for drinking water and rice cultivation. More than half of the southern delta's (Mekong Delta) freshwater reserves and 31.55 percent of the northern delta's (Red River Delta) water volume are affected by salinity, according to a MONRE national environmental report for 2016–20. Coastal provinces like Bac Lieu and Soc Trang face declining agricultural yields, forcing communities to abandon traditional livelihoods.[134] Climate change-driven sea level rises compound the crisis, pushing saltwater intrusion further inland and heightening the urgency for sustainable water management strategies.

In response, Viet Nam has made strides in policy reforms. These steps forward include a national plan to respond to oil spills, Decree No.65/2025 on marine resource management and Circular No.52/2024 on pollution control indicators. By 2023, 92 percent of industrial zones had wastewater treatment

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[131] *Tuoi Tre News.* 2016. Formosa ranked first in pollution incidents in 2016. (January 4). https://tuoitre.vn/formosa-dung-dau-cac-vu-gay-o-nhiem-nam-2016-1351267.htm

[132] *VietnamNet.* 2020. Viet Nam among top three countries in number of oil spills. (September 3). https://vietnamnet.vn/en/vietnam-among-top-3-countries-in-number-of-oil-spills-604232.html

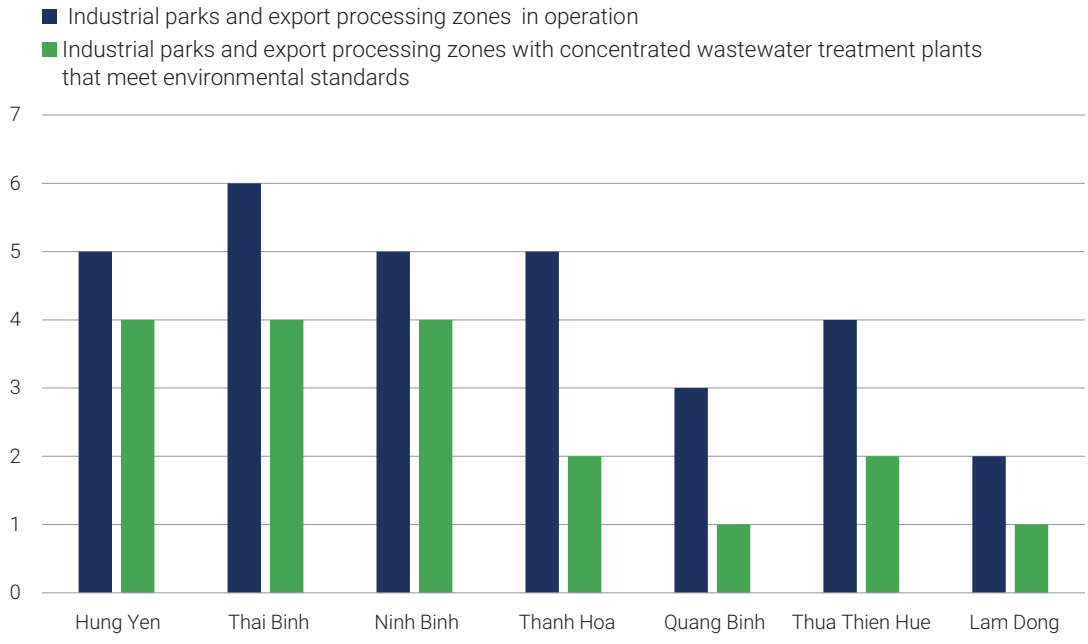
[133] *Thanh Nien News.* 2022. Thai Binh: After the oil tanker sinking incident, clams died en masse on the shore. (May 10). https://thanhnien.vn/thai-binh-sau-su-co-chim-tau-cho-dau-ngao-chet-trang-bai-1851499398.htm

[134] MONRE. 2021. *Report on national environmental status for 2016–20.* https://pilot.dcc.gov.vn/en/publications/report-on-national-environmental-status-1530

plants—an improvement from 63 percent in previous years.[135] However, enforcement remains uneven, with provinces like Quang Binh and Thai Binh struggling with outdated infrastructure, bureaucratic inefficiencies, and corruption that allows polluters to operate unchecked (National Statistics Office, 2025) (see Figure 3.5).

Amid these challenges, the central municipality of Da Nang has been a beacon of localized solutions.[136] It stands out as a model of proactive governance and community engagement, successfully integrating environmental safeguards with urban and industrial planning. Its 2021–25 Environmental Protection Plan mandates 100 percent waste recycling for industries, annual reductions in GHG emissions, and widespread environmental education. Initiatives like the 2023 "Blue Ocean" Festival—combining beach cleanups, art installations from recycled waste, and public workshops—demonstrate the power of blending policy with grassroots activism. Such models prove that sustainability is achievable when governments prioritize transparency, invest in green infrastructure, and foster civic participation.

Figure 3.5. Distribution of industrial park and export processing zone concentrated wastewater plants



Source: National Statistics Office, 2025.

[135] National Statistics Office. 2025. *The status of wastewater treatment and environmental protection in Viet Nam and lessons from Denmark.* (January 15). https://www.gso.gov.vn/en/other-news/2025/01/the-status-of-wastewater-treatment-and-environmental-protection-in-vietnam-and-lessons-from-denmark/

[136] *Finance Magazine. 2024.* What measures have the top five provinces/cities of Environmental Protection Index in Viet Nam implemented? Information Agency, Ministry of Finance. (May 25). https://tapchitaichinh.vn/5-dia-phuong-dung-dau-ca-nuoc-ve-chi-so-bao-ve-moi-truong-da-trien-khai-nhung-bien-phap-gi.html

Despite serious national and localized challenges, the marine sector's growth prospects appear more promising than the economy as a whole. Over the last decade, the marine sector has grown nearly 9 percent per year, as depicted in Table 3.2, faster than the overall economy. However, amidst this growth, there is a critical need to ensure the expansion of marine industries is sustainable and equitable. Sustainability means growth does not inflict harm on natural ecosystems, preserving their health and integrity for future generations. In addition, considering the vulnerability of marine ecosystems to climate change, it becomes imperative to safeguard these resources for future generations. Equitability further demands that the benefits of sustainable growth extend to all segments of society, particularly safeguarding the interests of the most vulnerable populations. Thus, balancing robust economic expansion with environmental stewardship and social equity is paramount to fostering a thriving and inclusive marine sector that contributes positively to economic development and environmental conservation efforts.

In Viet Nam, the concept of sustainable practices in marine economics is still new. Without action, there is a risk of further marine activities following an unsustainable path. For example, oil and gas exploration can lead to increased port and shipping operations, putting pressure on the ocean's resources. The government aims to make the marine sector more resilient and reduce pollution, but the link between these goals and economic growth is not always recognized. One key aim of marine accounting is to ensure that sectoral growth is sustainable. This means combining ecosystem and economic accounts and considering external factors affecting both.

Data on marine ecosystems in Viet Nam reveal several unsustainable trends:

- **Aquaculture impacts:** Aquaculture – particularly of catfish, white-leg shrimp, tiger shrimp and clams – has suffered declines in quantity and quality due to water pollution. This pollution incurs an additional cost of VND1,400 billion (US$60.2 million) annually, according to MONRE (2019).[137] In the Mekong Delta, water pollution has led to deaths and diseases in tiger shrimp production, with nearly 12,410ha of diseased and damaged areas recorded in 2018, a 26 percent increase from the previous year.[138] More than 58 percent of this damage is attributed to environmental factors.

- **Mangrove impacts:** Viet Nam has experienced significant losses of protective mangrove forests over time. From more than 250,000ha before 1950, it had reduced to 71,000ha by 1999, marking a 72 percent decline.[139] This loss is primarily attributed to toxic chemicals in earlier years and shrimp farming practices more recently. However, the scale of loss has reduced in the last two decades, with a net loss of 13,500ha between 1999 and 2015, partly due to some replanting efforts.

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[137] MONRE. 2019. *National Environmental Status Report 2018 on the Water Environment of River Basins.* Report, Viet Nam Natural Resources – Environment and Map Publisher, Hanoi. http://dwrm. gov.vn/uploads/download/files/bao-cao-htmt-quoc-gia-2018-moi-truong-nuoc-cac-lvs_ signed.pdf.

[138] *VNA. 2018. Mekong Delta Records over 12,000ha of Damaged Crustacean Farms in H1," Vietnam+ (VietnamPlus) (July 11)*, https://en.vietnamplus.vn/mekong-delta-records-over-12000ha-of-damaged-crustacean-farms-in-h1-post134451.vnp#:~:text=The%20Mekong%20Delta%20provinces%20saw%2012410ha%20of,percent%20against%20the%20same%20period%20last%20year.

[139] Nam V.N., Sasmito S.D., Murdiyarso D., Purbopuspito J., and MacKenzie R.A. 2016. *Carbon stocks in artificially and naturally regenerated mangrove ecosystems in the Mekong Delta.* Wetl. Ecol. Manag. 24: 231-244.

- **Fisheries impacts:** Despite an increase in capture fisheries over the last two decades, it has been accompanied by high rates of exploitation and declining stock conditions. Many stocks – including tuna, anchovy and seabream – are already fully or over exploited. Data indicate an overall decline of 13.9 percent in all marine fisheries stocks for 2011–15 compared to 2000–05, as reported by the MARD.

Viet Nam's path to sustainable coastal development requires a multi-pronged approach. First, stricter enforcement of existing laws—through real-time pollution monitoring and harsh penalties for violations—is critical. Second, investing in advanced wastewater treatment technologies and renewable energy infrastructure will reduce reliance on polluting industries. Third, amplifying community voices in policy design ensures that marginalized groups, from fishers to farmers, are not sidelined in the pursuit of growth. Fourth, decentralized decision-making can empower provinces to tailor solutions to local ecological and economic contexts. Finally, without systemic reforms and coordinated national efforts, Viet Nam risks irreversible damage to its ecosystems, economic stability, and long-term development goals. As the country restructures its administrative frameworks and implements marine spatial planning, the integration of ecological resilience into every policy decision will determine whether the nation achieves a sustainable balance—or succumbs to the paradox of growth without longevity.

3.4. What is the value of marine ecosystem services in Viet Nam?

Different approaches can be employed to value each major type of ecosystem service – provisioning, regulating, habitat, and cultural – with some more suitable for transaction-based valuations. For provisioning services, the ecosystem's value equals the resource rent, derived from market value and production costs of the final goods supported by the service. Regulating services, like flood control, can be valued by assessing avoided costs of damage to property or identifying costs of replacing the service with engineered alternatives. The value of cultural ecosystem services can be estimated using revealed preference methods like the travel cost method, which derives values based on user expenditures, or stated preference methods, which elicit estimates from users or stakeholders through surveys.

A robust valuation database highlights the worth of Viet Nam's ecosystems through a global comparison, yet gaps remain in research on open ocean ecosystems. Estimates of the value of marine ecosystem services in Viet Nam were derived from local studies utilizing the extensive Ecosystem Services Valuation Database (ESVD) developed by Brander et al. This comprehensive database encompasses 9,500 valuations from around the world, including 92 observations specific to Viet Nam. To ensure the reliability of data, this report selectively utilized 60 peer-reviewed data points from the studies included in the ESVD. Those studies were at various points throughout the 2000s and the 2010s. These valuations, drawn from seven distinct research projects conducted in various locations across Viet Nam, encompassed a range of ecosystem types. The valuation process involved converting values into US dollars using purchasing power parity (PPP) exchange rates and

standardizing them to 2010 prices. While most studies focused on specific areas, no local studies were available for open ocean ecosystems. Consequently, estimates for open ocean ecosystems were derived from international studies, with adjustments made to account for variations in willingness to pay between Viet Nam and respective countries of study, as detailed in Markandya and Hanh (2023).

The resultant average values per hectare for all three ecosystems are presented in Table 3.5, expressed in billions of Vietnamese Dong at 2010 prices. These values, deemed applicable in recent years given the range of study periods, were then multiplied by the respective areas of each biome as of 2021, also provided in Table 3.5, to obtain total values. Remarkably, the analysis reveals that most of the total ecosystem value (94 percent) is attributed to mangroves, with coral reefs contributing 2 percent, coastal systems (1 percent) and open ocean marine ecosystems (3 percent). Despite significant ecological and economic contributions, the combined value of these marine ecosystem services accounts for only 0.60 percent of Viet Nam's GVA, highlighting the need for greater recognition and preservation of these invaluable natural resources.

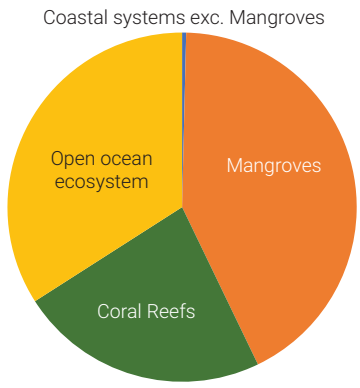
Table 3.5. Values of marine coastal biome, mangrove and coral ecosystems

Biome/Ecosystem	Area Ha.	Average Value in International USD/Ha./Yr.	Average Value in VND 000 2010 Prices	Total Value in VND Bn.2010 Prices	As % of GVA
Coastal Systems Exc. Mangroves	471,122	12.5	399.5	188.2	0.01%
Mangroves	302,359	2,432.2	45,270.8	13,688.0	0.56%
Coral Reefs	11,475	1,322.5	24,615.8	282.5	0.01%
Open Ocean Marine Ecosystem	169,617	1,950.3	36,300.0	416.5	0.02%
Total	784,956			14,575.2	0.60%

Source: World Bank estimates.

Figure 3.6. Significance of marine ecosystems and their components

Biome/Ecosystem	Average value in International USD/Ha./Yr.
Coastal systems exc. Mangroves	400
Mangroves	45,271
Coral Reefs	24,616
Open ocean ecosystem	36,300



Source: World Bank staff calculations based on data collected from the ESVD.

3.5. What is the government's vision for Viet Nam's marine economy as outlined in Resolution 36?

Resolution 36, adopted at the 8th Plenum of the 12th Party Central Committee, sets an ambitious goal for Viet Nam to achieve significant breakthroughs in six key marine sectors by 2030, prioritized as follows: 1) marine tourism and related services, 2) maritime economy, 3) exploitation of oil, gas and other marine mineral resources, 4) fishing and aquaculture, 5) coastal industry and 6) renewable energy and other new marine economic sectors.

Investments and Economic Activity Targets

To support this goal, the following detailed targets have been outlined in Resolution 36:

- **Infrastructure development:** Complete basic socio-economic infrastructure on inhabited islands, particularly for electricity, drinking water, communication, health, and education.
- **Marine survey:** Examine at least 50 percent of Viet Nam's sea area for marine resources and determine environmental conditions.
- **Ecological planning:** Ensure that 100 percent of coastal economic zones, industrial zones, and urban areas are planned and built with ecological sustainability in mind, including adaptation to climate change and sea level rises, with central wastewater treatment systems meeting national environmental standards.
- **Marine preservation:** Increase marine and coastal preservation and protected areas to cover at least 6 percent of the country's natural sea area.
- **Mangrove restoration:** Restore coastal mangrove forests to an area at least equal to their size in 2000.
- **Pollution control:** Significantly reduce marine environment pollution, including ocean plastic waste.
- **Waste management:** Ensure 100 percent of hazardous and domestic solid waste is collected and treated to meet environmental standards in coastal provinces and cities.
- **Coastal protection:** Develop measures to prevent and mitigate the impacts of tides, saltwater intrusion, and coastal erosion.

Most such targets involve scaling-up existing programs to grow the marine sector within the overall economy. Additionally, specific growth targets by 2030 relative to 2020 include:

- **Aquaculture:** Some 48 percent growth in aquaculture output, with a 3–4 percent uptick in aquatic production value, totaling 9.8 million tons in domestic seafood production (7.0 and 2.8 million tons from aquaculture and fisheries, respectively).

- **Oil and Gas:** Some 187 percent growth in oil and gas production, ensuring primary energy reaches 175–195 million TOE by 2030.
- **Offshore Wind:** An 18-fold increase in offshore wind capacity.
- **Water Transportation:** A 61 percent jump in water transportation, with cargo volumes rising from 1,140 to 1,423 million tons (container cargo from 38 to 47 million TEU) and passenger numbers increasing from 10.1 to 10.3 million.
- **Tourism:** Some 11.5 percent annual growth in all tourism, including marine tourism, with international visitors climbing by 8–10 percent per year and domestic visitors by 5–6 percent per year.

Coastal and Deep-Sea Mineral Exploitation

Viet Nam's waters hold about 35 types of minerals, ranging from fuels and metals to construction materials and precious stones. Recognizing this potential, the government has issued strategies for the development of the mineral and mining industry, with key targets by 2030 including:

- **Geological investigation:** Complete geological investigations in coastal areas, focusing on placer minerals and construction materials. Conduct investigations at a scale of 1:500,000 in deep-sea areas and bordering waters to discover deep-sea minerals.
- **Strategic exploration:** Continue large-scale exploration for strategic minerals like titanium-zircon and rare earths and prioritize deep hidden ore mines.
- **Mineral processing:** Establish industrial parks with advanced technology for mineral processing, ensuring investment efficiency, socio-economic benefits, and environmental safety.
- **Small-scale mining:** Minimize environmental pollution in small-scale mineral mining and processing facilities.
- **Deep processing technology:** Develop technologies for deep processing of minerals to meet national needs and exports.

The government has also set specific targets for projects related to mineral exploration, mining, and processing, with estimated required investment of US$18 billion for 2021–30 primarily for exploration projects, planning, and research activities.

The importance of enhancing coastal industry infrastructure to withstand challenges posed by climate change and sea level rises is also emphasized by Resolution 36. By prioritizing ecologically sustainable development and taking steps to prevent pollution and coastal erosion, Viet Nam aims to safeguard its coastal communities and vital economic assets. Concurrently, investments in renewable energy, particularly offshore wind, underscore the country's commitment to transition towards a greener and more diversified energy mix, while exploring emerging opportunities in new marine economic sectors. These concerted efforts reflect Viet Nam's resolve to harness the full potential of its marine resources in a sustainable and inclusive manner, driving economic prosperity and resilience for future generations.

3.6. What further measures are required to ensure the marine economy's sustainability?

The government faces an urgent imperative to address the multifaceted challenges confronting marine ecosystems, exacerbated by the looming specter of climate change. As Viet Nam charts a course for sustainable growth in its marine economy as outlined in Resolution 36, tackling these issues becomes not just a priority – but an existential necessity. The latest World Bank Country Environment Analysis[140] underscores the gravity of the situation, predicting significant declines in fish catches and heightened risks to coastal infrastructure due to rising sea levels and more frequent and severe storms. Climate-proofing of investments in housing and other infrastructure will raise costs and must be budgeted for. The additional costs of such investments by percentages have been estimated[141] and should be included in infrastructure budgets by the public and private sectors.

Viet Nam's vulnerability to typhoons, particularly along its northern coast, underscores the urgent need for climate adaptation measures. Sea level rises, compounded by storm surges driven by typhoons, pose a significant threat to coastal regions, with studies warning of substantial economic losses without effective adaptation efforts. The Red River Delta faces considerable risk, with projections suggesting as much as 9 percent of GDP could be at stake from a single severe storm surge by 2050. Furthermore, climate-induced shifts in weather patterns threaten to disrupt tourism, particularly during peak seasons, posing additional economic challenges. Two-thirds of Viet Nam's dike system, which stretches more than 2,659km, does not meet prescribed safety standards and even in many high-growth provinces, set standards leave substantial protection gaps.[142] At the same time, decisions on new investment locations should take the evolving risks of inundation into account. With the limited lifecycles of key infrastructure assets, some may also become stranded if built in areas where protection is limited or not possible at all.[143]

In confronting these challenges, the government must prioritize proactive measures to build resilience and adaptability within the marine economy. This entails investing in infrastructure, implementing stringent coastal protection measures, and fostering sustainable practices across sectors. Moreover, concerted efforts to mitigate GHG emissions and uphold international climate commitments are indispensable in safeguarding Viet Nam's marine ecosystems and securing the long-term prosperity of coastal communities. Only through bold and coordinated action can Viet Nam navigate the complexities of climate change and forge a path towards a sustainable and resilient marine economy.

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[140] World Bank. 2022. *Accelerating clean, green, and climate-resilient growth in Viet Nam: a country environmental analysis.* Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/37704.

[141] World Bank guidelines in Hallegatte, Stéphane, Jun Rentschler, and Julie Rozenberg. 2019. *Lifelines: the resilient infrastructure opportunity.* Sustainable Infrastructure Series. Washington, DC. World Bank. doi:10.1596/978-1-4648-1430-3. License: Creative Commons Attribution CC BY 3.0 IGO.

[142] Rentschler, J, de Vries Robbé, S, Braese, J, Huy Nguyen, D, van Ledden, M, and Pozueta Mayo, B. 2020. *Resilient shores: Viet Nam's coastal development between opportunity and disaster risk.* World Bank, Washington, DC.

[143] CWR. 2020. Changing risk landscapes – coastal threats to central banks. https://chinawaterrisk.org/notices/changing-risk-landscape-coastal-threats-to-central-banks/

Addressing the intensifying impacts of climate change on marine ecosystems necessitates proactive measures, such as early warning systems and nature-based solutions. These actions will influence the targets and planning for the marine economy, underlining the importance of warnings against extreme events and investments in nature-based solutions like mangroves and seagrasses. Additionally, ensuring the resilience of existing infrastructure and investing in climate-resilient new infrastructure are vital components of coastal area planning, including for tourism, to mitigate climate risks. Equity is paramount in ensuring the broader sustainability of marine economy plans. This entails measures to create local employment opportunities as part of tourism expansion without displacing communities, ensuring local communities can access resources in conservation areas and addressing climate impacts through creating new livelihood opportunities for affected communities.

Climate-proof investments in infrastructure are essential, to protect against sea level rises and extreme weather events, in alignment with Resolution 36. This involves investing in nature-based solutions such as the restoration of mangroves and adjusting fishery targets to account for changes in sustainable catch limits amid climate change. However, climate-proofing infrastructure investments will raise costs, which should be factored into public and private sector infrastructure budgets.

Investment and risk management for coastal protection to 2050 is critical, given the fragmented and incomplete hazard and socio-economic risk information currently available. A significant portion of Viet Nam's dike system does not meet safety standards, leaving substantial protection gaps in high-growth provinces. In response, decisions on new investments must consider changing inundation risks, focusing protection efforts on key locations rather than attempting to cover the entire coastline. Planning decisions must account for various risk scenarios, including average and rising sea levels. The World Bank report, "Resilient Shores," highlights five strategic interventions necessary to address coastal risks within the marine economy plan: strengthening data and decision-making tools, enforcing risk-informed planning, enhancing infrastructure resilience, leveraging nature-based solutions as well as improving preparedness and response capacity.[144] Particularly, the protection and economic contributions of ecosystems – such as mangroves and sand dunes – require a systematic approach to rehabilitation, conservation, monitoring, and management.

Fishery management requires reform to become cognizant of climate change impacts, particularly to address overfishing and unsustainable catch practices. This may involve introducing restrictions on catches through regulatory and fiscal instruments and supporting artisanal communities to transition away from dependence on unsustainable fishing practices. Drawing upon good practice examples from other countries can inform effective strategies for sustainable fishery management amidst changing environmental conditions.

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[144] Rentschler, J, de Vries Robbé, S, Braese, J, Huy Nguyen, D, van Ledden, M, and Pozueta Mayo. 2020. *Resilient shores: Viet Nam's coastal development between opportunity and disaster risk.* World Bank, Washington, DC.

3.7. How can policies and institutions ensure the sustainable implementation of Resolution 36 for the marine economy?

To enact Resolution 36, the government has endorsed several plans focused on marine economic development. They include national marine spatial planning (Resolution 22/NQ-CP, 2020), a master plan on exploitation and sustainable use of coastal resources (Decision No.25/QD-TTg, 2020), a master plan on development for a seaport system (Decision No.1579/QD-TTg, 2021) and planning for the sustainable exploitation and use of marine resources (Resolution 48/NQ-CP, 2023). A significant institutional reform was the establishment of a National Steering Committee in 2020,[145] chaired by a Deputy Prime Minister and comprising leading representatives from the National Assembly, ministries and People's Committees of 28 coastal provinces. This committee convenes annually to decide on planning and budgeting for the following year, with a standing body formed under the Viet Nam Agency of Seas and Islands (VASI), marking a pivotal milestone in bolstering State management of the marine economy.

Moreover, sustainable development of Viet Nam's marine economy necessitates enhanced synergies and coordination among sectors and the environmental management system. The 2022 UNDP report 'Blue economy scenarios for Viet Nam' underscores potential synergies and conflicts between marine economic sectors, revealing negative trade-offs for the environment and biodiversity in most sectors, barring renewable energy. Recognizing these interactions is crucial for policy makers to manage ocean resources for growth, while enforcing regulations that uphold environmental conservation. Strengthening regulatory frameworks and promoting sustainable practices is imperative to mitigate adverse environmental impacts, while fostering economic prosperity in the marine sector.

Table 3.6. Interactions between marine sectors

	RE Energy	Oil & Gas	Fisheries	Marine Tourism	Marine Transport	Environ-ment & Biodiversity
RE Energy	NA	+2	0	+1	+1	+2
Oil & Gas	+1	NA	0	0	+1	+2
Fisheries	+1	-1	NA	-1	-1	+3
Marine Tourism	+1	+1	+2	NA	-1	+3
Marine Transport	+2	+1	+1	+1	NA	+2
Environment & Biodiversity	+1	-2	-1	-1	-2	NA

Source: UNDP (2022).[146]
Note: The score for each cell is interpreted as the impact of the industry in the vertical column on the industry in the horizontal row and is a composite score that calculates both positive and negative effects (+3 positive, 0 neutral, -3 negative). Direction and values of interactions is determined based on sector experts' consensus. RE Energy is short for renewable energy.

[145] Decision No.203/QD-TTg, approved by the Prime Minister, on the establishment of the National Steering Committee for implementation of Viet Nam's Sustainable Marine Economic Development Strategy to 2030, with a vision to 2045 (February 6, 2020).

[146] UNDP. 2022. *Blue economy scenarios for Viet Nam.*

Development strategies for each marine sector are integral components of broader master plans designed to drive growth. For instance, offshore renewable energy planning aligns with the Eighth National Power Development Plan (Decision No.500/QD-TTg, 2023), while marine fisheries and aquaculture targets are embedded within the Viet Nam Fisheries Development Strategy (Decision No.339/QD-TTg, 2021). Similarly, coastal tourism and oil-gas development adhere to specific strategic directives (Decision No.147/QD-TTg, 2020, and Resolution 55-NQ/TW, 2020, respectively). Furthermore, the government's approval of a master plan for Seaport System Development (Decision No.1579/QD-TTg, 2021) signifies a holistic approach to maritime infrastructure development.

Emphasis must shift towards marine resource protection and biodiversity conservation. This is underscored by a strategy for sustainable exploitation and protection of marine and island environments until 2030 (Resolution 48/NQ-CP, 2023). This strategy not only reaffirms environmental targets, but also delineates marine economic space allocation for priority sectors that necessitates vigilant monitoring to prevent resource over-exploitation.

Historically, a lack of sectoral coordination has impeded Viet Nam's marine economy development, with each sector operating independently under different ministries. This fragmented approach hampers effective management and synergistic investment. Despite the establishment of the National Steering Committee to address coordination issues, significant reforms are still required to optimize sectoral collaboration. At provincial level, efforts to incorporate marine economic development into master plans are underway, but siloed sectoral planning persists. Recently, fresh initiatives have been initiated where neighboring provinces cooperate on common marine economic priorities to improve synergies and investment efficiency. For example, three coastal provinces in the South Central region (Khanh Hoa, Ninh Thuan and Phu Yen) signed a memorandum of agreement on socio-economic development cooperation in seven marine economic sectors and activities for 2024–25 with a vision to 2030.[147] Strengthening the capacity of provinces and regional coordination for marine economic development should be encouraged to maximize common resources and advantages as well as avoid conflicts and negative externalities to the environment. Regional cooperation initiatives, such as these inter-provincial agreements, aim to enhance synergies and investment efficiency. Strengthening provincial capacities and fostering regional coordination are crucial to leveraging collective resources and mitigating environmental risks.

Enhancing inter-ministerial coordination, particularly between the Ministry of Agriculture and Environment (MAE) and relevant ministries, is crucial. The MAE should ensure that climate scenarios are integrated into plans for implementing Resolution 36, with marine economy-focused measures requiring optimized data and coordination for effective implementation. Informing the public about marine spatial plans, managing progress towards sustainable development, and implementing governance frameworks are essential for effective marine resource management. Challenges remain, including limited marine area measurements, insufficient research on Viet Nam's ocean economy, ecosystem services, and the

[147] *Labor People's News.* 2024. Cooperation to develop seven economic sectors of the South-Central coast (in Vietnamese). https://nld.com.vn/hop-tac-phat-trien-7-nganh-kinh-te-bien-nam-trung-bo-196240124214737127.htm

nascent concept of an Ocean Accounting Database. More research is needed to understand the impacts of ecosystem services on marine activities, building upon values provided in existing reports.

While the government has outlined a list of priority steps to be taken by 2025 and 2030 to meet Resolution 36's marine economic objectives, several obstacles are apparent. Despite identification of key public investment projects with clear timelines and agency responsibilities, there is currently no specific funding or resource allocation to support implementation. Medium-term investment plans at central and provincial levels fail to prioritize marine-related public investment projects, while there is no established reporting, monitoring, and evaluation system to track progress or assess effectiveness of completed projects. Addressing these gaps requires establishment of an investment tracking framework, enhancement of data systems, and development of a national marine spatial plan to guide sustainable investment decisions and prevent environmental degradation. Additionally, institutional reforms are crucial for engaging non-state actors, realizing policy transparency, administrative efficiency, and public-private partnerships to attract private investment. Collaboration with diverse stakeholders, including development partners and NGOs, is essential to overcome common challenges and create a supportive environment for marine economic growth.

Developing a reliable information system on marine resources and economic activities as well as national marine spatial planning should be prioritized, as identified in Resolution 26, issuing a Master Plan and The Five-year Plan of Resolution 36.[148] Marine sectors have traditionally used diverse statistical criteria and methodologies, making it challenging to compare economic contributions and resource use efficiency. This complicates the reporting, monitoring, and evaluation of policies and investments within the marine space. The absence of a national marine spatial plan and integrated coastal zone management has resulted in uncoordinated sectoral growth and scattered investments. This fragmentation hinders potential synergies and negatively impacts environmental quality. Although work is underway to develop a national marine spatial plan, it will need regular evaluation, adjustment, and updating to align with development objectives. Such a process demands significant resources and coordinated efforts across various ministries.

Institutional reforms to engage non-state actors can stimulate marine economic growth by clearly setting out plans and rules to govern marine exploitation. Governments at central and local levels are prioritizing the development and upgrading of public infrastructures such as ports, roads, power supply, and coastal industrial parks—to create favorable conditions for business engagement. However, to attract private investors, mechanisms are essential to improve administrative procedures, enhance policy transparency, and establish credible plans. In line with this, initiatives like the Blue Economy Partnership Group by VASI aim to foster non-state participation and consultation in marine economic development planning.[149,150] Effective management of critical issues – like marine spatial planning,

[148] Resolution 26/NQ-CP on promulgating the master plan and five-year plan for implementation of Resolution 36-NQ/TW by the Government of Viet Nam (March 5, 2020).

[149] The Government of Viet Nam and relevant partners supported the establishment of a blue economy partnership in the form of an open and flexible framework, without legal commitments.

[150] *Viet Nam Plus News*. 2022. Viet Nam looks to set up blue economy partnership group. https://en.Viet Namplus.vn/Viet Nam-looks-to-set-up-blue-economy-partnership-group/224655.vnp

ocean plastic waste management, and natural resource accounting – can greatly benefit from open communication and coordination. Engaging development partners, NGOs, research agencies, and businesses will be crucial in addressing these shared challenges.

3.8. Policies, Institutions, and Investments – Recommendations for Viet Nam

Viet Nam's commitment to sustainable marine economic development, as outlined in Resolution 36, is driven by a comprehensive set of plans and institutional reforms.[151] Central to this effort is the establishment of the National Steering Committee in 2020, which brings together top government officials and representatives from 28 coastal provinces to coordinate policy, planning, and budgeting for marine economic development. Despite the substantial groundwork laid through these strategies, significant challenges remain, particularly in terms of sectoral coordination, data systems, and regional cooperation. To ensure effective implementation of these plans and achievement of sustainable marine economy growth, it is imperative to strengthen synergies across sectors, engage non-state actors, and bolster local governance capacity. Addressing climate change impacts, aligning investment strategies with environmental priorities, and ensuring rigorous monitoring and evaluation frameworks are also essential to foster a resilient and environmentally sound marine economy in the long term.

To support development of Viet Nam's marine economy in the next five years, a solid foundation for sustainable marine management must be quickly realized. An immediate first step is strengthening data systems, with improved marine resource and economic indicator data systems to deliver better insights into ecosystem and economic accounts. It is also essential to support coastal provinces by providing targeted training and resources to enhance local governance and planning capabilities, as well as facilitating regional cooperation among neighboring provinces to share best practices and strengthen collective action. Ensuring planning synergies across national and provincial marine strategies is another key priority. This includes preventing conflicts between sectors, conserving ecosystems, and introducing an investment tracker to enhance resource allocation transparency. Additionally, engaging non-state actors—such as NGOs, research agencies, and businesses—is vital to tackling shared marine challenges and fostering collaboration for a sustainable future.

Viet Nam must also ensure investment plans reflect the reality of the climate crisis. This includes resilience of coastal infrastructure, particularly in sectors like tourism, which is highly vulnerable to climate impacts. Strengthening sectoral coordination is another priority, with an emphasis on enhancing the role of the National Steering Committee to monitor sector-specific targets and promote cohesive development. Development of marine spatial planning and integrated coastal zone management systems should be finalized, ensuring that sectoral growth is not fragmented and marine resources are utilized sustainably. Encouraging regional cooperation, particularly through

[151] National marine spatial planning (Resolution 22/NQ-CP, 2020), a master plan on exploitation and sustainable use of coastal resources (Decision No.25/QD-TTg, 2020) and a master plan on seaport system development (Decision No.1579/QD-TTg, 2021), among others.

inter-provincial agreements, will help optimize the use of shared marine resources, maximize synergies, and mitigate potential environmental risks.

The following cross-cutting and sectoral/provincial recommendations could help build the foundations for a more resilient and sustainable marine economy in Viet Nam in the upcoming 2026–30 policy cycle:

Table 3.7. Recommendations for 2026–30

Cross-cutting		Economic Co-Benefits	Mitigation Co-Benefits	Adaptation Co-Benefits
Develop a framework for marine economy accounting	• **Adopt standardized methodologies:** Use frameworks like the System of Environmental-Economic Accounting (SEEA), particularly the SEEA Ocean Accounting framework, to standardize the measurement of marine economic activities. • **Define marine economic sectors:** Clearly define sectors, such as aquaculture, ecosystem services, fisheries, renewable energy, shipping and tourism, to ensure comprehensive coverage. • **Incorporate ecosystem services:** Quantify the value of ecosystem services (e.g., carbon sequestration, coastal protection, biodiversity) provided by marine environments to be included as a part of satellite accounts.	Medium	Low	Low
Strengthen data collection and management	• **Invest in marine data infrastructure:** Develop robust systems for collecting, managing, and sharing marine data, including satellite imagery, oceanographic data, and fisheries statistics. • **Leverage technology:** Use remote sensing, AI, and big data analytics to improve the accuracy and timeliness of marine economic data. • **Collaborate with stakeholders:** Engage with industries, research institutions, and local communities to gather data on marine activities and their economic impacts.	Medium	Low	Low
Build institutional capacity	• **Train professionals:** Provide training for statisticians, economists, and policymakers on marine economy accounting methodologies. • **Establish dedicated units:** Create specialized units within the National Statistical Office to focus on marine economy accounting. • **Foster collaboration:** Strengthen collaboration between government agencies, academia, and the private sector to share knowledge and resources.	Medium	Low	Low

Sectoral/Spatial		Economic Co-Benefits	Mitigation Co-Benefits	Adaptation co-benefit
Operationalize marine economy accounting	• **Policy integration:** Use marine economy accounts to inform marine spatial planning, sustainable fisheries management, and blue economy strategies. • **Incentivize sustainable practices:** Develop economic incentives (e.g., subsidies, taxes, or payments for ecosystem services) to promote sustainable use of marine resources.	Medium	Low	Medium
Enforce marine spatial planning (MSP) regulations	• **Draft and pass national MSP regulations within 12 months,** linking them to marine economy indicators. • **Establish an MSP task force** to oversee implementation and ensure alignment with marine economic goals. • **Launch pilot projects in three high-risk coastal regions** to test and refine MSP frameworks.	Medium	Low	Medium
Accelerate nature-based coastal protection	• **Restore and expand mangroves and seagrass plantations,** aiming to restore 50,000 hectares of mangroves by 2030 with legal protection. • **Designate 30 percent of national seagrass beds and coral reefs as protected areas** to enhance biodiversity and ecosystem resilience. • **Integrate nature-based solutions** into all climate adaptation plans and infrastructure projects to align with marine economy accounting frameworks.	High	High	High
Ensure sustainable and inclusive tourism growth	• **Launch a sustainable tourism certification program** with biennial audits to ensure compliance with environmental and social standards.	Medium	Medium	Medium

ANNEXES

Annex 1.0. Update on the five policy packages of the 2022 CCDR

CCDR Policy Packages	Update on Progress – April 2025
Priority Package 1: A coordinated regional program for the Mekong Delta. This program should focus on stemming land subsidence and saltwater intrusion by curtailing sandmining and groundwater extraction, adapting farming practices, increasing freshwater flows and aquifer recharges, and restoring mangroves. Existing physical assets should also be retrofitted to become less vulnerable to inundation, while the Land Law including land use planning should be amended to prevent further encroachment on natural vegetation cover. Moreover, new developments should account for climate risks through systematic environmental assessments. All such measures will require strengthening the Regional Coordination Council and correcting the public investment deficit of the recent past. This will also involve revising existing transfers from central to local governments, while encouraging the use of specific instruments, such as green bonds, to finance new projects.	A regional Mekong Delta Master Plan was adopted in June 2022. In July and August 2023, then Prime Minister Pham Minh Chinh signed decisions on the establishment of coordinating councils for six regions across the country: the Red River Delta, North Central and Central Coast, Southeast, Central Highlands, Mekong Delta and the Northern Midlands and Mountainous regions. The councils are responsible for coordinating linking activities for regional socioeconomic and infrastructure development, with priority given to transport infrastructure. They will study and propose the formation of a fund for regional infrastructure development. The Mekong Delta's coordinating council had an inaugural meeting in September 2023. It saw officials from central agencies and representatives from 13 regional localities explore mechanisms and policies for regional development, as well as the connectivity and coordination among projects that promote intra-regional and inter-regional linkages. *https://vietnamlawmagazine.vn/coordinating-council-for-mekong-delta-region-opens-first-meeting-70552.html*
Priority Package 2: An integrated coastal resilience investment program for key urban centers and connecting infrastructure. Central coastal areas are prone to extreme weather events, highlighting the need to upgrade	On December 15, 2024, Viet Nam's Ministry of Natural Resources and Environment unveiled the Master Plan on Sustainable Exploitation and Use of Coastal Resources for 2021–30, with a vision to 2050. Approved by the Prime Minister under

CCDR Policy Packages	Update on Progress – April 2025
road and power assets to climate-resilient design standards. Building the resilience of coastal areas will also depend on effective land-use planning and investments through a regional Mekong Delta Master Plan adopted in June 2022. Special emphasis should be placed on strengthening and enforcing policies and regulations for industry resilience, including in industrial parks, and envisioning relocation when necessary. Cities should invest more in digital technologies to optimize weather-risk management and early warning systems. In addition, since it is impossible to eliminate all risks, expanding the use of insurance and risk-hedging instruments should be priorities.	Decision 1117, this ambitious plan outlines a vision to transform coastal areas into economic and cultural hubs by 2050, focusing on sustainability, renewable energy, eco-tourism, and marine biotechnology. It offers strategic investment opportunities while emphasizing environmental preservation, cultural heritage, and socioeconomic development. *https://www.vietnam-briefing.com/news/vietnam-master-plan-coastal-resource-sustainability.html/*
Priority Package 3: A targeted air pollution reduction program in the Hanoi airshed to reach the World Health Organization interim target by 2030 and enhance labor productivity gains. Data from the World Air Quality Report indicates that air pollution in the capital exceeded WHO guidelines by at least five times for half of each year from 2018 to 2021, while PM2.5 concentrations are predicted to increase given the absence of adequate air pollution regulations and the planned expansion of coal capacity. According to government plans, 10 new coal-fired power plants will be put in operation in the northern region by 2030. Agricultural pollution is also expected to grow in the absence of policies targeting agricultural residue burning and fertilizer use. Effective improvements in Hanoi's air quality will require urgent actions in close coordination with neighboring provinces. Priorities should include reducing the reliance on coal, for example, by repurposing the 100MW plant in Ninh Binh. Other measures will have to be put in place to incentivize farmers to use fewer polluting inputs and burn less waste, improve public transportation systems, and apply tougher standards on motor vehicle emissions.	March 2025: Hanoi is considering establishment of a Low Emission Zone and Hoan Kiem, a core district of Hanoi, is expected to pilot one such zone. Most recently, three important documents were adopted: the revised Capital Law of 2024 and two newly approved master plans for Hanoi. The revised Capital Law specifically outlined several tasks to establish low-emission zones. In the master plans, environmental concerns are prioritized as urgent tasks to be addressed from 2025 to 2030. *https://hanoitimes.vn/hoan-kiem-s-low-emission-zone-pilot-sets-stage-for-greener-hanoi.645320.html* *https://vietnamnews.vn/environment/1693983/hanoi-urgently-seeks-solutions-to-combat-air-pollution.html*
Priority Package 4: Acceleration of the clean energy transition. The energy sector accounts for about 60 percent of the country's GHG emissions, and the government	The Government of Viet Nam approved the Revised Power Development Plan 8 (PDP8) in 2023 and in April 2025 (Prime Ministerial Decision No. 768/QD-TTg).

is working to align power sector investments with its COP26 net zero commitment. This is an immediate task, given the lead time for implementing energy sector investments. Renewable energy deployment (in particular, offshore wind) could be accelerated by improving the regulatory framework, including transparent and competitive procurement procedures (auctions), to encourage private sector participation. Bankable power purchase agreements aligned with international standards can mobilize much-needed private investment in the sector. Ensuring investments in the power grid capacity, which can provide flexibility to absorb additional renewable energy will be important. Accelerating implementation of energy efficiency plans — including through effective pricing policies such as a carbon tax or an emissions trading system — is also a priority. In addition, encouraging low-carbon energy sources by monitoring the carbon footprint of large companies, including along their value chains, is vital. Many companies have already committed to their own net zero targets. The government could link support to state-owned enterprises with actions that accelerate low-carbon energy consumption.	Under the revised National Power Development Plan for 2021–30 with a vision to 2050, Viet Nam's power generation capacity will reach 183,291–236,363MW. According to the revised PDP8, total installed power generation capacity is projected to reach 183,291–236,363MW by 2030, a 30–50 percent increase over the previously approved capacity of 150,489MW. By 2050, total installed capacity is projected to rise dramatically to 774,503–838,681MW, with renewable energy forming the backbone of the system. In particular, solar power capacity will reach 293,088–295,646MW (35.3–37.8 percent of total power generation capacity), offshore wind will reach 113,503–139,079MW (14.7–16.6 percent), onshore wind will reach 84,696–91,400MW (10.9 percent), and battery storage will account for 11.5–12.4 percent of total capacity. Nuclear energy is expected to provide a stable base load at 10,500–14,000MW, representing 1.4–1.7 percent of the total system. The revised PDP8 also emphasizes promotion of direct power purchase agreements and production of new energy sources, aiming to contribute 30–60 percent of renewable energy output, depending on market demand and infrastructure development. The guiding principles behind the revised PDP8 are a regional balance, system feasibility and safety, and alignment with sustainable economic growth, energy security, and national defense—all in the context of the global energy transition. *https://vneconomy.vn/government-approves-revised-power-development-plan-8.htm*
Priority Package 5: A new social contract to protect the most vulnerable people. Climate change tends to disproportionally affect poorer households in vulnerable areas or those less prepared to cope with the consequences. Some mitigation actions proposed could also have a regressive impact, such as through broadening a carbon tax or the greater inability of unskilled workers to secure a new job during the transition to cleaner technologies. Implementing a modern, scaled-up adaptive social safety net could improve the effec-	Progress was made in rolling out a national ID card, and digitization of social protection system in 2023–24. This has led to the social protection roster swelling by about one million citizens. The roll out of an adaptive social protection system and a comprehensive national skills program are still a work in progress.

tiveness of post-disaster assistance. Protecting the most vulnerable segments of the population against price increases in transport and energy resulting from the energy transition and use of carbon pricing instruments should be prioritized. This could be achieved by transferring part of the carbon tax revenue to social programs. Investment will also be needed in skills development programs to support workers exiting the labor market involuntarily. Beyond this, a comprehensive national skills program should be developed to correct skills mismatches in green industries by reforming educational training. Protecting the most vulnerable must be underpinned by advance information and citizens' participation in public debates about the adaptation and mitigation measures envisaged nationally and locally.

Annex 1.1. Description of the MANAGE model

The World Bank's MANAGE model is a single-country, recursive, dynamic computable general equilibrium (CGE) model that relies on a neoclassical structural modeling approach. Most model assumptions follow standard CGE literature (an extended documentation and user guide for the model can be found in World Bank 2024a).

The model is designed to incorporate several climate shock transmission channels (factor productivity, factor stock, sector yield, household demand and commodity trade) and to capture the effects along several aspects of the economy, such as socio-economic conditions (GDP, consumption, and investment), fiscal conditions (government revenue, fiscal deficit, and public debt), external conditions (trade, foreign investment, and current account), as well as the distributional impact across industries, factors of production and households, identifying those likely to be most adversely affected.

Climate actions include adaptation and mitigation policy scenarios represented by the effects of types of investment and financing options, thereby identifying trade-offs. This version of the model incorporates a detailed analysis of energy supply and demand, taking into consideration various sources of electricity generation and the corresponding energy mix. Energy production in this version of the MANAGE model distinguishes five major types of electricity generation activities: coal, gas, oil, hydro, and renewables (wind, solar and others). The electricity generation mix can be endogenously determined based on the relative cost of each generation activity or target. Finally, the model is set up to include and track the evolution of GHG emissions by type (CO_2, N2O, CH4 and FGAS) and sources (use of production factors, volume of production, use of commodities and land use changes).

Annex 1.2. Baseline and alternative scenarios

The baseline macroeconomic framework is calibrated to the CGE, while modelling of climate change impacts uses three alternative climate scenarios, which correspond to the three RCPs. Results compare deviations from the baseline across climate scenarios with and without additional adaptation efforts. The key assumptions are:

- **Baseline scenario:** In this study, a growth pathway was calibrated to 2050 to form the baseline for analyzing the impact of climate change on long-term economic development. GDP growth until 2026 is taken from the World Bank's most recent projections for Viet Nam (World Bank, 2024). It is assumed that GDP growth would gradually decrease from 6.5 percent in 2026 to 4.3 percent in 2050, and that all other exogenous variables would grow at the same rate as GDP. Government investment and spending are fixed as a share of GDP, while government savings adjust endogenously to balance the government account. Foreign savings and the exchange rate are fixed, while domestic prices adjust to restore the current account balance. Investment levels adjust to ensure the saving-investment balance, as savings are fixed. Demographic trends modelled follow high demographic transition United Nations population scenarios that foresee population growth remaining just above 2 percent in 2050 (this compares to below 2 percent in the median population scenario, which is unlikely). It does not assume actions to increase adaptation to or mitigate climate change beyond those already planned in existing government development strategies. Results presented throughout the report will include deviations from the baseline across climate shock channels, with and without additional adaptation and mitigation efforts.

- **Climate scenarios:** Three alternative climate scenarios (RCP2.6, RCP4.5, and RCP8.5) are used due to uncertainty related to climate change – they are labeled optimistic, most likely and pessimistic scenarios, respectively. To incorporate these impacts in the CGE model, the analysis considers the main impact channels that will cause shocks to the country's economy.

The modeling exercise aims to quantify the impacts of climate change and policy using a large set of assumptions to help assess the challenges and trade-offs. However, the results are not definitive, and specific numbers should be used cautiously. There are some key modeling limitations including potential missing impact channels or challenging channels to incorporate into the model. They would make total GDP impacts much larger than those estimated in this study.

Annex 1.3. Indirect effects

Indirect effects of climate change on the economy can take place through several channels as follows:

1. Production linkages: activities linked through forward and backward production linkages.

2. Factor substitution effect: firms compete on the factor markets to hire labor, capital, and land. As factors suffer supply and productivity shocks, activities adapt by substituting them, considering their relative prices, and the activity's production cost structure.

3. Price effect: the output supply gap tends to increase prices, which in turn affects purchasing power. Consumers substitute goods and services for which prices have increased with products that have a relatively lower price. The ease with which products are substitutable depends on price and income elasticity of demand.

4. Income effect: an important share of households and firms' income accrues from factor remuneration. Declining labor and capital income, combined with increasing prices, tend to reduce consumption and savings.

5. Crowding-out effect: government revenue from direct and indirect taxes declines. With expenditure maintained at the baseline level, deficit increases. Government debt increases consequently both from external and domestic resources.

6. Investment effect: investment is financed via domestic and external savings. Domestic private savings are declining on average, while the government deficit is increasing. With foreign savings fixed as a share of GDP, total savings declined, resulting in lower investment. This, in turn, exacerbates the capital stock reduction because of flood destruction.

7. Trade channel: it is such that supply and price effects result in lower exports. Imports decline due to lower demand (intermediate, final, and investment).

Annex 1.4. Impact of global climate change on water resources

Preliminary analysis of global climate change impacts on water resources provides new estimates on potential impacts through three channels: water availability, crop production, and hydropower. The analysis is focused on non-Mekong Delta River basins.

On hydropower generation, the preliminary analysis finds that by 2031–50 under all five dry scenarios, hydropower generation declines compared to the no climate change reference, while it increases under all five wet scenarios. On average, declines are more significant during 2041–50, reaching up to -7.1 percent.

Regarding crop production, on average, unmet irrigation demands are higher under the dry scenarios (Table A1.4.1). However, differences are small, and the wet mean scenario shows higher variability (larger reductions and increases) in unmet demands relative to the no climate change reference. Unlike hydropower, some wet scenarios show higher unmet demands than dry scenarios, resulting in a less consistent pattern during 2041–50.

Table A1.4.1. Unmet irrigation water demands

Decade	Demands (Thousand GWh)			Change vs Reference	
	No Climate Change Reference	Mean of Wet Scenarios	Mean of Dry Scenarios	Mean of Wet Scenarios	Mean of Dry Scenarios
2030s	1.70%	2.10%	2.60%	0.4%	0.8%
2040s	1.80%	2.90%	3.70%	1.1%	1.9%

Impacts on irrigated crops are limited, ranging between -3.7 and -4.8 percent during 2041–50. This is partly because the analysis excluded the Mekong Delta, which uses almost 45 percent of Viet Nam's irrigation water. However, the analysis finds that production impacts are greater for rainfed than irrigated crops by more than double due to the less reliable water supply. In fact, the impact on overall and rainfed crop production in non-Mekong basins is substantial (Table A1.4.2).

Table A1.4.2. Changes in crop production, non-Mekong basin

Group	Decade	Mean of Wet Scenarios	Mean of Dry scenarios
All crop production	2031–40	-3.1%	-2.2%
	2041–50	-5.4%	-4.3%
Irrigated crops	2031–40	-2.8%	-1.9%
	2041–50	-4.8%	-3.7%
Rainfed crops	2031–40	-5.4%	-4.1%
	2041–50	-9.2%	-9.2%

Source: World Bank and Industrial Economics, Inc.

Annex 1.5. Damage functions

A dataset was prepared as an input into the MANAGE model developed to analyze the impacts of climate change in Viet Nam. This builds on earlier work for the CCDR with updated estimates in some categories and extensions to the set to cover a wider range of future climate scenarios.

Table A.1.5.1: Categories of climate-related damage

Channel of impacts	Categories of damage
Labor productivity	Heat stress
Capital stock	River flooding
	Typhoons
	Sea level rises
Agriculture and other sectors	Agriculture: Rice and other crops
	Fishery
	Forestry
	Hydro energy

The first set of extensions relate to impacts in: (a) changes in labor productivity, (b) annual expected damage from floods and (c) annual expected damage from typhoons. The figures are based on the work of Climate Analytics.[152]

[152] For details see: Climate Analytics, 2022. Climate Impact Explorer. Available at: https://climate-impact-explorer.climateanalytics.org/.

- For labor productivity, average productivity in agriculture is used (all agriculture including forestry and fisheries, agriculture excluding forestry and fishery, forestry alone and fishery alone; and average productivity in construction – two separate numbers) during 1986–2006. This was obtained from Ohno Kenichi who prepared a report on labor productivity for the Government of Viet Nam.[153]

- For river flood losses and typhoon losses, Climate Analytics gives estimates of expected river flood losses as a percentage change on losses incurred in a reference period around 2015. To obtain the baseline loss, data on losses from 2010 to 2020 was collected and averaged out.[154] As data was in current prices in VND, these were deflated to obtain 2010 prices and then converted into US dollars using the 2010 average exchange rate.

Looking at extreme events of less or more severe nature losses corresponding to the 10th and 90th percentiles of the distribution of losses from 2010 to 2020 were calculated and used to project future losses under the different scenarios.

Annex 1.6. Budgetary policies and actions to drive green growth

Areas of intervention	Categories of damage
Fiscal strategy	Strengthening fiscal strategies to address climate change requires integrating climate sensitivity into public financial management. This can be achieved by estimating and tagging the positive, negative, and neutral climate impacts of public expenditures, investments, and tax policies, focusing on both adaptation and mitigation efforts. Establishing a robust monitoring and reporting system will enhance the ability to track and analyze climate-related expenditures, inform evidence-based climate change policy and planning, and effectively communicate climate finance efforts to the international community.
Inter-governmental fiscal transfers	Incorporate incremental financing needs into unconditional transfer systems for sub-national governments, aligning allocations with their climate vulnerability and risk profiles. Additionally, incentivize green and climate actions through conditional transfers, such as ecological fiscal transfers and payments for ecological services, to promote sustainable development and climate resilience at the local level.

[153] Ohno Kenichi, Thanh Duc Nguyen, and Huong Thi Pham. 2021. *Viet Nam Productivity Report - Identifying Growth Challenges and Exploring a Way Forward.* Hanoi: Viet Nam National University Press. https://gdforum.sakura.ne.jp/ja/pdf20/[EN]VNProductivityReport_PreliminaryFinal2020_0904.pdf

[154] Viet Nam Disaster and Dyke Management Authority. 2020. Bảng thống kê thiệt hại do thiên tai năm 2006-2020 [*Statistics of damage caused by natural disasters 2006-2020*]. Available at: https://phongchongthientai.mard.gov.vn/Pages/Thong-ke-thiet-hai.aspx

Areas of intervention	Categories of damage
Spending and investment	Provide for fiscal mechanisms and incentives that promote linkage of investments across levels of government towards climate change adaptation and mitigation actions and address legal impediments in the State Budget Law to inter-linked public investment across levels of government. Apply the climate change classification and tagging on both investment and recurrent expenditure on climate change and introduce a specific task code for climate change spending in the Treasury and Budget Management Information System (TABMIS).
Public investment	Explicitly reference climate change impacts and mitigation in the classification of public investments within climate change, environmental protection, and construction-related laws. Integrate climate risk considerations into public investment by first developing climate risk exposure maps for critical infrastructure networks, such as transport and water systems. Mandate climate change screening and assess adaptation measures during the early stages of investment planning, including pre-feasibility and feasibility studies, particularly for projects with high climate risk exposure. Mandated reporting to provide information on climate change relevance in investment policy reports and project feasibility studies should be integrated into legal documents (e.g., on ODA and investment).
Asset management	Optimize the infrastructure asset portfolio by aligning it with vulnerability profiles and climate risks. Systematically integrate retrofitted criteria and measures to minimize the risk of stranded assets and enhance long-term resilience and sustainability.

Annex 1.7. Policy options mapped to the National Adaptation Plan with country examples

Areas of intervention identified by NAP	Actions and objectives	Country examples
Disaster risk reduction **NAP: (2) Respond to natural disasters, prevent flooding in big cities, and consolidate river and sea dikes and reservoirs' safety**	Climate resilient infrastructure investments	Thailand's Flood Management Projects: construction of flood barriers, reservoirs, and drainage systems to mitigate the impact of heavy rainfall and prevent flooding in urban areas like Bangkok.
	Implement policies, strategies, and actions to minimize the vulnerabilities of communities and societies to disasters exacerbated by climate change.	The Philippines' Community-Based Disaster Risk Reduction: empowering local communities to identify risks, develop contingency plans, and implement risk reduction. China's Flood Control and Management: the government has invested heavily in flood control infrastructure – such as dams, reservoirs and levees – to mitigate flood risks and protect vulnerable areas.

Areas of intervention identified by NAP	Actions and objectives	Country examples
Climate-smart agriculture NAP: (3) Ensure food security	Facilitate precision agriculture: use of advanced technology, data analytics, and innovative farming practices to optimize agricultural production while minimizing environmental impacts and maximizing resource efficiency.	Israel's Precision Irrigation: techniques such as drip irrigation and soil moisture sensors enable efficient water to use and reduce the risk of crop failures due to water stress.
	Facilitate crop diversification: help enhance climate resilience via risk mitigation, soil health, improved water management, pest and disease control and biodiversity conservation. Economic stability is also promoted from risk reduction.	Costa Rica's Shade-Grown Coffee and Nigeria's Taungya Agroforestry Systems: integrating fruit and timber trees, or other perennial crops into agricultural landscapes can diversify income sources, improve soil health, and provide ecosystem services such as carbon sequestration and biodiversity conservation. Agroforestry practices are particularly suitable for hilly and upland areas in East Asia.
	Enhance livestock management practices mitigates the impacts of climate change on livestock and livestock farming systems.	Colombia's Silvopastoral Systems for Livestock Management: extensive areas of silvopastoral systems, where trees are integrated with livestock grazing. Trees like leguminous species are planted in pastures to provide shade, fodder, and timber while improving soil fertility. This system helps increase the productivity and sustainability of livestock production.
Water management NAP: (4) Ensure water security	Adopt a holistic approach to integrated water resource management: manage water resources in a way that considers the interconnectedness of surface water, groundwater, and other elements of the hydrological cycle.	Japan's Integrated River Basin Management: the Yasugawa River Basin in Shiga prefecture employs a comprehensive strategy that involves stakeholders from various sectors in decision-making processes, including flood control, water supply, agriculture, and conservation. Singapore's Rainwater Harvesting: rooftop collection systems and underground reservoirs that store rainwater for later use, reducing reliance on imported water sources and enhancing resilience to droughts.

Areas of intervention identified by NAP	Actions and objectives	Country examples
Water management NAP: (4) Ensure water security	Promote water conservation: water-saving practices such as efficient irrigation techniques, fixing leaks in water distribution systems, and implementing water-efficient appliances and fixtures can help conserve water resources.	China's Sponge City Initiative: promotes implementation of green infrastructure such as permeable pavements, green roofs, and rain gardens to absorb and retain rainwater, reducing runoff and mitigating flood risks, while replenishing groundwater reserves. India's Watershed Development Projects: construction of soil and water conservation structures such as check dams, contour trenches, and percolation tanks to capture rainwater and recharge groundwater. Watershed committees comprising local farmers are formed to plan, implement, and manage watershed activities. Participatory approaches and community mobilization are key components of these projects.
	Protect and restore natural ecosystems such as wetlands, forests and watersheds to enhance water quality, regulate water flows, and provide other ecosystem services.	Japan Green Roofs and Walls: in urban areas, green roofs and walls are increasingly utilized to absorb rainwater, reduce runoff, and mitigate urban heat.
Building resilience of local communities **NAP (5) Effective: Climate change adaptation communities**	Promote community-based adaptation projects to identify vulnerabilities to climate change and develop locally appropriate strategies.	The Philippines: implemented by NGOs and local government, activities include establishment of community-based early warning systems for typhoons and sea level rises, mangrove reforestation and rehabilitation, sustainable fisheries management, and capacity building for disaster preparedness and responses. Bangladesh: led by the International Centre for Climate Change and Development, activities include construction of cyclone shelters and raised platforms for livestock during floods, promotion of climate-resilient agricultural practices, training on disaster preparedness and evacuation procedures, and livelihood diversification through alternative income-generating activities.

Areas of intervention identified by NAP	Actions and objectives	Country examples
	Promote knowledge sharing and capacity building within communities to enhance their ability to understand, anticipate, and respond to climate change impacts.	Bangladesh's Community-Based Adaptation Training: organizations like the International Centre for Climate Change and Development and the Bangladesh Centre for Advanced Studies provide training and capacity-building that cover various aspects of climate change adaptation, including disaster preparedness, livelihood diversification, ecosystem-based approaches, and community-based early warning systems.
NAP (6): Financial mobilization for climate change adaptation	Address contingent liabilities from climate shocks for governments, businesses, or households.	Indonesia's Climate Change Adaptation Fund: provides financial support for adaptation projects and initiatives. It supports community-based adaptation efforts, ecosystem restoration projects, and infrastructure upgrades aimed at enhancing resilience to climate change impacts, thereby reducing contingent liabilities associated with climate-related disasters and damage. China's Agricultural Insurance Policies: helps farmers cope with climate-related risks such as droughts, floods, and extreme temperatures. These policies provide financial compensation to farmers in the event of crop losses due to adverse weather conditions, reducing contingent liabilities associated with agricultural production.
	Create fiscal space for investment in climate resilience.	Carbon Taxation/Fees: Colombia, Indonesia, South Africa.
	Leverage green finance to mobilize private investment in climate resilience (resilient infrastructure). 1. Green bonds 2. Green credits	The Philippines's BDO First Green Bond (US$150 million), Viet Nam's BIDV Green Bond (US$100 million). India's tradable green credit program.

Annex 2.1. Mitigation policies analysis – MANAGE model assumptions

The updated MANAGE model was used to quantify the contribution to GHG emission objectives and the economy-wide impacts of mitigation policies (government policies and the MANAGE model are outlined in Annexes 2.1–2.5). While acknowledging the complexity and uncertainty related to various aspects of the green transition, such as speed of technological changes in predicting the dynamic long-term decarbonization pathway, the model can provide useful information about the potential costs and benefits of certain mitigation policy impacts. The underlying assumptions on parameters drive model behavior, dynamics and hence results. The baseline scenario assumptions are the same as for the baseline in Chapter 1. The power mix in the baseline scenario is kept as the base year when coal was still important, which led to continued increases in sectoral emissions. In addition, GHG emissions in the baseline are calibrated to match baseline emissions in Viet Nam's NDC and NSCC to evaluate the impacts of mitigation policies on emissions reductions. Then, the analysis considered two main scenarios: (1) combination of the current mitigation policies outlined without considering the additional gains from some of these reforms and (2) the combination of the current mitigation policies with these additional gains.

Five key mitigation policies are modelled based on available policy documents (see Annexes 2.1–2.5 for details). Simulations assume full implementation of these policies.

(i) **Changing power mix by phasing out coal and investing in renewable energy:** The model assumes that a power mix is calibrated to match with the PDP8 scenario.

(ii) **Improving energy efficiency:** Based on VNEEP3 targets, the model assumes that energy efficiency in industrial and services production would gradually increase and reach 5 percent by 2050 compared to the baseline. Energy efficiency is also assumed to improve for the other economic agents' energy use.

(iii) **Electrification in transport:** The impacts of transport sector policies (mainly road sector) are introduced gradually in the model until 2050 through several channels:

- The rise in biofuel use is introduced as an increase in the intermediate use of biofuels in the refined petroleum sector, substituting crude petroleum. The shock size is 1 percent per year, reaching 30 percent by 2050.
- The increase in the number of LNG buses is introduced as an up-tick in LNG use by the road transport sector, substituting refined petroleum. The shock size is 0.5 percent per year, reaching 15 percent by 2050.
- The increase in the number of electric vehicles is introduced as a rise in electricity use by the road transport sector, further substituting refined petroleum. The shock size is 0.5 percent per year, reaching 15 percent by 2050. An increase in household demand for electricity is assumed, such that 50 percent of household demand for refined petroleum is substituted by electricity.

(iv) **Low-carbon agriculture:** Assumed use of mitigation options for agriculture gradually reduces emissions intensity of crop production and livestock.

(v) **Carbon pricing:**[155] An effective carbon tax is introduced gradually, starting at US$15/$tCO_2e$ in 2024 and progressively increasing to US$30/$tCO_2e$ in 2030 and to US$42.5/$tCO_2e$ in 2050.[156]

Additional gains from mitigation actions could create opportunities for growth. The expanded scenario considers the following:

(i) **Increased labor productivity linked to reduced air pollution exposure:**[157] The model assumes that a 1 percent decrease in air pollution augments labor productivity by 0.1 percent.

(ii) **Improved competitiveness:** The model assumes that by expanding its low-carbon production, Viet Nam could increase its exports by 10 percent (relative to a baseline scenario) over 2023–50.

(iii) **Recycling revenues from carbon pricing:** The revenue recycling options are the same with Carbon Pricing Assessment Tool (CPAT) scenarios.

Annex 2.2 Transport and agriculture as major contributors to mitigating GHGs

Green transition in the transport sector

The transportation sector is accelerating its electrification process. While this sector's rapid evolution has contributed to Viet Nam's economic development, it is one of the largest contributors to the nation's GHG emissions, accounting for 7 percent of total GHG emissions in 2021.The Green energy transportation – Reduction of carbon and methane emissions of transportation sector action program (Decision No.876/QD-TTg, July 2022) was the first policy specific to decarbonizing transportation. It is expected to contribute to air pollution and GHG emission reductions to help meet the NDCs by 2030 and net zero target by 2050. Using Avoid-Shift-Improve metrics, this action program shows the electrification of fleets across all transport modes is expected to play a major role in decarbonizing the sector (World Bank, 2024).[158]

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[155] With CPAT scenarios, only the results with a carbon tax are reported.

[156] The level set for the carbon price should be taken as indicative rather than as an optimal price level. In the model, the carbon price is used as a mechanism to transmit the effects of emission reductions to different sectors of the economy. Forcing sectors to reduce emissions will affect each in different ways based on the emission intensity of outputs as well as the flexibility of these sectors in substituting carbon-intensive inputs with other inputs.

[157] Shihe Fu, V Brian Viard, Peng Zhang. 2021. *Air Pollution and Manufacturing Firm Productivity: Nationwide Estimates for China*, The Economic Journal, Volume 131, Issue 640, November 2021, Pages 3241–3273. Jooste, Charl & Loch Temzelides, Ted Paul & Sampi Bravo, James Robert Ezequiel & Dudu, Hasan. (2022). Pollution and Labor Productivity: Evidence from Chilean Cities. Policy Research Working Paper Series 10236, the World Bank.

[158] World Bank. 2024. *Recommendations to the National E-Mobility Roadmap and Action Plan.*

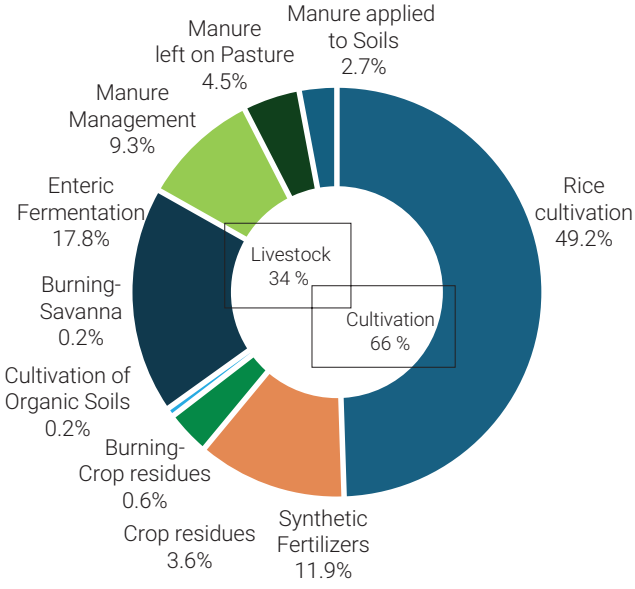
Decarbonizing the transportation sector largely depends on progress in road transport, especially in terms of passengers and freight. Encouragingly, Viet Nam has seen recent rapid growth in e-mobility. Within the segment of two-wheelers (2Ws) representing more than 90 percent of total vehicle stock, the transition from internal combustion engine to electric 2Ws is already taking place in Viet Nam. Since 2014, the market share of electric 2Ws in Viet Nam has steadily risen from 120,000 units sold in 2014 to 408,000 units in 2022, reaching 12 percent of annual 2W sales. On the production side, Viet Nam's domestic manufacturing or assembly of electric 2Ws began in 2014 and took-off in 2016. In 2014, the main focus was e-bicycles with 93,028 units manufactured/assembled, followed by electric motorcycles (21,365 units). Since 2016, the focus shifted to electric 2Ws at 213,132 units in 2020, 10-fold higher than in 2014.[159] However, Decision No. 876/QD-TTg targets at least 50 percent of urban vehicles, and 100 percent of urban buses and taxies to use electricity and green energy by 2030. An ambitious target is also established for 2050, when all road motorized vehicles will be electric. These targets have several technical and socio-economic implications for Viet Nam, including increased demand for EV supply, chargers, and batteries for power generation, distribution of gasoline and diesel demand and job creation from e-mobility related industries.

Strong agriculture sector commitment to net zero transition

The agriculture sector has formulated key mitigation policies for emissions reductions in agricultural development (Decision No. 1693/KH-BNN-KHCN in April 2023). Agriculture is still the third largest national contributor of GHG emissions (15 percent of total emissions in 2021), despite forestry plantations compensating for deforestation, land clearing in agriculture and changed LULUCF (land use, land use changes and forestry) from a net emitter to a carbon sink since 2011. Within the agriculture sector, cultivation and livestock account for 66 and 34 percent of the sector's emissions, respectively (Figure A2.2.1). Especially, rice cultivation is responsible for around two-thirds of cultivation's emissions. In addition, methane and nitrous oxide are two mains sectoral GHGs (Figure A2.2.2). In response, Viet Nam has a strong commitment to reduce 30 percent of methane emissions by 2030 compared to 2020 and joined the Glasgow Declaration on Forest and Land Uses at COP26. This commitment translated into Decision No. 942/QD-TTg (August 5, 2022) on approval of an action plan for methane emissions reductions by 2030, with the agriculture sector taking a key role. Becoming an urgent task, the Ministry of Agriculture and Rural Development issued Decision No.1693/KH-BNN-KHCN approving the plan to reduce GHG emissions (including methane) in agricultural and rural development until 2030, with a vision to 2050.

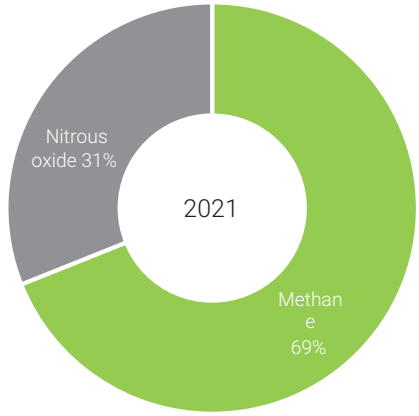
[159] Ibid.

Figure A2.2.1. Agriculture emissions, 2021



Source: Climate Watch.

Figure A2.2.2. Emissions by type of agriculture sector, 2021



Source: Climate Watch.

The decarbonization action plan for agriculture, outlined in Decision No. 1693/KH-BNN-KHCN, is anchored in three key sets of measures associated with key sub-sectors: (i) cultivation: smart water and irrigation management by using low-carbon technology, such as Alternate Wetting and Drying (AWD), System of Rice Intensification (SRI) and rice-shrimp or rice-fish diversified systems and replacing high-quality fertilizer and pesticide, (ii) livestock: efficient manure management, and improved feed and fodder management and (iii) forestry: adoption of agroforestry. Those practices are also classed as climate-smart agriculture that contribute to adaptation objectives mentioned in Chapter 1 of this report.

Annex 2.3. Viet Nam Energy Efficiency Program

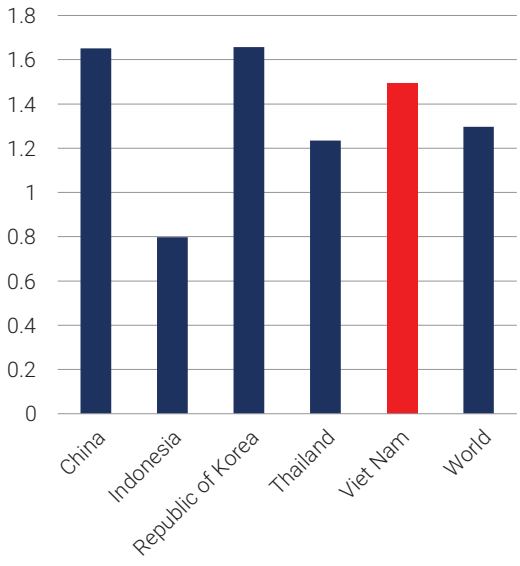
Viet Nam has demonstrated a strong commitment to enhance energy efficiency in industry and households' electricity consumption to help achieve net zero emissions objectives. Its primary energy consumption per GDP, the main metric of energy efficiency, is higher than the world average (Figure A2.3.1) with industry, transport and residential the three main energy consuming sectors. (Figure A2.3.2).

The National Energy Efficiency Program for 2019–30 contains specific objectives to reduce energy consumption by 8–10 percent during 2019–30. It promotes demand-side energy efficiency targets,

such as saving total national energy consumption, reducing power loss and energy consumption of specific industrial sectors. The program targets several areas of action: reducing power loss by 6 percent and decreasing energy consumption in major industrial sectors (steel by 5–16.5 percent, chemical industries by a minimum of 10 percent, plastic manufacturing by 21.5–24.8 percent), cement (minimum of 10.89 percent), textile and garments (minimum of 6.8 percent), paper industry (9.9–18.8 percent) and beverages (4.6–8.4 percent). More generally, the government intends to ensure that 90 percent of industrial parks and 70 percent of industrial clusters apply solutions to use energy economically and efficiently. Also, it plans to facilitate a 5 percent reduction of fuel and oil consumption in transportation compared to consumption forecasts by 2030 and formulate regulations on fuel consumption for two-wheel motorbikes and nine-or-less seater cars of new production, assembly, and importation. Additionally, the authorities plan for a series of training courses, certifications, and development of plans on economic and efficient use of energy at local and provincial levels (Table A2.3.1).

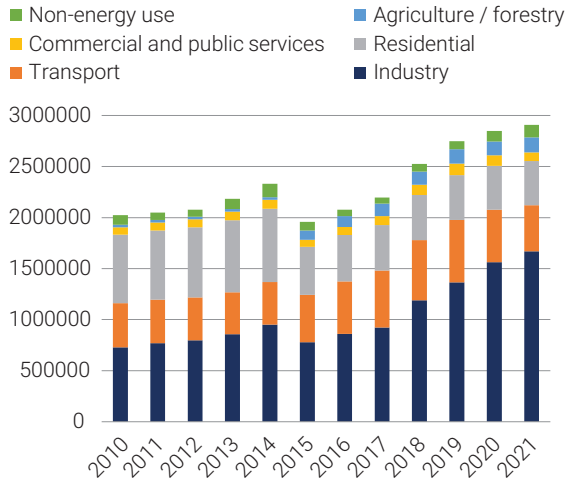
The objectives will be achieved through promoting use of energy-efficient equipment, enforcing energy-efficiency management of new buildings, establishing energy standards for industries and public transport development, amongst others.

Figure A2.3.1. Primary energy consumption per GDP (kWh/$)



Source: IEA.

Figure A2.3.2. Final energy consumption (TJ)



Source: IEA.

Table A2.3.1. Key objectives of Viet Nam Energy Efficiency Program

Key objectives	2025 (%)	2030 (%)
Energy savings in total energy consumption	5–7	8–10
Energy loss	Less than 6.5	Reduce less than 6
Energy consumption in industry		
(i) steel	3.–10	5.00–16.5
(ii) chemicals	at least 7	at least 10
(iii) plastics production	18–22.5	21.5–24.8
(iv) cement	at least 7.5	at least 10.9
(vi) textile and garment	at least 5.	at least 6.8
(vii) alcohol, beer and soft drink	3.–6.9	4.6–8.4
(viii) paper	8.–15.8	9.9–18.5

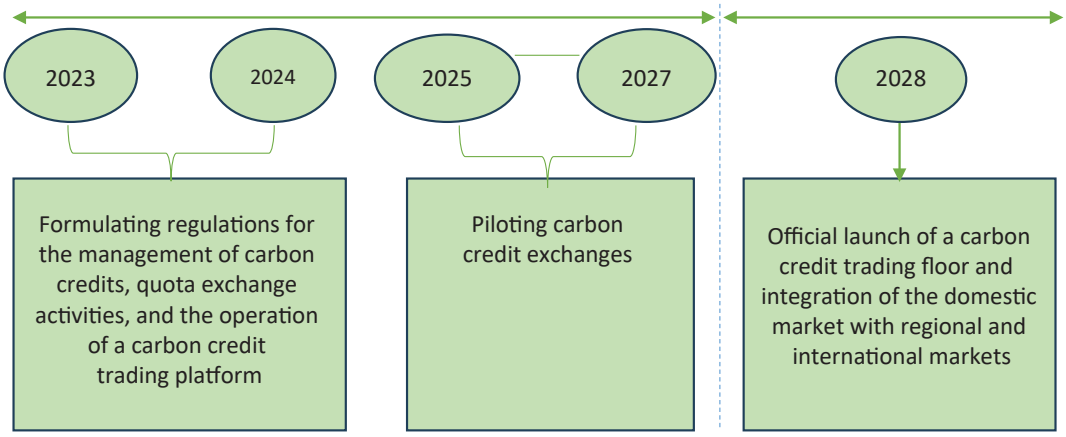
Source: Decision 280/QD-TTg (March 2019).

Annex 2.4. Carbon pricing in Viet Nam – existing and on-going efforts

Development of a domestic emissions trading system

As a carbon market is an effective carbon pricing tool in mitigation activities, Decree No.06/2022/ND-CP provided a two-phase roadmap for development of a domestic carbon market (Figure A2.4.1). As carbon markets raise the cost of carbon emissions, resulting in increased business costs, this should motivate enterprises in heavy emitting sectors to reduce emissions, such as by changing to green technology and improving energy use structures. Decision No. 01/2022/QD-TTg mandated a list of sectors and facilities that must conduct GHG inventories, including energy, transportation, construction, industrial processes and agriculture-forestry, the largest contributors of total GHG emissions of Viet Nam.

Figure A2.4.1. Carbon market development plan



Source: Author's illustration of Decree No. 06/2022/ND-CP.

Recently, Decree No. 06/2022/ND-CP was revised to accelerate carbon market development in Viet Nam. The main revisions included: i) adding target facilities subject to GHG inventory requirements, ii) making the review of GHG inventory results mandatory, iii) revising the roadmap for allocating GHG emission quotas, iv) clarifying eligibility for companies to participate in the carbon market, and v) adding quota targets regarding controlled substances. Especially, the draft revised decree proposed a tiered allocation of GHG emission quotas, with the largest GHG-emitting industries allocated first including thermal power generation, steel and cement production. These sectors are among the sectors that the EU has enacted regulations on the EU CBAM, which covers steel, aluminum, cement, electricity, hydrogen, and fertilizer imported into the EU.

Annex 2.5. Fiscal policies underpinning the decarbonization process

Viet Nam already has experience in implementing several environment-related taxes, fees and charges to boost mitigation efforts. First, the Environmental Protection Tax[160] is an excise tax on fossil fuels introduced in 2010. As an indirect tax, it is collected on products and goods that, when used, are deemed to cause negative environmental impacts, especially petroleum and coal. Second, the Natural Resources Tax[161] is payable by industries exploiting Viet Nam's natural resources such as petroleum, minerals, forest products, seafood and natural water. The tax rates vary depending on the natural

[160] Law on Environment Protection Tax (No.57/2010/QH12).
[161] Resolution No. 084/2015/UBTVQH13.

resources exploited and are applied to the production output at a specified taxable value per unit. This tax is allocated to local government budgets to finance restoration of the environment in areas where natural resources are exploited and to ensure social benefits to address negative impacts of natural resources exploitation on local communities. Third, fees related to environmental protection include an environmental protection fee for wastewater,[162] exploitation of minerals[163] and an environmental protection fee for emissions recently submitted for National Assembly approval.

Tax incentives for renewable energy and green production have been introduced in Viet Nam. This includes feed-in tariffs to encourage investment in renewable energy sources like solar, wind, and biomass. These tariffs guarantee a fixed price for electricity generated from renewable sources, providing financial stability for investors and accelerating growth of the renewable energy sector. The government also offers various tax incentives, such as Corporate Income Tax reductions, import duty exemptions for renewable energy equipment, and land use fee reductions for renewable energy projects. These incentives aim to attract domestic and foreign investment in the renewable energy sector. Finally, to promote adoption of electric vehicles, Viet Nam is offering tax exemptions and reductions for electric vehicle imports and production. This is part of the broader strategy to reduce emissions from the transportation sector.

Annex 2.6. PDP8 implementation: costs and delays

The post-PDP8 landscape will require substantial investment, although incremental investment needs will depend on variable renewable energy cost declines. The total cost of necessary investments for generation and transmission is estimated at US$523.1 billion between 2031 to 2050 (Table A2.6.1). More than 90 percent would be invested in generation capacity, mainly by the private sector (Table A2.6.2). In Viet Nam's current energy sector structure, transmission would have to be met through public investment (80 percent of investment in transmission).

The economic impacts of following PDP8 would depend heavily on future costs of energy sources and financing. In a worst-case scenario, where investment is borne by the public sector and crowds-out other investments and consumption, GDP could be lower post-PDP8. Impacts could range from 0.5 percent by 2030 to 2.9 percent by 2050. However, if technology costs for renewable energy continue to fall in line with leading modelling estimates by the IEA and Bloomberg NEF, post-PDP8 could result in lower energy costs and a boost to GDP.

[162] Decree No. 164/2016/ND-CP.
[163] Decree No. 164/2016/ND-CP.

Figure A2.6.1 PDP8 emissions reduction

(as % change from the baseline)

Emissions reduction			
	2030	**2040**	**2050**
PDP8	-4.68%	-10.81%	-15.34%

Source: World Bank staff simulations using MANAGE model

Table A2.6.2a. PDP8 investment needs

Investment (US$ billion)	2021-30	2031-50
Generation	119.8	484.4
Transmission	15	38.6
Total	134.7	523.1

Table A2.6.2b Investment by sector 2021–30

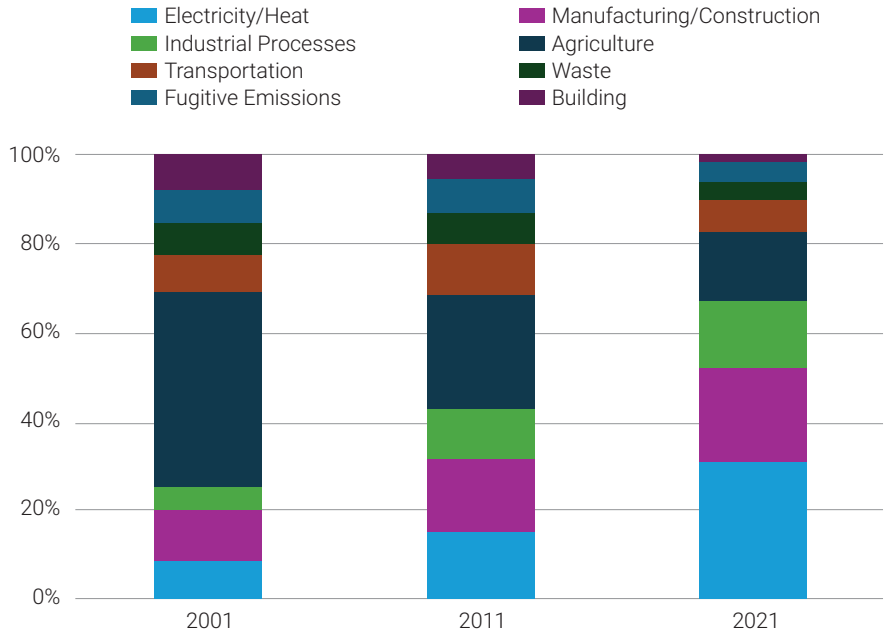
Investment (US$ billion)	Public	Private	Total
Generation	24.0	95.8	**119.8**
	20%	*80%*	*89%*
Transmission	12.0	3.0	**15.0**
	80%	*20%*	*11%*
Total	36.0	98.8	**134.8**
	27%	*73%*	

Source: PDP8 (2023).

While the vision for a green transition was reinforced by an abundance of strategies and resolutions since 2021, institutional gaps in coordination, capacity and accountability continue to hinder progress. Effective implementation of mitigation policies requires clear regulations, strong enforcement mechanisms, and coordination among government agencies. Coordination (horizontal and vertical) on policy design and implementation has faced challenges due to the spread of responsibilities across ministries and between central and sub-national governments.

The late approval of PDP8 and the associated action plan highlights challenges in coordinating key stakeholders – including ministries, local authorities and private sector investors – to develop a coherent and forward-looking energy strategy. Initially, PDP8 was expected to be finalized and approved by the government by 2020 to guide the country's energy strategy during 2021–30, with a vision to 2045. However, due to various factors – including complexities in balancing energy security, economic growth, and environmental sustainability – the plan was delayed multiple times. The final version of PDP8 was only approved in May 2023, approximately three years behind the original schedule. After 10 months, the PDP8 action plan was approved by Decision No. 262/QD-TTg (April 1, 2024). This delay has several implications for Viet Nam's energy sector, including uncertainties in investment planning, particularly for renewable energy projects, and challenges in meeting the country's rapidly growing electricity demand.

Annex 2.7. Evolution of composition of Viet Nam's GHG emissions (excluding LUCF)



Source: IEA.

Annex 3.1. Data on the economic sectors included in the marine economy

No.	Ocean economic sectors	VSIC 2018 - 2-digit	Approach to calculate value added	Details
1	Marine aquaculture and exploitation	Fishing and aquaculture - 03	Total compensation of employees in acting enterprises by kinds of economic activity	**1. Data source:** Total compensation of employees in acting enterprises by kinds of economic activity: Fishing and Aquaculture. **2. Measurement:** Value added of Fishing and Aquaculture to ocean economy. **3. Limitations:** The approach may not account for the ocean-related share in the industry. The results could be underestimated.

No.	Ocean economic sectors	VSIC 2018 - 2-digit	Approach to calculate value added	Details
2	Exploitation of crude oil, gaseous or liquefied natural gas	Extraction of crude petroleum and natural gas - 06	Value Added	**1. Data source:** Value added of mining and quarrying industry from ADB's IO table. Total compensation of employees in acting enterprises by kinds of economic activity: Extraction of crude oil and natural gas. Total compensation of employees in mining and quarrying from official statistics. **2. Measurement:** Value added of extraction of crude oil and petroleum. **3. Limitations:** This approach may not account for differences in capital intensity nor profit margins across activities. Key assumption is that employee compensation is used as a proxy for value added share, assuming that the distribution of wages reflects the economic contribution of crude oil and petroleum extraction.
3	Seafood and aquatic products processed and preserved	Manufacture of food products - 10	Total compensation of employees in acting enterprises by kinds of economic activity	**1. Data source:** Total compensation of employees in acting enterprises by kinds of economic activity: Manufacture of food products. Revenue Data: Net revenue of the food processing industry (VIRAC, 2023). **2. Measurement:** Value added of seafood products and processing. The seafood-related share is determined by applying a proxy based on revenue. Specifically, according to VIRAC (Viet Nam Industry Research and Consultancy) research in 2023, processing and preserving seafood accounts for more than 50 percent of the total net revenue of the food processing industry > Multiply the total compensation of employees in the manufacture of food products sector by the 50 percent seafood processing share to estimate the economic contribution of seafood processing. **3. Limitations:** Key Assumption: Revenue share is a valid proxy for employee compensation distribution within the food processing industry. Limitation: This approach may not fully account for variations in profit margins, labor intensity, or capital use between seafood processing and other food processing sectors.

4	Fuel oil and gasoline, petroleum processing products of all kinds	Manufacture of coke and refined petroleum products - 19	Value Added	**1. Data source:** Value added at basic price of coke, refined petroleum, and nuclear fuel in ADB IO Table for Viet Nam. **2. Measurement:** Value added of the manufacture of sea-related minerals and products. **3. Limitations:** The approach may not account for the share of ocean-related in the industry.
5	Manufacture of ships and boats	Manufacture of other transport equipment - 30 Repair, maintenance and installation of machinery and equipment - 33	Total compensation of employees in acting enterprises by kinds of economic activity	**1. Data source:** Total compensation of employees in acting enterprises by kinds of economic activity: Manufacture of other transport equipment and repair and installation of machinery and equipment. **2. Measurement:** Value added of the manufacture of ships/boats. Calculating the share of ships/boats manufacturing within the manufacture of other transport equipment sector based on the ratio of employees in ship/boat enterprises to those in other transport equipment manufacturing (average ratio result from 2010 to 2013 since data from 2014 to 2020 is not available) as a proxy. Inclusion of repair and installation of machinery and equipment. **3. Limitations:** The unclear share of ship/boat manufacturing that is ocean-related.
6	Sea freight and maritime transportation	Water transport - 50 Warehousing and support activities for transportation - 52	Both value added and compensation	**1. Data source:** Warehousing and support activities for transportation. Value added of water transportation from ADB's Input-Output table. **2. Measurement:** Value added of marine transportation. **3. Assumption:** Maritime transport made up 53.4 percent of the total cargo turnover in 2022 (General Statistics Office - GSO). **4. Limitations:** The methodology lacks granularity. Using 53.4 percent as a proxy for ocean share may not highly accurate due to the lack of comparability of figures across different sources or time periods. which can influence the result of economic contribution.

No.	Ocean economic sectors	VSIC 2018 - 2-digit	Approach to calculate value added	Details
7	Offshore Wind	No Code	Value Added	**1. Data source:** Value added at basic price of offshore wind retrieved from the World Bank Offshore Wind Roadmap report. **2. Measurement:** Value added of offshore wind. **3. Limitations:** The approach may not account for the share of ocean-related in the industry. It only reflects a part of the contribution of the renewable energy industry to GDP.
8	Travel and tourism (Pure marine)	Passenger transport: Land transport, transport via railways, via pipeline; Water transport; Air transport; Warehousing and support activities for transportation; Postal and courier activities - 49, 50, 51, 52 Accommodation; Food and beverage service activities - 55, 56 Administrative and supporting activities: Travel agency, tour operator and related activities - 79 Art, entertainment and recreational activities: Creative, art and entertainment activities; Libraries, archives, museums and other cultural activities; Lottery activities, gambling and betting activities; Sports activities and amusement and recreation activities - 90-93	Value added and compensation	**1. Data source:** Pure marine share of total tourism GDP from UNDP and VASI's report (2022) on Blue Economy scenarios for Viet Nam. Data in this report was collected from coastal provinces, calculations conducted by UNDP. The World Bank does not guarantee the results retrieved from this. **2. Measurement:** Value added of marine tourism. Use the results of pure marine share of total tourism GDP as estimation for value added of marine tourism. Apply consistently across all years except 2020. For 2020, use the revenue of travel and tourism market in Viet Nam in 2020 (revenue of Viet Nam's travel and tourism market from Statista) multiply with the percentage of GDP of pure marine part in tourism GDP in 2019 which was also calculated in the UNDP report.[164] **3. Assumptions & Limitations:** The share of marine tourism is assumed to remain stable over time. The exclusion of 2020 accounts for anomalies in tourism revenue.

[164] UNDP & VASI, *Blue Economy Scenarios for Vietnam, 2022.*

The selected marine ecosystem services provide a range of services consisting of:

- Provisioning services, the contributions of ecosystems to the production of marketed goods. The habitat for larval and juvenile provided for commercial fisheries by coastal wetlands is an example.
- Regulating services, where certain characteristics of ecosystems beneficially affect natural processes. Flood control/mitigation provided by intact shorelines are an example.
- Habitat services, that provide maintenance of species' lifecycles (including nursery services) and support genetic diversity, which in turn provides related provisioning services.
- Cultural services, where ecosystems support human activities such as tourism and recreation.

Annex 3.2. Review of global experiences in blue economy and relevance for Viet Nam

Countries employ diverse approaches to develop their blue marine economies, considering sectoral growth potential and research and development capabilities. Here are some examples:

China

China is actively pursuing development of its marine economy, with a focus on traditional and emerging sectors.[165] The government has set ambitious marine economy growth targets, aiming for annual growth of 8 percent, with the ultimate goal of contributing 10 percent to the country's GDP by 2015.[166] To achieve this, China emphasizes integrated management of coastal and marine resources, including implementation of national marine functional zoning planning. This approach seeks to balance economic development with environmental protection by designating specific areas for different types of activities.

The modernization of China's marine economy involves upgrading traditional sectors such as fisheries through technological innovation and equipment enhancement. Additionally, there is a concerted effort to promote high-growth sectors like coastal tourism and marine farming. By investing in these areas, China aims to optimize resource utilization and foster sustainable economic growth along its extensive coastline.

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[165] Since 2011, China's "blue economy" strategy has formed, starting from the development planning project of the "Shandong Peninsula green economic zone" and expanding to coastal provinces and cities.

[166] The marine economy reached 10 percent of GDP in 2015, China Daily reported on January 18, 2013. http://www.chinadaily.com.cn/business/2013-01/18/content_1613657 3.htm

United States

The United States has long recognized the importance of ocean policy and sustainable economic development. The National Policy for the Stewardship of the Ocean, Our Coasts, and the Great Lakes underscores the need for ecosystem-based management, considering the entire marine ecosystem when making management decisions. This approach prioritizes scientific research and data-driven decision-making to ensure the health and resilience of ocean ecosystems.

In recent years, the United States has launched initiatives like the Ocean Climate Action Plan, which aims to harness ocean resources to mitigate climate change impacts and empower coastal communities. By focusing on areas such as coastal adaptation, clean energy, maritime infrastructure, and sustainable fisheries management, it seeks to address pressing environmental challenges while promoting economic growth and resilience in coastal regions.

Japan

Japan's maritime policy is guided by the Basic Act on Ocean Policy and the Basic Law on Ocean Policy, which outlines principles and responsibilities of stakeholders in ocean management.[167] However, Japan acknowledges challenges in policy implementation, particularly the need to enhance the effectiveness of State management processes and strengthen coordination between different agencies.

To address these challenges, Japan is working to shift towards horizontal management approaches and improve coordination mechanisms. The focus is on sustainable development and marine spatial planning to ensure that economic activities are balanced with environmental conservation efforts. By aligning policies and enhancing coordination, Japan aims to achieve its goals of promoting sustainable ocean management and economic growth.

European Union

The European Union (EU) has identified the blue economy as a key driver of economic growth and job creation. Its Blue Growth Agenda aims to unlock the economic potential of marine sectors, such as aquaculture, maritime tourism, and marine biotechnology.[168] This agenda is supported by initiatives like the Blue Economy Innovation Plan, which focuses on improving access to marine information, implementing marine spatial planning, and enhancing marine surveillance.

Through strategic guidance and monitoring mechanisms, the EU aims to ensure that blue growth is achieved in a sustainable and inclusive manner. By promoting innovation, fostering collaboration, and integrating environmental considerations into policymaking, the EU seeks to harness the economic opportunities offered by the marine environment, while safeguarding its long-term health and resilience.

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[167] The Japanese Government Cabinet approved the first Basic Plan in March 2008, the second in April 2013 and the third in May 2018. https://www8.cao.go.jp/ocean/english/index_e.html

[168] https://webgate.ec.europa.eu/maritimeforum/system/files/Blue%20Growth%20Final%20Report%2013092012. Pdf

India

India's Blue Economy policy focuses on harnessing ocean resources efficiently and sustainably to drive economic growth, enhance employment and protect the environment, aligning with the United Nations' Sustainable Development Goals. The Prime Minister's Economic Advisory Council's 2020 draft Blue Economic Policy Framework outlines a comprehensive strategy to boost GDP through inclusive and sustainable development in the maritime sector. This policy emphasizes integrating ocean-related competencies and capacities across seven priority areas: creating a national accounting framework for the blue economy, promoting coastal marine spatial planning and sustainable tourism, enhancing marine fisheries and aquaculture, advancing blue manufacturing and technology, upgrading maritime logistics and infrastructure, responsibly developing offshore energy and deep-sea mining, and ensuring maritime security and international cooperation. By aligning national and provincial strategies and engaging with non-state actors, India aims to create a resilient and sustainable blue economy that supports economic growth and environmental stewardship.

Republic of Korea

Republic of Korea has pursued an ocean strategy since 2002 with the Ocean Korea 21 (OK21) initiative, aiming to boost the ocean sector's contribution to national GDP from 7 percent (US$33 billion) in 2005 to 10 percent by 2016. The 10-year operational plan for OK21 aligns with the commitments made at the World Summit on Sustainable Development and the East Asian Seas Sustainable Development Strategy. In 2008, the Republic of Korea integrated land and sea management programs, which enhanced implementation of cohesive land and sea policies. This integration prompted the revision of the Coastal Zone Management Law in 2009 and establishment of a coastal zoning scheme, with almost all coastal local governments developing and implementing their coastal management plans. To address the decline of marine ecosystems and support sustainable blue growth, Republic of Korea developed a Master Plan on Marine Spatial Management, initiated in 2018 and completed in 2022. This national policy aims to reduce conflicts in marine space and promote sustainable use. Emphasizing the role of science, technology and private sector involvement, the plan fosters development of ocean economic initiatives. Local governments are actively involved, contributing ideas to the master plan and taking responsibility for its implementation.

Australia

Australia envisions a blue marine economy that supports ecological, economic, and social benefits through an ecosystem-based management model at the core of decision-making for industries, communities, and various fields. To mainstream the blue economy as an economic development model, address the risks of ecosystem degradation and climate change, and seize emerging opportunities, Australia has initiated multiple programs and projects at State, grassroots, and international levels. One pivotal initiative is the establishment of the Blue Economy Cooperative Research Center in 2019, which promotes a $329 million research project through a decade-long collaboration with 45 national and international industry partners, projected to contribute over $4 billion to the national economy. The country's comprehensive approach to the blue economy is detailed in the National Marine

Science Plan 2015–25, which includes investment of $100 billion by 2025 to tackle seven key areas: maintaining maritime sovereignty, ensuring energy and food security, conserving biodiversity, and ecosystem health, fostering sustainable development of coastal cities, understanding, and adapting to climate change, and achieving equitable resource allocation. However, as Joanna Vince (2014)[169] points out, Australia's ocean governance faces the challenge of balancing the use and conservation of marine resources amid the pressing threats of climate change and ocean acidification. Marine spatial planning, especially within the Exclusive Economic Zone, is recognized as an effective tool to address these issues. The Australian Government developed the marine biological planning framework under the Environment Protection and Biodiversity Conservation Act (1999) to manage Australian waters effectively, set broad biodiversity targets, identify regional priorities, and outline strategies to maintain healthy and productive oceans.

The Philippines

In the Philippines, coastal zone management operates through a decentralized system, granting significant authority to local governments. Blue Economy projects typically emerge from collaborations between various government levels, external donors, and NGOs, rather than from centralized national initiatives (Satizábal et al., 2020).[170] The private sector increasingly invests in ocean-based business opportunities, particularly in sustainable fisheries and marine and coastal tourism, which are closely linked to the country's "natural marine capital"—the primary driver of the Philippines' ocean economy (PEMSEA, 2018).[171] According to Satizábal et al. (2020), the Philippines' Blue Marine Economy agenda emphasizes treating oceans as "natural capital," focusing on green carbon initiatives aimed at identifying and exploiting economic opportunities. These initiatives seek to transform governance by pricing and mapping ecosystem services to support market-based mechanisms like carbon markets and green bonds. This approach highlights the importance of addressing inequality in Blue Economic Development, particularly the unequal distribution of benefits among coastal users.

Annex 3.3. International experience with fiscal instruments to support marine policies

To achieve Sustainable Development Goal 14 (SDG 14) – conserving and sustainably using the oceans, seas, and marine resources – various fiscal instruments, alongside legal and regulatory tools, can provide crucial incentives. Examples of such fiscal strategies include:

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[169] Joanna Vince. 2014. *Ocean governance and marine spatial planning in Australia.* Australian Journal of Maritime & Ocean Affairs, Volume 6, 2014 – Issues 1. https://doi.org/10.1080/18366503.2014.888137

[170] Satizabal.P, Dressler W. H, Fabinyi.M & Pido.M. D .2020. *Blue economy discourses and practices: reconfiguring ocean spaces in the Philippines.* Maritime Studies, 19, 207-221.

[171] PEMSEA 2018. State of Oceans and Coasts: Philippines. http://pemsea.org/sites/default/files/NSOC_Philippines_0.pdf: GEF, UNDP, PEMSEA.

Higher License Fees for Foreign Fishing Fleets: Increasing license fees for foreign fishing operations can serve dual purposes. It raises funds for fishery management and helps control the number of fishing boats. For instance, the Pacific Island countries' fee hikes in 2014 nearly quadrupled their revenue from fishing licenses. This approach can reduce overfishing by foreign fleets, while generating funds for sustainable management of marine resources.[172]

Subsidies to Artisanal Fishers During Catch Restrictions: When catch restrictions are necessary to prevent over exploitation, providing subsidies to small-scale fishers can mitigate the economic impact. In Bangladesh, the government declared five sites in the lower Meghna Basin as hilsa sanctuaries to protect this vital fish species. To offset the loss of income for more than 210,000 affected households, the government supplied 40kg of rice per household and offered alternative income-generating activities. Although no formal impact evaluation has been conducted, the increased fish catch levels indicate this compensation scheme has positively influenced both hilsa populations and fisher livelihoods.[173]

Balancing Short-Term Fiscal Revenues and Long-Term Sustainability: Sometimes, present-day fiscal revenues must be sacrificed to ensure sustainable fish stocks and future income. In 2014, Kiribati closed the Phoenix Islands Protected Area, the largest marine reserve in the Pacific Ocean, to commercial fishing to allow tuna stocks to recover. This decision prioritized long-term conservation over immediate fishery revenue but aimed at secure future economic benefits. To balance this, small-scale or subsistence fishers were exempt from these restrictions, allowing them to maintain their livelihoods while broader conservation goals were pursued.[174]

These examples illustrate how fiscal instruments like taxes, subsidies, and conditional transfers can be effectively used to support sustainable marine practices and achieve targets of SDG14.

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[172] IMF, Asia and Pacific Small States Monitor, Quarterly Bulletin, *Special Topic—Leveraging Marine Fishery Resources: Implications for Fiscal Policy,* (http://www.imf.org/external/np/apd/ssm/2014/0414.pdf), 2014.

[173] Mohammed, E.Y., D. Steinbach and P. Steele. 2018. *Fiscal reforms for sustainable marine fisheries governance: Delivering the SDGs and ensuring no one is left behind.* Marine Policy, 93, 262-270.

[174] Ibid.

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